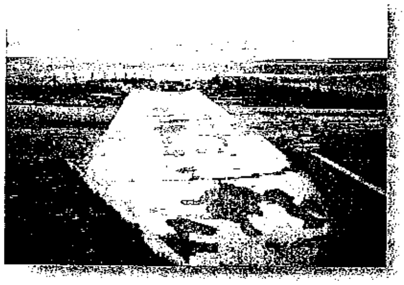
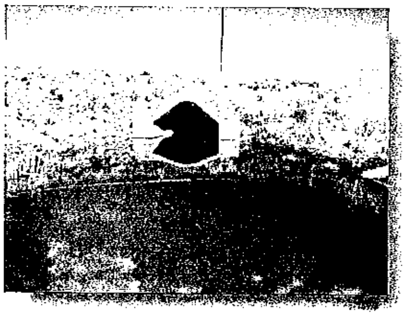
Master Development Drainage Plan

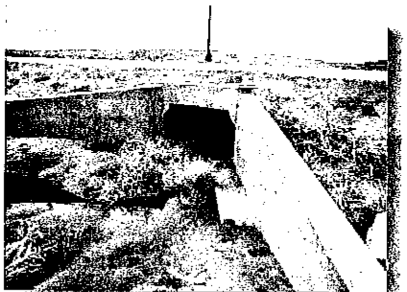
Colorado Springs Airport and Business Park

in the

Windmill Gulch and Big Johnson Drainage Basins

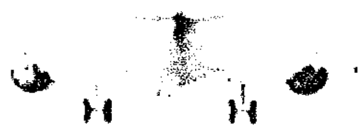






Prepared for

COLORADO SPRINGS AIRPORT



CH2MHILL

19 South Tejon Street, Suite 500
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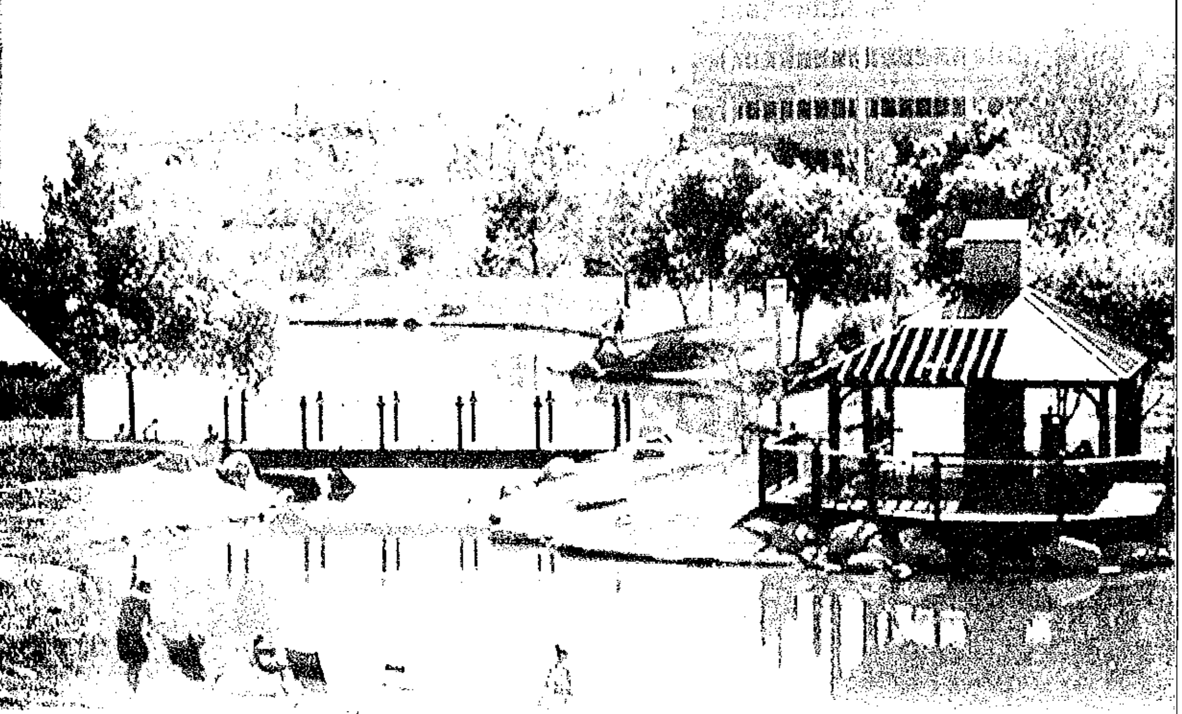

June 2005

Master Development Drainage Plan

Colorado Springs Airport in the Windmill Gulch and Big Johnson Drainage Basin(s)

Prepared for:

COLORADO SPRINGS AIRPORT

Colorado Springs Airport Business Park Concept Plan

Prepared by:

CH2MHILL

19 S. Tejon Street, Suite 500
Colorado Springs, CO
80903-1505

June 2005

DEN/T122004001.DOC

MASTER DRAINAGE DEVELOPMENT PLAN
COLORADO SPRINGS AIRPORT IN THE WINDMILL GULCH AND BIG JOHNSON DRAINAGE BASINS

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/County 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.

COLORADO REGISTERED PROFESSIONAL ENGINEER MARK ROSSER 32181 06-03-05

Mark Rosser, P.E., CO# 32181

DEVELOPER'S STATEMENT

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

COLORADO SPRINGS AIRPORT

Business Name

By: Richard G Goena

Title: AVIATION ASSISTANT DIRECTOR

Address: ADMINISTRATION OFFICE
7770 DRENNAN ROAD
COLORADO SPRINGS, CO 80916

CITY OF COLORADO SPRINGS

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

~~Business Name~~ 6/13/05 Date

Contents

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Acronyms and Abbreviations

A/DACG	Arrival/Departure Airfield Control Group
AF	acre feet
AMC	antecedent moisture condition
Airport	Colorado Springs Airport
cfs	cubic feet per second
cfs/acre	cubic feet per second per acre
City	City of Colorado Springs
CMP	corrugated metal pipe
CUHP	Colorado Urban Hydrograph Procedure
DB-1	Detention Basin No. 1
DB-2	Detention Basin No. 2
DB-3	Detention Basin No. 3
DB-4	Detention Basin No. 4
DB-5	Detention Basin No. 5
DB-6	Detention Basin No. 6
DB-7	Detention Basin No. 7
DB-8	Detention Basin No. 8
DB-10	Detention Basin No. 10
DB-11	Detention Basin No. 11
DB-13	Detention Basin No. 13
DB-100	Detention Basin No. 100
DB-200	Detention Basin No. 200
DB-250	Detention Basin No. 250
DB-400	Detention Basin No. 400
DB-500	Detention Basin No. 500
DB-700	Detention Basin No. 700
DB-900	Detention Basin No. 900
DCM	Drainage Criteria Manual for City of Colorado Springs/El Paso County
DBPS	Drainage Basin Planning Studies
fps	feet per second
ft	feet
ft/ft	feet per feet

FIRMs	Flood Insurance Rate Maps
HERCP	horizontal elliptical reinforced concrete pipe
MDDP	Master Development Drainage Plan
mi	mile
MITCAT	Massachusetts Institute of Technology Catchment Model
NOAA	National Oceanic and Atmospheric Administration
NRCS	National Resource Conservation Service
RCB	Reinforced concrete box
RCP	reinforced concrete pipe
sq miles	square miles
SWMM	Stormwater Management Model
UDSWM	Urban Drainage Stormwater Model
USDAHL	United States Department of Agriculture Hydrograph Laboratory (model)
WQCV	Water Quality Capture Volume

SECTION 1.0

Introduction

The purpose of this report is to present the Master Development Drainage Plan (MDDP) for the portion of the Colorado Springs Airport (Airport) that lies within the Windmill Gulch and Big Johnson Drainage Basin(s). This MDDP is prepared in association with a Concept Plan for a proposed Business Park development on Airport land within these basins. However, areas of future aviation development in both basins, beyond the limits of the proposed Business Park, are considered in the evaluations and recommendations presented.

1.1 Need and Purpose of MDDP

According to the *Drainage Criteria Manual for the City of Colorado Springs/El Paso County* (DCM), a MDDP is required for any phased development greater than 10 acres (City of Colorado Springs, 1994). The purpose of an MDDP is to provide the following:

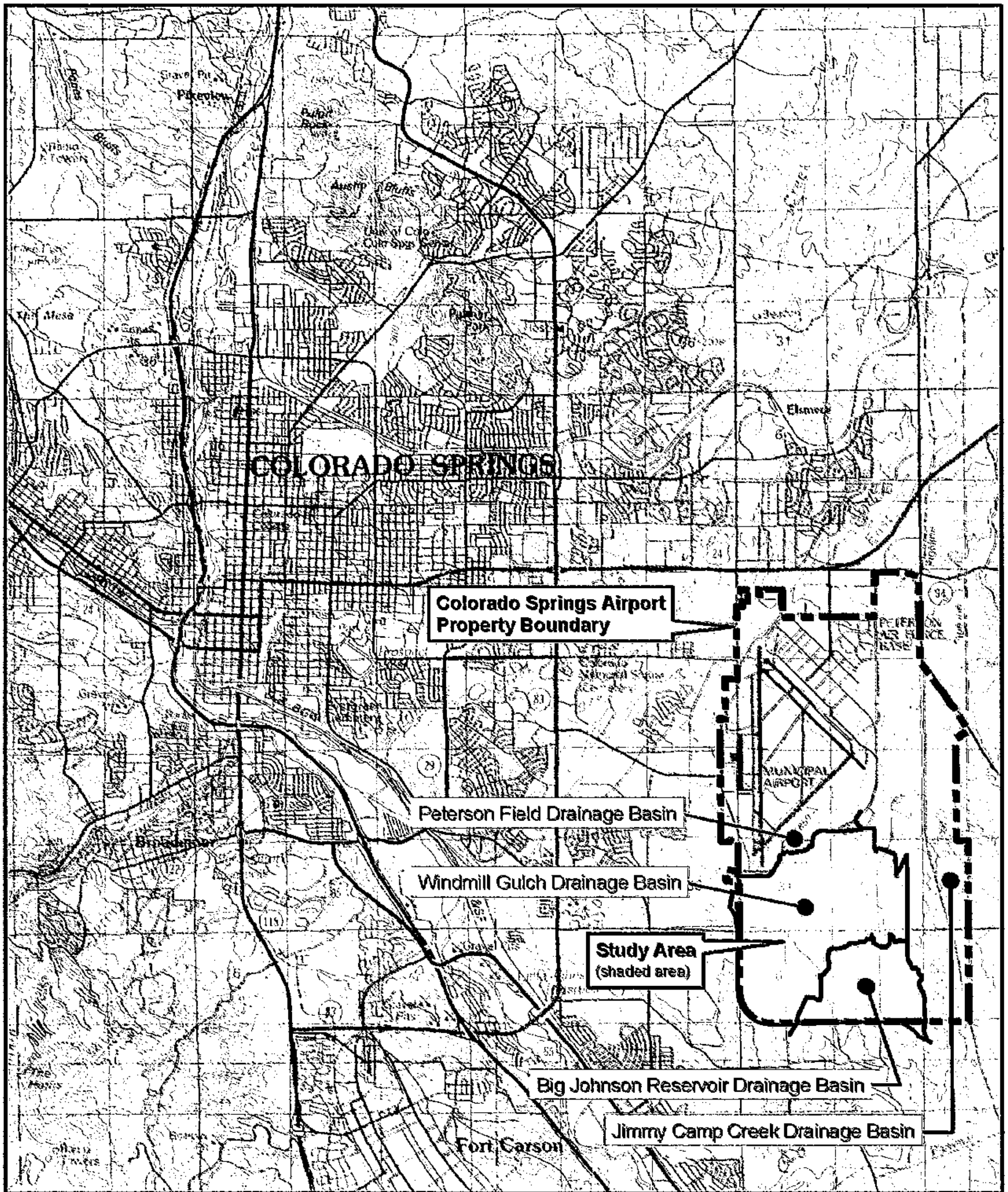
- Identify major drainage ways, ponding/detention areas, locations of culverts, bridges, open channels, and drainage areas tributary to the proposed development.
- Present solutions to drainage problems identified in the governing Drainage Basin Planning Studies (DBPS).
- Analyze the ability of downstream facilities to pass developed runoff away from the proposed development.

The MDDP presents hydrologic analysis, conceptual location, and type of drainage improvements needed as the Airport develops. After approval by the City of Colorado Springs (City), the MDDP will provide the drainage master plan for Airport development within the Windmill Gulch and Big Johnson Drainage Basin(s).

1.2 General Location and Description

The Airport is located in the southeastern portion of the City, within Sections 3, 4, 5, 6, and 8 of Township 14 South, Range 65 West, and Sections 19, 20, 21, 28, 29, 30, 31, 32, and 33 of Township 15 South, Range 65 West, of the Sixth Principal Meridian, as illustrated in Exhibit 1-1. The Airport property is bounded by Powers Boulevard to the south and west, by Peterson Air Force Base to the north, and by Open Space to the east. Areas surrounding the Airport property include industrial, commercial, and residential developments, Open Space, and Peterson Air Force Base.

The Airport property generally comprises the uppermost portions of the Jimmy Camp Creek, Peterson, Windmill Gulch, and Big Johnson Drainage Basins. The Peterson Basin generally drains the north half of the Airport property, including Peterson Air Force Base, the main terminal, and infield and runway areas to the north of the main terminal. A MDDP for Airport property in the Peterson Basin has recently been completed by URS Corporation (URS Corporation, 2004).



0 4,000 8,000
Scale in Feet

Projection: Colorado State Plane Coordinate System
Central Zone, 3476
North American Datum of 1983 (NAD83)

Exhibit 1-1
Vicinity Map

Colorado Springs Airport
Master Development Drainage Plan
Windmill Gulch & Big Johnson Drainage Basins

CH2MHILL DEN \acebra\gis\projects\COS-Airport-MDP\Report-figs\Exhibit_1-1.mxd 01-24-2005

The Jimmy Camp Creek Basin is located along the eastern edge of the Airport property and includes portions of Runway 17L/35R and undeveloped land east of the runway. If or when Airport development within the Jimmy Camp Creek Basin is proposed, a MDDP for the Airport in that basin may be needed.

The study area for the MDDP includes the uppermost portions of the Windmill Gulch and Big Johnson Drainage Basins as depicted in Exhibit 1-1. It encompasses the southern portion of the Airport and is composed of the main terminal parking lots, car rental facilities, portions of Runway 17L/35R, and considerable undeveloped land extending southward to Powers Boulevard. Specific characteristics of both drainage basins will be discussed in the next section.

1.3 Windmill Gulch and Big Johnson Drainage Basin Description

As noted previously, there are no off-site areas that drain onto the Airport within the Windmill Gulch and Big Johnson Drainage Basin(s). The study area and major drainage basin boundaries are shown in Exhibit A-1 in Appendix A.

A total of 2.75 square miles of Airport property lies within the Windmill Gulch Drainage Basin. Topography within the study area ranges in elevation from 6,140 feet above sea level at its highest point to 5,900 feet at its lowest point. Within the Airport property, the Windmill Gulch Basin drains to the west and south through a series of detention areas, open drainageways, and culverts. A storm drain system is present beneath the terminal parking area at the north (upstream) end of the basin. Runoff eventually flows to one of five culvert crossings of Powers Boulevard (see Exhibit A-1 in Appendix A), where it leaves the Airport property and enters Windmill Gulch on the west side of Powers Boulevard.

A total of 1 square mile of Airport property lies within the Big Johnson Drainage Basin. The property slopes towards the south, with the topography ranging in elevation from 6,098 feet at its highest point to 5,900 feet at its lowest point. This portion of the watershed is undeveloped with an open channel being the primary stormwater conveyance system. Stormwater runoff is conveyed along the existing drainageways to culvert crossings at Powers Boulevard at the southern boundary of the Airport (see Exhibit A-1 in Appendix A). Downstream of the culverts, stormwater runoff continues across undeveloped land, eventually reaching the Big Johnson Reservoir located approximately 1 mile south of Powers Boulevard.

1.4 Future Development

In 2001, the Airport completed a Business Park Master Plan. The Business Park Master Plan was prompted by the availability of significant vacant land at the Airport, and the City's goal of developing a major employment center in southeastern Colorado Springs. Initial environmental studies were undertaken in 2002. In 2003, the Airport authorized development of a Concept Plan, this MDDP, and an Environmental Assessment for development of a Business Park, as shown and approved in the 2001 Master Plan (Barnard Dunkelberg and Company Team, 2001). The current Master Plan, which amends the approved 2001 Plan, is shown in Exhibit A-2 in Appendix A. It illustrates the types and distributions of land uses, which are proposed for the Business Park development.

In concert with the amended Business Park Master Plan, the Airport has developed a Concept Plan for the proposed development. The Concept Plan is shown in Exhibit A-3 in Appendix A. It was developed as an example of what ultimate parcel configuration, building layout, and Business Park access may include. Together, the Business Park Master Plan and Business Park Concept Plan provide the basis for future development at the Airport for land that is not dedicated to future aviation use.

Outside of the proposed Business Park, areas for future expansion of the existing public Airport facility and for new aviation-related development are identified in the 1998 Colorado Springs Airport Master Plan (Barnard Dunkelberg and Company Team, 1998). The Airport Master Plan provides the basis for future land use outside the Business Park used by this MDDP.

SECTION 2.0

Previous Studies

A number of studies have been previously conducted analyzing stormwater drainage at the Airport. The timeline shown in Exhibit 2-1 provides a chronological listing of those studies over the last 16 years. The particular reports that were reviewed in preparation for this MDDP are summarized in Exhibit A-4 in Appendix A.

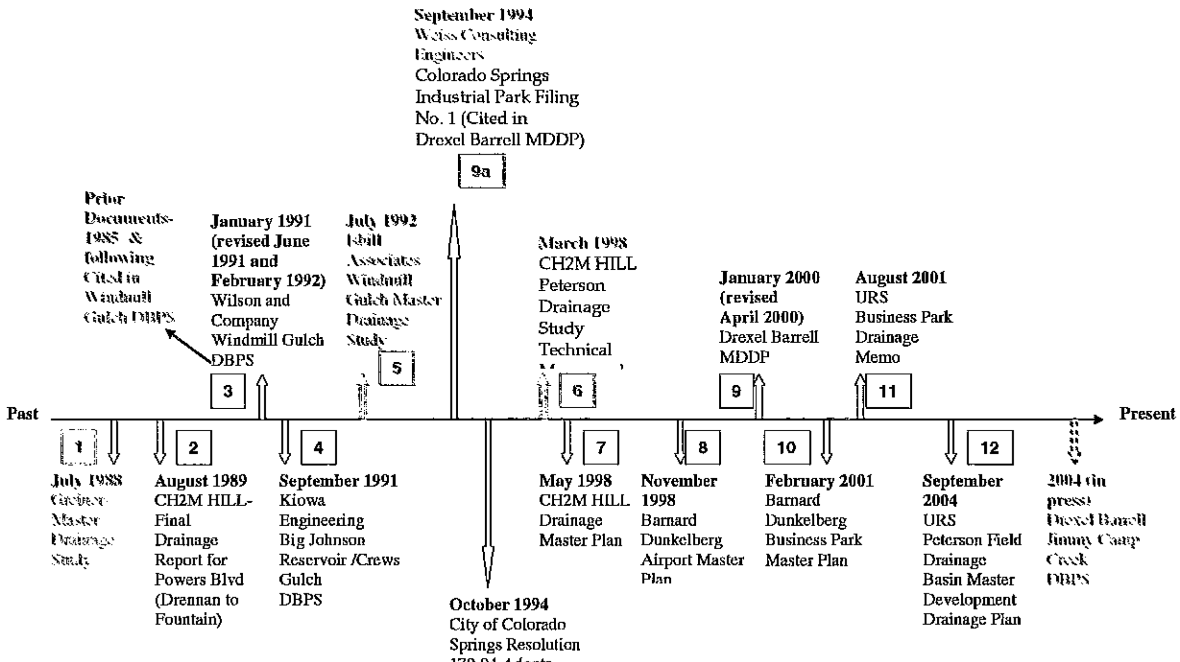


EXHIBIT 2-1
Timeline of Previous Studies

Three of the studies listed above are particularly relevant to the current MDDP.

- **Timeline Reference 3.** The *Windmill Gulch Drainage Basin Planning Study* (Wilson, 1992a) used TR-20 to analyze historic conditions and future developed conditions for the entire drainage basin. The DBPS established specific design points and allowable stormwater discharges at the Airport boundary that set the constraints for drainage planning and stormwater release for the Airport in the Windmill Gulch Drainage Basin.
- **Timeline Reference 4.** The *Big Johnson Reservoir/Crews Gulch Drainage Basin Planning Study* (Kiowa, 1991) used TR-20 to analyze historic conditions and future developed conditions for the entire drainage basin. The DBPS established design points and allowable stormwater discharges at the Airport boundary that govern drainage planning and stormwater release for the Airport in the Big Johnson Drainage Basin.
- **Timeline Reference 7.** The *Colorado Springs Airport Drainage Master Plan* (CH2M HILL, 1998) used Colorado Urban Hydrograph Procedure (CUHP) and Urban Drainage

Stormwater Management Model (UDSWM) to analyze the pre-development condition of the Airport and presented a master drainage plan concept for future development over the entire Airport. The developed condition hydrology, hydraulics, and drainage plan presented in that report is updated and further developed in this MDDP in accordance with the proposed Business Park development and current plans for aviation-related development outside the Business Park.

Design points and allowable discharges for both the Windmill Gulch and Big Johnson Drainage Basin(s) are presented later in the Design Criteria portion of this document.

SECTION 3.0

Historic (Pre-developed) Condition Hydrology

Evaluation of historic condition hydrology is an important step in developing a drainage plan for new development because it defines historic drainage patterns and locations where stormwater is released from a property and determines the peak discharges at those locations. These attributes of the watershed then guide the allowable location and peak flow rates for stormwater discharges in the future, developed condition.

For Airport property in the Windmill Gulch and Big Johnson Basins, the design points and allowable peak discharges have already been defined in the Windmill Gulch DBPS and Big Johnson DBPS, both of which have been approved and adopted by the City. Within the Windmill Gulch Drainage Basin, the DBPS has already served as the blueprint for a number of downstream improvements that have subsequently been constructed, including onstream detention facilities, culverts, open channels, conduits, and inlet structures.

Because the two DBPS have evaluated historic condition hydrology for the Airport within the Windmill Gulch and Big Johnson Drainage Basins and have determined allowable releases for future planning, new hydrologic evaluation of the existing conditions in the study area were not conducted for this MDDP. This approach was discussed with City Subdivision Engineering in April 2004 as documented in Appendix B, and it was agreed that the MDDP would only include a summary of the existing condition hydrology that had previously been performed.

It is helpful to provide some historical context regarding the existing condition hydrology presented in the Windmill Gulch DBPS to show how the allowable release rates were determined. Prior to construction of the "new" Airport terminal and entrance road in 1994, a considerable portion of the Airport property lying within the Windmill Gulch Drainage Basin drained to internal sump areas that captured and retained all runoff. As described in the Windmill Gulch DBPS, a total of 1.7 square miles of land within the Airport, mostly north of Drennan Road, was tributary to these internal sumps and did not contribute runoff to Windmill Gulch. Thus, existing condition hydrologic analyses to determine historical peak discharges from the Airport to Windmill Gulch considered only that portion of the total Airport acreage that was tributary to the basin, approximately 1.0 acres. The peak discharges from this limited tributary area were calculated and used by the DBPS to define the allowable releases from the Windmill Gulch Basin for future developed conditions.

The existing (historical) condition hydrology at the Airport that was performed in the DBPS for the Windmill Gulch and Big Johnson Basins is reviewed and summarized below (Wilson, 1992a); (Kiowa, 1991).

3.1 Soil Type

Soils within the Airport property consist of sandy loams interspersed with coarse sand. These soils are highly erosive and have moderate to high infiltration rates and erosive potential. Soils within the project area are classified as Natural Resource Conservation Service (NRCS) hydrologic soil groups A and B, as shown in Exhibit A-5 in Appendix A.

3.2 Land Use

The Airport land use as it existed prior to the new Airport terminal construction formed the basis for the existing condition hydrologic evaluations in the DBPS. Prior to Airport construction, there were few to no improvements and a basin imperviousness of 1 to 2 percent was assumed for selecting curve numbers for subbasins within the two watersheds. An aerial image showing today's existing conditions (spring 2004) is provided in Exhibit A-6 in Appendix A.

Both basins consisted of agricultural land. The agricultural land is composed primarily of a big bluestem-prairie sandreed tallgrass community and a shortgrass matrix community. A small wetland area (0.2 acres), dominated by dense cattails, is present within the principal Windmill Gulch tributary drainageway just east of Powers Boulevard. Site photographs contained in Appendix C include typical images of the agricultural land as it is preserved today.

3.3 Basin Characteristics

The DBPS delineated drainage subbasins for existing conditions using a variety of sources for topographic information. Exhibit A-6 in Appendix A shows the subbasins that were defined as well as the major property boundary design points delineated in the Windmill Gulch and Big Johnson DBPS.

As previously discussed, prior to development of the new Airport terminal site in 1994, the Windmill Gulch subbasins north of Drennan Road (DBPS Basins 64, 66, 68, and 72) and Subbasin 70 south of Drennan Road drained to local sump areas where collected runoff infiltrated into the ground or evaporated. South of Drennan Road, the Windmill Gulch subbasins (DBPS basins 28, 30, 38, 46, 48, 50, 52, and 62) drained to the south and the west, toward Powers Boulevard where several culverts cross beneath the street, allowing runoff to reach Windmill Gulch eventually.

Within the Airport, the Big Johnson Basin drains to the south, toward Powers Boulevard. The Big Johnson/Crews Gulch DBPS identified five subbasins north of Powers Boulevard on Airport property that drain to three different culvert crossings of Powers Boulevard. After crossing Powers Boulevard, runoff flows from the subbasins continue to Big Johnson Reservoir, which is approximately 1 mile south.

Exhibit 3-1 summarizes the hydrologic characteristics that were used in the two DBPS to describe the existing (historical) condition of the tributary subbasins in the Airport.

EXHIBIT 3-1
Existing Condition TR-20 Input-Windmill Gulch and Big Johnson Basins Drainage Basin Planning Studies

DBPS Subbasin	DBPS Design Point at Airport Boundary	Subbasin Area (sq mi)	Composite CN for TR-20)
	Windmill Gulch Basin (tributary subbasins only)		
28	7	0.11	71
30	7	0.14	69
38	8, 9, 10	0.09	74
46	11	0.09	69
48	11	0.09	61
50	11	0.21	60
52	11	0.08	67
62	Not designated	0.23	60
Total		**1.02**	
Big Johnson Basin			
57	61	0.07	56
58	32	0.18	51
59	32	0.17	53
60	32	0.44	48
61	62	0.08	51
Total		**0.94**	

Source: Kiowa, 1991 and Wilson, 1992a

Construction of the new Airport site in 1994 altered the historic drainage patterns for Airport property in the Windmill Gulch Basin. In the *Colorado Springs Airport Drainage Master Plan* (CH2M HILL, 1998), CH2M HILL recognized a number of areas north of Drennan Road where stormwater runoff is collected and detained and one large remaining sump area where runoff is retained (see Exhibit A-6 in Appendix A). This plan estimated a total available detention volume of 413.1 acre-feet (AF), while the sump area had an estimated available volume of 155.5 acre-feet. The Plan concluded that these volumes exceed the quantity of runoff generated from their tributary areas under existing conditions at that time. The outflows from the detention sites are combined with the flows from the undeveloped portions of the watershed in the southwest corner of the Airport property. The combined flows drain under Powers Boulevard and are carried southwestward to Windmill Gulch. A complete existing condition analysis of the Airport property in Windmill Gulch Basin, wherein attenuated flow from north of Drennan Road is combined with undeveloped flows south of Drennan Road, was not presented in the plan.

3.4 Rainfall

Both DBPS documents analyzed the 100-year, 24-hour storm. Rainfall data will be obtained from the DCM for a Type IIA storm with antecedent moisture condition (AMC) II. Rainfall depths for the 24-hour storm were found to be 4.5 inches.

3.5 Runoff

TR-20 software was used to combine and route subbasin hydrographs through a drainage system to generate runoff hydrographs at each design point. The peak rates shown in Exhibit 3-2 resulted from the analysis of the 100-year, 24-hour storm, and represent the peak flow at the farthest downstream design point where stormwater runoff would leave the Airport property. Exhibit 3-2 also shows the future condition allowable discharge that was used in the future condition models reported in each DBPS. These are discussed further in the next section.

EXHIBIT 3-2
Existing Condition Peak Runoff Rates-Windmill Gulch and Big Johnson Basins

DBPS Design Point	Tributary Basins	Peak Runoff Rate 100-yr, 24-hr (cfs)	Future Condition Allowable Peak Runoff (cfs)
Windmill Gulch (tributary subbasins only)			
Not designated	62	90	-[2]
11 (J)	46, 48, 50, 52	230	150[1]
8, 9, 10	38	40	275
7 (I)	28, 30	150	250
Big Johnson Basin			
32 (5A-2)	58, 59, 60	85	85
61 (5B-2)	62	25	36
62 (5A-3)	57	22	50

Source: CH2M HILL, 1998

cfs = cubic feet per second

[1] Includes non-tributary (sump) basins: 64, 66, 68, 70, 72
[2] Subbasin 62 was included into allowable discharge at design point 11

SECTION 4.0

Design Criteria for Future Condition Analysis

This section documents the design criteria, which govern drainage design for future development of Airport property in the Windmill Gulch and Big Johnson Watershed(s). These criteria are found in the Windmill Gulch and Big Johnson/Crews Gulch, DBPS documents, and in the DCM (Wilson, 1992a); (Kiowa, 1991) and (City of Colorado Springs, 1994).

4.1 Drainage Basin Planning Studies – Identification of Design Points and Allowable Discharges

It was confirmed through discussions with City Subdivision Engineering in April 2004 that design discharge points of most significance for the purposes of the current MDDP would be at those locations where stormwater discharges leave the Airport property. Design discharge points and allowable discharges are those identified in the Windmill Gulch DBPS and Big Johnson DBPS as discussed in the previous section. Exhibit 4-1 and Exhibit 4-2 provide a summary of the design points identified and their respective allowable discharges based on the appropriate DBPS. The design points are also identified for reference on Exhibit A-6 in Appendix A.

EXHIBIT 4-1
Windmill Gulch Drainage Basin Design Points and Allowable Discharges (at Airport property boundary)

DBPS Structure Identification	DBPS Design Point Identification	Location Description	Structure Description	Allowable 100-yr, 24-hr Peak Discharge (cfs)
11	J	~2,000 feet south of Drennan Road, a Powers Boulevard undercrossing	double 8' x 6' RCB	150
10		~3,150 feet south of Drennan Road, a Powers Boulevard crossing	42" CMP	150
9		~3,750 feet south of Drennan Road, a Powers Boulevard crossing	60" CMP	40
8		~4,250 feet south of Drennan Road, a Powers Boulevard crossing	60" CMP	85
7	I	~5,800 feet south of Drennan Road, a Powers Boulevard crossing	double 8' x 3' RCB	250

Source: Wilson, 1992a

CMP = corrugated metal pipe

RCB = reinforced concrete pipe

EXHIBIT 4-2
Big Johnson Drainage Basin Discharge Points and Allowable Discharges (at Airport property boundary) per Big Johnson/Crew Gulch DBPS (Kiowa, 1991)

DBPS Design Point Identification	Location Description	Structure Description	Allowable 100-yr, 24-hr Peak Discharge (cfs)
62 (5A-3)	~9400 feet south of Drennan Road along Powers Boulevard	Existing culverts, sizes unknown (determine)	50
32 (5A-2)	~11550 feet south of Drennan Road along Powers Boulevard	Existing culvert, 60" RCP (verify size)	85
61 (5B-2)	~14500 feet south of Drennan Road along Powers Boulevard	Existing culvert, 36" RCP (verify size)	36

Source: Kiowa, 1991

RCP = reinforced concrete pipe

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

The DCM governs the design of storm drainage facilities within the City and El Paso County (City of Colorado Springs, 1994). Although the full design of storm drainage facilities is not included in the MDDP scope, it is necessary to determine the location and size of the major drainage improvements that will be needed when the Airport property develops. Several DCM requirements are particularly relevant to the MDDP effort. They are outlined below.

- Accepted computer simulation models for storm runoff include TR-20, HEC 1, STORM, MITCAT, SWMM, USDAHL, SWM-IV, and CUHP. A combination of CUHP and SWMM were used in the current MDDP effort, as described in further detail in the hydrology section of this report.
- The depth of street flow at the gutter flow line shall not exceed 12 inches for Type A (local/residential) and Type B (collector/minor arterial) during the major storm (100-year storm).
- Storm drainage conduits shall have a design life of 50 years or greater, a minimum diameter of 15 inches, a maximum flow velocity of 18 feet per second (fps) (unless pipe manufacturer allows greater velocity), and a minimum mean flow velocity of 2.5 fps. Minimum manhole spacing ranges from 500 to 750 feet depending on the diameter of the conduit.
- Storm drainage channels shall have a velocity below 5 to 6 fps unless rip rap or soil cement is used, a Froude number below 0.9 for the 100-year storm, a depth of 5 feet or lower, and side slopes no steeper than 4:1 (horizontal to vertical) for grass-lined channels.
- The storm drainage system shall generally have: velocities which increase (or at least do not decrease) as flow travels downstream, slopes which are generally below critical slope, and a hydraulic grade line which is at least 1 foot below ground surface.

The DCM contains additional criteria for improving water quality for stormwater runoff prior to discharging runoff from the site. Stormwater quality criteria are discussed separately in Section 6.1, Detention Facilities.

4.3 Floodplains

Through an examination of the U.S. Federal Emergency Management Agency Flood Insurance Rate Maps (FIRMs) (1997), it was determined that no regulatory floodplains exist within the Windmill Gulch and Big Johnson Drainage Basin(s) within Airport property. A map showing the regulatory floodplains from the FIRMs for the property surrounding the Airport is provided in Exhibit A-7 in Appendix A.

SECTION 5.0

Future Condition Hydrology

A hydrologic analysis of the proposed future developed conditions for the study area was conducted using CUHP and UDSWM modeling software. Input data for CUHP include the rainfall hyetograph, soils characteristics, and future land use and imperviousness, and watershed characteristics (size, length, slope, length to centroid). CUHP modeling generates a runoff hydrograph for each basin as a function of the rainfall and watershed characteristics. UDSWM was used for flood routing of the hydrographs through a network of pipes, open channels, and detention basins that represent the proposed layout of the recommended drainage facilities.

The following paragraphs document the hydrologic parameters used for future developed condition hydrology.

5.1 Rainfall

In accordance with the DCM, analyses for both the 100-year, 24-hour storm, and the 100-year 2-hour storm were conducted. The 24-hour storm generates a higher runoff volume, and hence, was used to determine required detention volumes. Sizing of conveyance elements considered both the 24-hour and 2-hour storm events as described in Section 6.0, Hydraulic Analysis.

Rainfall depth for the 100-year, 24-hour storm at the Airport site was obtained from the U.S. Department of Commerce, National Oceanic and Atmospheric Administration Precipitation-Frequency Atlas of the Western United States (NOAA Atlas 2) (Miller et al. 1973), Figure 31 (Isopluvials of 100-year, 24-hour Precipitation in Tenths of an Inch). The figure is reproduced in the DCM as Figure 5-4e, and a copy is included in Appendix D for reference. The 100-year, 24-hour rainfall depth taken from the figure for the study area is 4.4 inches.

An incremental rainfall hyetograph was generated using the rainfall depth for the 100-year, 24-hour storm, and the cumulative Type IIA storm distribution (15-minute intervals) provided in the DCM (City of Colorado Springs, 1994). The cumulative and incremental rainfall hyetographs are provided for reference in Appendix D. The CUHP computer model allows the user to specify the time increment (between 5 and 15 minutes). Five-minute increments were selected for this analysis due to the basin sizes and the short times of concentration (ranging from 8 to 38 minutes, averaging 18 minutes). A model time increment longer than 5 minutes would not accurately capture peak flows from basins with short times of concentration.

The use of a 5-minute time increment, while appropriate for the typical basin size, leads to complication when trying to model a 24-hour storm event in CUHP. Rainfall input into CUHP is limited to 72 incremental rainfall depths per storm. This would be consistent with a 6-hour storm event at 5-minute increments, or an 18-hour storm event at 15-minute intervals. However, a 24-hour storm hyetograph at 5-minute incremental depths would consist of 288 total data points, more than can be accepted by CUHP.

Two options were considered to address this software limitation. First, the use of a "truncated" version of the hyetograph was considered. The truncated hyetograph would capture 72 incremental depths, including the peak incremental depths, and an approximately equal number of increments on either side of the peak. By excluding the hyetograph tails, this option would limit that actual rainfall to 3.6 inches in 6 hours, rather than the full 4.4 inches in 24 hours. It would preserve the highest intensity portion of the hyetograph which would have the most impact on peak flows and detention volumes.

The second option would use a "modified tails" hyetograph. The modified tails hyetograph would capture 72 incremental depths, including the peak incremental depths and an approximately equal number of increments on either side of the peak. However, the incremental depths leading up to and following the peak would be modified to include the depth of rainfall occurring before and after the 72 selected increments, (that is, the tail portions missing in the first option). In this manner, the full 4.4 inches of rainfall would be included into the hyetograph, but the 24-hour rainfall would effectively be compressed into a 6-hour event. Further explanation and documentation of the development of the modified tails hyetograph are provided in Appendix D for reference. A graphical representation of the entire 24-hour hyetograph and the truncated and modified tails hyetographs are presented in Exhibit 5-1 below.

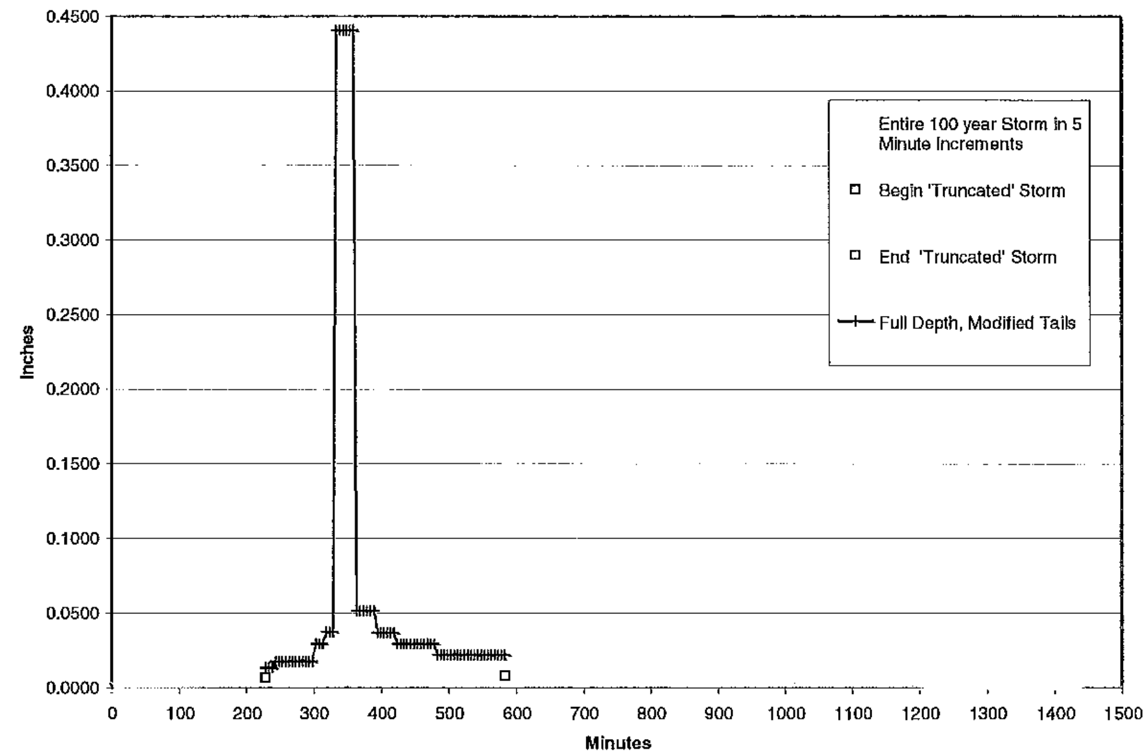


EXHIBIT 5-1
Graphical Depiction of Incremental Type IIA Rainfall, 100-year, 24-hour Storm

The use of the truncated hyetograph is determined to be less preferable because it is possible for the portion of the actual 24-hour hyetograph occurring after the 72 modeled increments to increase the needed storage volumes of some of the detention facilities. In other words, the model could potentially underestimate the volumes needed for detention basin storage. Instead, the modified tails hyetograph is selected for this analysis because it captures the entire 100-year, 24-hour storm depth of 4.4 inches within its 72 increments. This approach is slightly conservative, because it condenses the 24-hour storm depth to occur within 6 hours (72 increments), without altering the peak increments.

The 100-year, 2-hour storm was also modeled to analyze whether the shorter, higher intensity event would be more critical for evaluating peak runoff flow and sizing conveyance facilities. CUHP converts a 1-hour storm duration to a 2-hour storm duration. The 100-year, 1-hour storm rainfall depth was determined using the regression equation provided in NOAA Atlas 2. The 100-year, 1-hour rainfall depth for the study area was determined to be 2.64 inches. Documentation of the computation of this rainfall depth is provided in Appendix D.

5.2 Soil Type

Soils within the Airport are classified as NRCS hydrologic soil groups A and B. Soil groups A and B are moderately to highly erosive, and have moderate to high infiltration rates. In accordance with the DCM, Type A soils were treated as Type B soils where overlot grading was expected to occur. The distribution of soil types for the Study Area is shown in Exhibit A-5 in Appendix A.

Soil characteristics impact CUHP modeling by influencing the input values used for initial and final infiltration rates, as well as rate of decay for Horton's infiltration equation. Appropriate values for these parameters were determined based on soil type and proposed land use. Due to the dominance of Type B soils at the site, either naturally or because of development activity, infiltration parameters for Type B soils were used for each subbasin. Infiltration parameters are as follows:

- Initial Infiltration = 4.5 inches/hour
- Final Infiltration = 0.6 inches/hour
- Decay Coefficient = 0.0018

5.3 Land Use and Imperviousness

For the purposes of this MDDP, proposed future land-use is based on several sources as identified in Section 1.4, Concept Development Plan. Land use categories include office, industrial park, research and development, community commercial, hospitality commercial, neighborhood commercial, distribution, roads, runways, airport, military, aviation-related, golf course, and Open Space.

Percent impervious values were assigned to the land uses listed above in accordance with the DCM. Exhibit 5-2 lists the land uses and percent impervious values assigned to the various land use categories, as well as the values recommended by the DCM for the same or comparable land uses.

EXHIBIT 5-2
Land Use and Percent Impervious

Land Use	Percent Impervious	City/El Paso County DCM
Aviation Related	100	100 (streets)
Commercial	95	95 (commercial)
Golf Course	5	2-7 (parks, cemeteries, greenbelts)
Office/Industrial Park/R & D	95	95 (commercial) 80-95 (light industrial-commercial)
Open Space	2	2-7 (parks, cemeteries, greenbelts)
Roadway	100	100 (streets)
Runway	100	100 (streets)
Infield Area: Runway or Roadway Interchange (Unpaved)	5	2-7 (parks, cemeteries, greenbelts)

Source: City of Colorado Springs, 1994.

Because not all categories included in Exhibit 5-2 are listed in the DCM, land uses with similar characteristics were selected for comparison. Areas designated for use as stormwater detention were assigned an impervious value equal to that of the general land use assigned to the area.

Based on the relationships shown in Exhibit 5-2, all Airport property in the Windmill Gulch and Big Johnson Drainage Basin(s) was assigned an imperviousness value. The results are shown in Exhibit A-8 in Appendix A, where land areas are shaded according to their assigned percent imperviousness.

5.4 Watershed Characteristics

In addition to the major design points at the Airport property boundary (shown in Exhibit A-6 in Appendix A), intermediate design points within the interior of both the Windmill Gulch and Big Johnson Drainage Basin(s) were identified. Intermediate design points are located where large drainage flow paths come together, where drainage paths cross major roadways (existing or proposed), and where fixed-capacity structures exist or are proposed. Areas tributary to these intermediate design points were then delineated, subdividing each major drainage basin into a number of smaller basins. Existing topographic contours, supplemented with proposed roadway contours, were used to delineate the subbasins. The ridgeline historically dividing the Windmill Gulch and Big Johnson Basins within the Airport was generally preserved in the delineation of subbasins with some deviation where proposed roadways and parcel boundaries did not follow the historic ridgeline. The resulting mosaic of subbasins and subbasin design points are also shown in Exhibit A-8 in Appendix A, as are the historic and proposed watershed boundaries between Windmill Gulch and Big Johnson Basins.

Times of concentration, for use in CUHP, were computed using a spreadsheet for drainage basins with areas of 90 acres or less. The flow path for each subbasin was divided into its components, overland and shallow concentrated or concentrated flow reaches. Slopes for each segment of the flow path were computed using existing contours. Time of concentration calculations are provided in Appendix D.

The subbasin delineation provides the framework for data input into CUHP. Model input parameters, such as basin area, composite percent impervious, channel length, and length to centroid, were computed using Geographic Information Systems software. Subbasin parameters are summarized in Exhibit 5-3 below.

EXHIBIT 5-3
Basin Characteristics

Subbasin	Imperviousness	Channel Length (feet)	Distance to Centroid (feet)	Subbasin Area (square miles)	Subbasin Area (acres)	Time of Concentration (minutes)
Windmill Gulch Drainage Basin						
South System (Tributary to Design Point 888)						
400	0.52	2,399	1,446	0.18	115	N/A
450	0.74	2,024	941	0.13	83	21.2
451	0.83	1,088	542	0.04	26	12.5
500	0.31	3,318	1,473	0.39	250	N/A
550	0.47	2,971	1,486	0.13	83	26.5
551	0.79	1,563	1,003	0.06	38	18.7
600	0.72	1,921	1,046	0.06	38	20.7
South System (Tributary to Design Point 525)						
525	0.27	928	214	0.05	32	15.2
North System (Tributary to Design Point 777)						
625	0.76	873	52	0.03	19	14.9
650	0.70	3,075	1,519	0.18	115	N/A
660	0.93	3,394	2,080	0.31	198	N/A
675	0.46	4,986	2,159	0.11	70	37.7
685	0.21	4996	2492	0.09	58	37.8
700	0.18	3,610	1557	0.11	70	30.1
725	0.09	3,415	1,124	0.19	122	N/A
750	0.82	3,897	1,625	0.10	64	31.7
800	0.72	1,414	649	0.12	77	15.3
825	1.00	1,119	498	0.02	13	8.0
850	1.00	3,334	1,910	0.13	83	21.3
875	0.94	3,131	858	0.14	90	27.4
900	0.66	1,886	924	0.07	45	20.5
925	1.00	1,658	764	0.05	32	14.8
950	1.00	3,303	1,525	0.12	77	18.9
Big Johnson Drainage Basin						
100	0.17	859	306	0.05	32	14.8
150	0.91	1,064	615	0.03	19	11.0
200	0.09	6,508	3,021	0.37	237	N/A
215	0.34	2003	759	0.05	32	21.1
225	0.88	985	531	0.03	19	10.2
250	0.96	1456	660	0.09	58	10.4

EXHIBIT 5-3
Basin Characteristics

Subbasin	Imperviousness	Channel Length (feet)	Distance to Centroid (feet)	Subbasin Area (square miles)	Subbasin Area (acres)	Time of Concentration (minutes)
260	0.96	1486	600	0.06	40	17.2
270	0.99	2073	1139	0.14	90	21.5
275	0.96	1,002	462	0.03	19	11.8
300	0.02	2,945	1,517	0.14	90	26.4

5.5 Summary of Colorado Urban Hydrograph Procedure Results

Based on the input parameters discussed above, CUHP generated runoff hydrographs, total runoff volumes, peak runoff rates, and time to reach peak runoff for each of the subbasins listed in Exhibit 5-3. A summary of peak subbasin runoff rates and runoff volumes calculated by CUHP for the 100-year, 24-hour storm is provided in Exhibit 5-4. The actual input and output files for the Windmill Gulch and Big Johnson CUHP models are included in Appendix E. The time to reach peak runoff was generally consistent for each subbasin at 2 hours 25 minutes.

EXHIBIT 5-4
CUHP Excess Precipitation Volumes and Subbasin Peak Runoff Rates; 100-year, 24-hour Storm

Subbasin	Peak Runoff (cfs)	Volume of Excess Precipitation (AF)
Windmill Gulch Drainage Basin		
400	458	51.8
450	400	24.4
451	121	8.0
500	675	51.8
525	123	6.4
550	333	19.8
551	186	11.7
600	181	11.1
625	94	5.7
650	531	32.6
660	913	65.2
675	232	16.7
685	177	11.0
700	255	13.1
725	291	21.0
750	272	19.8
800	359	22.2
825	63	4.3
850	413	28.1
875	419	29.7
900	210	12.4
925	152	10.8
950	363	26.0

EXHIBIT 5-4
CUHP Excess Precipitation Volumes and Subbasin Peak Runoff Rates; 100-year, 24-hour Storm

Subbasin	Peak Runoff (cfs)	Volume of Excess Precipitation (AF)
Big Johnson Basin		
100	107	5.9
150	93	6.2
200	429	40.6
215	132	6.8
225	93	6.1
250	273	19.2
260	181	12.8
270	335	14.7
275	93	6.4
300	335	14.7

5.6 Basin Runoff from Urban Drainage Stormwater Management Model – Baseline Condition (No Detention Facilities)

The storm runoff hydrographs generated by CUHP were routed through the proposed drainage systems using the UDSWM model. Initially, a system of storm sewer conduits and open channels was schematically developed to progressively collect runoff from tributary subbasins and upstream conveyance elements, combining flows to final delivery to the major basin design points. No detention facilities were included in order to calculate the undetained peak discharge from the watersheds. Those discharges to the DBPS design points are compared to the DBPS allowable discharges in Exhibit 5-5.

EXHIBIT 5-5
UDSWM Peak Discharge at Property Boundary Design Points; 100-year, 24-hour Storm with No Detention

DBPS Design Point Reference Number	MDDP Design Point Reference Number	MDDP Peak Undetained Discharge[1] (cfs)	DBPS Allowable Peak Discharge (cfs)
Windmill Gulch Basin			
11 (J)	777	4854	150
8, 9, 10	525	123	275
7 (I)	888	1520	250
Big Johnson Drainage Basin			
62 (5A-3)	1,001	200	50
32 (5A-2)	1,002	1437	85
61 (5B-2)	300	335	36

[1] Does not account for limitations in capacity of discharging culvert.

Schematic diagrams of the proposed drainage systems for the Windmill Gulch and Big Johnson Drainage Basin(s) were prepared using the FSA graphical user interface to the UDSWM model. Diagrams showing the schematic networks are provided for reference in Appendix F.

5.7 Basin Runoff from UDSWM – With Recommended Detention Facilities

As shown in Exhibit 5-5 above, all but one of the projected peak flows for the undetained condition exceed the peak discharge allowed by the DBPS. Therefore, several detention strategies were evaluated in order to reduce the peak discharge at each design point to the allowable rate. Initially, a scenario involving the placement of detention only at the most downstream ends of the system (DBPS design points) was modeled. The initial run provided a rough estimate of the total volume of detention which would be required to reduce the future condition peak discharge to the allowable discharge at each property boundary design point. In successive model runs, detention facilities were placed in areas upstream within the drainage system thereby reducing the size of the most downstream detention basins. Following several intermediate designs, a recommended detention scenario was identified for the Windmill Gulch and Big Johnson Drainage Basins. The preferred detention scenario emphasizes storage upstream within each sub-drainage system, thereby minimizing the need and associated cost for large conveyance elements to convey high-peak flows from upstream basins to downstream detention facilities. Minimizing downstream detention has the further benefit of limiting disturbance to areas dedicated to Open Space and lessening potential conflict with the proposed golf course.

The recommended detention locations and conveyance paths and connections for both the Windmill Gulch and Big Johnson Drainage Basin(s) are shown in Exhibit A-9 in Appendix A. The UDSWM model input and output files are provided for reference in Appendix F. Exhibit 5-6 summarizes the results of the UDSWM modeling in terms of the peak discharges at the property boundary design points with the recommended detention, and it compares those values to the allowable discharge rates cited in the DBPS. Exhibit 5-6 can be compared to Exhibit 5-5 to quantify the benefit of flow attenuation resulting from the recommended detention basin scenario.

As can be seen in Exhibit 5-6, the recommended discharge at MDDP design point 777 (298 cfs) is nearly twice as high as the discharge modeled in the DBPS (150 cfs). Because of the considerable area that drains to this point (1088 acres), the higher release rate is recommended. To compensate for this higher rate, the recommended release rate at MDDP design point 525 (123 cfs) is less than half of the rate modeled in the DBPS (275 cfs). Only 32 acres, all within the proposed golf course, will drain to design point 525. With this modification, total release from the Airport site still meets DBPS objectives, and there should be no significant downstream impacts resulting from this modification, as the two design points are close to each other and to Windmill Gulch.

In Exhibit 5-6, the recommended discharge at MDDP design point 300 is considerably higher than the rate modeled in the Big Johnson DBPS (332 cfs vs. 36 cfs). No development is proposed in subbasin 300. The peak rate calculated in this MDDP by CUHP and UDSWM modeling is for existing undeveloped conditions. The Big Johnson DBPS used TR-20 software and input a very low curve number value for this basin (see Exhibit 3-1) that resulted in a peak runoff value of only 25 cfs. The variation in peak rate between the two studies is due to differences in software used, in storm hyetograph input, in watershed characterization, and watershed area (0.14 sq mi in the MDDP vs. 0.07 sq mi in the Big Johnson DBPS). Because the intent of the Big Johnson DBPS is to limit peak flow at key discharge points to historic values, and because no change to historic condition is proposed, planning for a detention facility at this location is not warranted and is not recommended.

EXHIBIT 5-6
UDSWM Peak Discharge at Property Boundary Design Points; 100-year, 24-hour Storm Event with Detention

DBPS Design Point	MDDP Design Point	Peak Discharge With Recommended Detention (cfs)	DBPS Allowable Peak Discharge (cfs)
Windmill Gulch Basin			
11 (J)	777	298	150
8, 9, 10	525	123	275
7 (I)	888	249	250
Total		670	675
Big Johnson Basin			
62 (5A-3)	1001	48	50
32 (5A-2)	1002	71	85
61 (5B-2)	300	335	36
Total		454*	171

The detention facilities shown in Exhibit A-9 in Appendix A are tabulated in Exhibit 5-7. The table also shows the required detention volumes for the 100-year, 24-hour storm that were calculated by the UDSWM model.

The UDSWM model output for water quantity storage does not take into account storage volume needed for water quality purposes. Computation of recommended storage volume for water quality improvement, as well as the total recommended design volumes and peak discharges for the detention ponds are discussed further in Section 6.0, Hydraulic Design.

In addition to the detention facilities shown in Exhibit 5-7, on-site detention will be required for the three office and commercial parcels that lie within subbasin 500 and are tributary to detention site Number 7. The parcels are identified on Exhibit A-9 in Appendix A. On-site detention is required there to reduce the size of detention site Number 7 so as not to conflict with golf course design and routing, and also to provide stormwater quality treatment at those parcels rather than at detention site Number 7. Refer to Section 6.1.2, Water Quality Capture Volume for further discussion.

EXHIBIT 5-7
UDSWM Model Output: Water Quantity Storage Needs; 100-year, 24-hour Storm

Detention Site	UDSWM Storage Volume Needed for Reduction of 100-year, 24-hour Peak Flow[1] (AF)
Windmill Gulch Detention Sites	
1	26.8
2	56.1
3	35.2
4	61.3
5	73.3
6	56.2
7	21.7
8	32.3
10	15.5
11	21.5
13	17.2
Sub-total	417.1
Big Johnson Detention Sites	
100	3.9
200	4.7
250	3.2
400	3.1
500	50.9
700	33.9
900	3.8
Sub-total	103.5
Total	520.6

[1] Model output only. Does not include additional storage volume needed for water quality improvement.
[2] Because the Airport does not propose any development in the basin tributary to DBPS design point 61 (5B-2) (MDDP Design Point 300), construction of detention facilities is not proposed for inclusion with the Business Park development.

SECTION 6.0

Hydraulic Design

The hydrologic analysis provides the basis for identifying drainage improvements that will be necessary to manage storm runoff associated with future development and to limit peak discharges from the Airport in a manner consistent with the Windmill Gulch and Big Johnson DBPS.

6.1 Detention Facilities

Exhibit A-8 in Appendix A summarizes the recommended number and location of detention facilities. The aerial extent shown for each basin approximates the space requirement that will be needed to provide the storage volumes listed in Exhibit 5-7, based on preliminary grading of the basins and the existing topography. Final shapes and sizes of the detention facilities will ultimately be determined as site plans are developed.

The City requires that stormwater runoff be treated to improve the quality of runoff released from a developed site. Volume 2 of the DCM requires that a Best Management Practice with water quality capture volume (WQCV) be incorporated as an integral component of the storm drainage system. Where stormwater quantity detention facilities are proposed, a quality component should be incorporated (City of Colorado Springs, 1994).

The final recommended sizes for the detention facilities combine the WQCV with the storage volume identified in Exhibit 5-7 that is needed for attenuating peak flow. Determination of WQCV for the Airport property in the Windmill Gulch and Big Johnson Basins is explained below.

6.1.1 Water Quality Considerations

Volume 2, Section 4.1 of the DCM requires that WQCV be provided for new development or significant redevelopment of 1 acre or greater, and that the WQCV be incorporated into stormwater quantity detention basins when proposed. In addition, the DCM states that onstream WQCV facilities must be designed to serve the entire upstream watershed, even if upstream developments have installed their own WQCV facilities.

6.1.2 Water Quality Capture Volume

WQCVs were computed for each subbasin following the procedure outlined in Volume 2, Section 4.2 of the DCM. The WQCVs (including sediment storage) for downstream detention facilities were computed considering the total tributary area, regardless of whether upstream WQCVs exist. The total required storage volume (stormwater attenuation plus WQCV) for each detention facility was then computed by adding half of the WQCV (including sediment storage allowance) to the 100-year, 24-hour model output storage volume for each detention facility identified in Exhibit 5-7. Exhibit 6-1 below summarizes the 100-year model output storage volumes, WQCV adjustments, and total design volumes for each of the detention basins. The WQCV results are provided in Appendix G for reference.

EXHIBIT 6-1
Detention Basin Design Volumes

Basin Identification	Tributary Subbasins	Computed Total WQCV (AF)	Total WQCV Plus Sediment Allowance (AF)[1]	Volume to be Added to 100-year, 24-hour Storage (AF)	100-year, 24-hour UDSWM Model Storage Need (AF)	Basin Design Storage (AF)
		WQCV	(WQCV + S) = 120 Percent WQCV	50 percent (WQCV + S)		
Windmill Gulch Detention Basin						
1	675, 685	1.7	2.0	1.0	26.8	27.8
2	660	7.1	8.6	4.3	56.1	60.4
3	950, 925	4.5	5.4	2.7	35.2	37.9
4	900,650,675. 685	5.3	6.4	3.2	61.3	64.5
5	875, 850, 825, 750	9.1	10.9	5.5	73.3	78.8
6	675, 685, 660, 950, 925, 900, 650, 875, 850, 825, 750, 800, 625, 700	30.8	37.0	18.5	56.2	74.7
7	500, 675, 685, 660, 950, 925, 900, 650, 875, 850, 825, 750, 800, 625, 725, 700	32.7	39.2	19.6	21.7	21.7[2]
8	550, 551, 600, 550, 451, 450, 400	9.4	11.3	5.6	32.3	37.9
10	550	1.4	1.7	0.8	15.5	16.3
11	551, 600, 550	3.3	4.0	2.0	21.5	23.5
13	725	0.6	0.7	0.4	17.2	17.6
Big Johnson Detention Basin						
100	100, 150	1.0	1.2	0.6	3.9	4.5
200	225	0.6	0.7	0.4	3.2	3.6
250	215	1.0	1.2	0.6	4.7	5.3
400	150	0.7	0.8	0.4	3.1	3.5
500	200, 250, 260, 270, 275	6.9	8.3	4.1	50.9	55.0
700	250, 260	3.2	3.8	1.9	33.9	35.8
900	275	0.7	0.8	0.4	3.8	4.2

[1]S = Volume allowance for sediment accumulation.
[2]WQCV storage is not recommended for Detention Basin 7.

Detention Basin 7 (DB-7) is not recommended to include a WQCV due to its location relative to air traffic paths. The inclusion of a WQCV at this location has a potential safety risk to Airport operations. Field observations suggest that shallow groundwater exists in this area, and a water quality outlet would impound the shallow groundwater. Impoundment of the shallow groundwater would create permanent open water, or conditions favorable for the establishment of wetland species, thereby attracting waterfowl and increasing the potential for incident with aircraft taking off from Runway 35L/17R.

Detention facilities having the capacities listed in the "Basin Design Storage" column above have been preliminarily graded into the existing topographic contours. The area of the water surface for each of the recommended detention basins is shaded in blue in Exhibit A-9 in Appendix A. For the purpose of determining the conceptual footprint of the detention facilities, 3H:1V pond side slopes were used, and target depth was a maximum of 9 feet. For conceptual layout purposes, pond inverts were placed a maximum 11 feet below the lowest nearby lot or roadway elevation contour, to ensure at least 1 foot of freeboard when full. Final shapes and sizes of the basins will be determined as development and parcel grading plans are proposed and approved.

6.2 Conveyance Elements

Conveyance elements (open channels, storm drains, culverts, and streets) will be needed within the drainage system in order to safely convey stormwater runoff within the drainage basins to the outfalls at the Airport boundary. The locations for the recommended conveyance elements were selected based on the Concept Plan and the locations of proposed detention facilities. Conveyance routing was designed to collect and convey flows in a manner consistent with the drainage network modeled in CUHP/Stormwater Management Model (SWMM).

Flood routing results from UDSWM provide the basis for the design of the recommended storm drainage network. Modeling was performed for both the 100-year, 24-hour event and for the 100-year, 2-hour event. The resulting peak flows for each element were compared and the larger value was used as the basis for sizing the conveyance element.

Streets are an integral component of any storm drainage system. For storm drain systems located within street corridors, portions of the stormwater runoff can be carried in the streets. The flow-carrying capacity of the streets was determined in accordance with the DCM, using the proposed roadway cross sections and profiles. The street cross sections used and their capacity calculations are provided for reference in Appendix H.

For conceptual sizing purposes, where pipes are recommended velocities were kept below the DCM recommended limit of 18 feet per second. For conceptual sizing purposes, where grassy channels are recommended, channel velocities are below the DCM recommended limit of 5 feet per second. Slopes flatter than existing ground were used when needed to keep channel velocities below 5 feet per second. It is anticipated that drop structures will be needed to dissipate excess potential energy for channels having slopes flatter than existing ground. Channel side slopes of 4H:1V were used for conceptual sizing. Channel flow depths were kept at or below 5 feet (excluding freeboard). Additional conceptual element information, including ground slope, length, anticipated flow velocity, and need for drop structures, is provided in Appendix H.

Exhibit 6-2 is a summary table for the proposed conveyance elements. The table provides the design flow, allowable street flow, conduit or channel flow, and attributes for the conveyance element that is recommended. The alignments of the recommended drainage system are shown in Exhibit A-9 in Appendix A.

EXHIBIT 6-2
Recommended Conveyance Elements: Conceptual Design Flows and Sizes

Element Identification	Reach Flow from UDSWM Model[1] (cfs)	Street Capacity (cfs)	Street Flow (cfs)	Remaining Element Flow (cfs)	Element Slope (ft/ft^2)	Recommended Element Size (pipe diameter, box dimensions, or channel dimensions)
Windmill Gulch Conveyance Elements						
2 1 A	504	NA	0	504	0.006	6X6 box
2 1 B	126	NA	0	126	0.015	42" pipe
2 2	252	NA	0	252	0.010	60" pipe
2 3	11	NA	0	11	0.005	21" pipe
4 1 A	943	NA	0	943	0.005	10X6 box
4 1 B	409	NA	0	409	0.005	78" pipe
4 2	275	NA	0	275	0.005	72" pipe
5 1 A	419	N/A street slopes uphill	0	419	0.027	60" pipe
5 1 B	210	320	210	0	0.027	None
5 2	10	N/A due to pond invert elev relative to street elev.	0	10	0.007	21" pipe
5 4A	272	N/A-no street	0	272	0.018	66" pipe
5 4B	272	N/A-no street	0	272	0.005	72" pipe
6 1 A	411	N/A-street slopes uphill	0	411	0.015	66" pipe
6 1 B	159	369	159	0	0.022	None
6 3 B	22	N/A-pond invert elev lower than street elev.	0	22	0.0050	27" pipe
6 3 A	116	N/A	0	116	0.032	36" pipe
6 4 A	190	N/A	0	190	0.006	6'W x 3.4'D channel
7 2 A	25	N/A	0	25	0.025	3'W x 2'D channel
7 2 B	25	N/A	0	25	0.020	24" pipe
7 1 A	512	N/A	0	512	0.003	8'W x 5'D channel
7 1 B	148	N/A	0	148	0.007	5'W x 3'D channel
7 1 C	34	N/A	0	34	0.020	4'W x 2'D channel
8 1 A	144	NA-street slopes uphill	0	144	0.0070	54" pipe
8 1 B	76.5	264	77	0	0.0070	None
8 2 A	206	95	95	111	0.0050	54" pipe
8 2 B	21	NA-no street	0	21	0.0130	2'W x 2'D channel
8 2 C	21	NA-no street	0	21	0.0110	24" pipe
8 3 A	399	NA-too many slope changes	0	399	0.0010	8'W x 8'H box
8 3 B	160	NA-too many slope changes	0	160	0.0070	54" pipe
8 3 C	80	206	80	0	0.0070	None
8 4 A	769	NA	0	769	0.0025	10'W x 6'D channel
8 4 B	565	NA	0	656	0.0030	10'W x 5.5'D channel

EXHIBIT 6-2
Recommended Conveyance Elements: Conceptual Design Flows and Sizes

Element Identification	Reach Flow from UDSWM Model[1] (cfs)	Street Capacity (cfs)	Street Flow (cfs)	Remaining Element Flow (cfs)	Element Slope (ft/ft[2])	Recommended Element Size (pipe diameter, box dimensions, or channel dimensions)
8 4 C	542	NA	0	542	0.0030	10'W x 5'D channel
8 4 D	542	NA	0	542	0.0050	7'W x 6'H box
Big Johnson Conveyance Elements						
1	22	NA	0	22	0.0250	2' W x 2' D channel
2A	38	NA	0	38	0.0050	36" pipe
2B	38	NA	0	38	0.0190	5' W x 2' D channel
3A	42	NA	0	42	0.0700	21" pipe
3B	19	NA	0	19	0.0357	18" pipe
3C	93	NA	0	93	0.0250	36" pipe
4A	100	NA	0	100	0.0080	4' W x 2' D channel
4B	57	NA	0	57	0.0260	30" pipe
5	335	NA	0	335	0.0225	60" pipe
6	11	NA	0	11	0.0590	18" pipe
7	181	NA	0	181	0.0098	54" pipe

[1] Reach flow listed here is the greater of the 100-year, 24-hour and the 100-year, 2-hour flows for each reach.
[2] ft/ft = feet per feet

SECTION 7.0

Discussion and Recommendations

This section summarizes the recommended storm drainage improvements that will be required to capture, contain, and convey runoff through future development of the Airport property. Phased implementation of the improvements is also generally addressed. The discussion is general because construction phasing will depend upon the manner in which the site eventually develops. At this conceptual stage, the development pattern cannot be discerned as it is dependent upon a large number of factors, including local economic activity, market demands, and approaches to infrastructure funding.

7.1 Drainage Planning Approach

The drainage approach presented by this MDDP is designed to accomplish the following objectives:

- Attenuate developed runoff to meet allowable peak discharge at the property boundary as defined in the DBPS.
- Coordinate detention basin and conveyance element location with Concept Plan layout and future aviation-related development.
- Minimize detention basin size and number in Open Space and golf course areas in order to preserve natural values in the Open Space and reduce impacts to golf course operations.
- Optimize detention basin and conveyance element size and layout to manage infrastructure costs.

Drainage planning for development of the 3.8-square-mile (2,433 acre) portion of the Airport property that lies within the Windmill Gulch and Big Johnson Drainage Basins has the primary challenge of providing sufficient detention storage to control runoff release from the property to levels that are protective of downstream property and infrastructure. This MDDP has been developed in accordance with the two Drainage Basin Planning Studies that previously determined the stormwater flows and drainage improvements needed to achieve that goal. Hydrologic and hydraulic modeling downstream of the Airport property has not been performed as part of this drainage planning effort.

The detention requirements at the Airport are significant, perhaps more so than is common for site development. The primary reason for this is that, prior to Airport development, 60 percent of the Windmill Gulch Basin drained internally (large sump, or retention, areas) and did not contribute storm runoff to Windmill Gulch. The Windmill Gulch DBPS recognized this fact and used the undeveloped peak runoff discharges that were calculated from the tributary 40 percent to guide future allowable release from the property under future development, when the full 2.75-square-mile area would become tributary to

Windmill Gulch. Exhibit 7-1 compares historic condition and future condition parameters for tributary area, peak discharge values, and unit release rates (Wilson, 1992a).

EXHIBIT 7-1
Comparison of Peak Historic/Allowable Release Rates for Airport Property, from Windmill Gulch DBPS

Developed Condition	Tributary Area (sq miles[1])	Peak Runoff (cfs)	Unit Peak Runoff (cfs/acre[2])
Historic (undeveloped)	1.04	510 (calculated)	0.77
Future (developed)	2.8	675 (allowable)	0.38

[1] sq miles = square miles
[2] cfs/acre = cubic feet per second per acre

Exhibit 7-1 indicates that detention storage in the Windmill Gulch portion of the study area will need to attenuate release of fully developed Airport runoff to a unit rate of only 0.38 cfs/acre, approximately half the unit rate calculated for the historic undeveloped condition. The hydrologic modeling presented in the previous section has determined that reaching this goal will require 461 acre-feet of storage volume (not including WQCV), as summarized in Exhibit 5-7.

Preserving the historic drainage patterns, wherein 60 percent of the Windmill Gulch area would continue to drain internally to large retention areas was not considered feasible for several reasons. These include changes to drainage patterns that have already been made in association with development of the new Airport terminal, the large volume and land area that would be required to retain the full quantity of developed runoff, and the potential hazard to aviation that could result from retention of standing bodies of water for long periods of time. Standing water might attract birds and other wildlife that could pose increased danger to flight activity.

No historic retention areas have been identified in the Big Johnson Basin within the Airport. However, as shown in Exhibit 7-2, the undeveloped, historic unit discharge rate calculated for the Airport basins by the DBPS is a relatively low 0.22 cfs/acre, only 29 percent of the historic unit discharge calculated in the Windmill Gulch DBPS. Because this relatively low historic unit rate was used by the DBPS to define the future allowable peak discharge from the Airport, development within the Big Johnson Basin will also have to provide significant detention storage in order to attenuate flow to this level. A total of 112 acre-feet of detention volume will be required (not including WQCV) as presented in Exhibit 5-7.

EXHIBIT 7-2
Comparison of Peak Historic/Allowable Release Rates for Airport Property, from Big Johnson DBPS

Developed Condition	Tributary Area (sq miles)	Peak Runoff (cfs)	Unit Peak Runoff (cfs/acre)
Historic (undeveloped)	0.94	132 (calculated)	0.22
Future (developed)	1.00	171 (allowable)	0.27

Drainage facility layout presented in this MDDP is coordinated with the Concept Plan for business park development that was submitted to the City concurrent with the MDDP. To the extent that actual development may occur in a slightly different pattern than shown by the buildings, parcel boundaries, and secondary road alignments in the Concept Plan, it is recognized that modifications to the conceptual drainage plan provided here may be warranted in the future. Site-specific drainage reports and drainage plans that accompany future improvement plans for Airport parcels will need to coordinate with this MDDP, and with the drainage infrastructure completed at that time.

7.2 Summary of Recommended Improvements

To reduce and contain runoff from the proposed developments described in this MDDP and to provide the required WQCV in accordance with Volume 2 of the DCM, the detention basins listed in Exhibit 7-3 are recommended when all areas scheduled for development are constructed (City of Colorado Springs, 1994). Locations and approximate areas of the detention basins are indicated in Exhibit A-9 in Appendix A. Phasing of the construction of these basins will depend on the pattern and timeline of build-out of the proposed developments, and is discussed further in the next section.

EXHIBIT 7-3
Summary of Proposed Detention Basins

Detention Basin	Basin Volume (AF)	Detention Basin	Basin Volume (AF)
Windmill Gulch Basin		**Big Johnson Basin**	
1	27.82	100	4.5
2	60.36	200	5.3
3	37.9	250	3.6
4	64.48	400	3.5
5	78.76	500	55.0
6	74.68	700	35.8
7	21.7	900	4.2
8	37.94	100	4.5
10	16.34	200	5.3
11	23.48		
13	17.56		
Total	461.0	Total	112.0

In addition to detention facilities, proposed development will require storm drainage conveyance infrastructure. The conveyance elements listed in Exhibit 7-4 are recommended when all areas scheduled for development are constructed. Locations of the conveyance elements are indicated in Exhibit A-9 in Appendix A. The conveyance elements shown are the major facilities needed downstream of detention facilities, or are major conduits in the proposed right-of-way that serve to collect runoff from individual parcels. In addition to these conveyance elements, secondary systems will be proposed in future site-specific drainage reports to locally collect and convey parcel runoff to the MDDP drainage facilities.

As indicated in Exhibit 7-4, a combination of open channels and closed conduit are proposed. Open channels generally have the benefit of lower cost, lower velocities, and potential water quality enhancement through sedimentation and infiltration. Open channels have been proposed where judged appropriate.

EXHIBIT 7-4
Summary of Conveyance Infrastructure Needs

Conveyance Element	Element Length (ft)	Recommended Element Size	Conveyance Element	Element Length (ft)	Recommended Element Size
Windmill Gulch Basin			**Big Johnson Basin**		
2 1 A	2800	6X6 box	1	310	2' W x 2' D channel
2 1 B	1360	42" pipe	2A	285	36" pipe
2 2	1520	60" pipe	2B	504	5' W x 2' D channel
2 3	466	21" pipe	3A	109	21" pipe
4 1 A	2430	10X6 box	3B	297	18" pipe
4 1 B	409	78" pipe	3C	723	36" pipe
4 2	466	72" pipe	4A	805	4' W x 2' D channel
5 1 A	2784	60" pipe	4B	379	30" pipe
5 1 B		None	5	393	60" pipe
5 2	709	21" pipe	6	450	18" pipe
5 4A	691	66" pipe	7	434	54" pipe
5 4B	500	72" pipe			
6 1 A	500	66" pipe			
6 1 B		None			
6 3 B	900	27" pipe			
6 3 A	1190	36" pipe			
6 4 A	1000	6'W x 3.4'D channel			
7 2 A	1600	3'W x 2'D channel			
7 2 B	700	24" pipe			
7 1 A	1900	8'W x 5'D channel			
7 1 B	460	5'W x 3'D channel			
7 1 C	1020	4'W x 2'D channel			
8 1 A	785	54" pipe			
8 1 B		None			
8 2 A	1290	54" pipe			

EXHIBIT 7-4
Summary of Conveyance Infrastructure Needs

Conveyance Element	Element Length (ft)	Recommended Element Size	Conveyance Element	Element Length (ft)	Recommended Element Size
	Windmill Gulch Basin			**Big Johnson Basin**	
8 2 B	770	2'W x 2'D channel			
8 2 C	270	24" pipe			
8 3 A	1700	8'W x 8'H box			
8 3 B	950	54" pipe			
8 3 C		None			
8 4 A	604	10'W x 6'D channel			
8 4 B	440	10'W x 5.5'D channel			
8 4 C	780	10'W x 5'D channel			
8 4 D	895	7'W x 6'H box			

Existing culverts at the Airport property boundary were evaluated for their condition and capacity, in order to determine their adequacy to convey the proposed flows. In general, the existing culverts have the capacity to convey the proposed flows, as shown in Exhibit 7-5 below, with two exceptions. The existing culverts at MDDP design points 525 and 1001 are recommended to be replaced, due to siltation, vegetation, and poor condition inhibiting their use. Future modification of Powers Boulevard culverts may be required in association with future roadway improvements by others.

EXHIBIT 7-5
Adequacy of Existing Property Boundary Discharge Culverts

DBPS Design Point	MDDP Design Point	Estimated Structure Capacity (cfs)	Existing Structure Condition	Proposed Discharge (cfs)
Windmill Gulch				
11	777	400	good	298
8, 9, 10 (3 culverts)	525	350	good	123
7	888	860	good	249
Big Johnson				
5A-3 (3 culverts)	1,001	115	good	48
5A-2	1,002	100	fair	71
5B-2	300	360	good	335

Several of the existing culverts within the Airport property will be removed during roadway improvement or business park construction. Existing culverts beneath the Return to Terminal Road, and the Airport Exit Road are expected to remain in place. In addition, a new culvert is needed under the Airport Entrance Road, to convey flows from detention Number 1 to Number 4.

7.3 Sequencing and Phasing of Drainage Improvement Construction with Business Parks

This MDDP was developed to provide flexibility for accommodating phased buildout of the study area. As development occurs, the facilities needed to convey and detain runoff from the developments to existing or new hydraulic elements and to the Airport boundary will need to be constructed. The following paragraphs describe some of the factors that will control the timing of construction of the improvements described above. Refer to Exhibit A-6 in Appendix A for location of existing features, Exhibit A-8 in Appendix A for subbasin locations, and Exhibit A-9 in Appendix A for locations of proposed facilities. Information on the sizes and lengths of the various conveyance elements is found in Exhibit 7-4 and detention basin volumes are summarized in Exhibit 7-3.

7.3.1 Windmill Gulch Basin

Detention Basin No. 1 (DB-1). DB-1 is located 2000 feet NW of an existing detention facility (WG-1) that detains runoff from the storm drain system serving the south half of Runway 17L/35R (subbasins 675 and 685). Currently, collected runoff is released to the northwest from WG-1. Construction of DB-1 will be required when the proposed military facility (Arrival/Departure Airfield Control Group [A/DACG]) is constructed over the existing WG-1 in subbasin 270. The A/DACG facility will drain southward, but site construction will eliminate WG-1, forcing it to be reconstructed to its new configuration to continue its current functionality. When A/DACG is constructed, a new 78-inch RCP and a 10-foot by 6-foot RCB (conveyance elements 41A and 41B) must be constructed to convey flows to the new location for DB-1. DB-1 will discharge via a proposed culvert (conveyance element 42, a 72-inch RCP) under the Airport Entrance Road, to detention Number 4. Alternately, if Canadair Point is constructed before the A/DACG, conveyance element 41B should be constructed. As modeled in CUHP and UDSWM for future conditions, the peak inflow into DB-1 is 895 cfs, while outflow is restricted to a maximum of 275 cfs.

Detention Basins No. 2 (DB-2) and No. 3 (DB-3). DB-2 and DB-3 are also located at the general site of existing detention facilities, WG-1b and WG-2, respectively. WG-1b and WG-2 are hydraulically connected by a 60-inch culvert beneath Drennan Road (inbound). Regrading of WG-1b to create DB-2 will be required when Canadair Point or Sikorsky Grove is constructed or when the north portion of East Aviation Development Area in subbasin 660 is constructed. Regrading of WG-2 to create DB-3 will be required when Sikorsky Grove is constructed and/or when additional development in subbasins 925 and 950 is proposed. Downstream conveyance element 52 will be constructed under Sikorsky Grove at the same time. As determined in the future conditions hydrologic modeling, the peak inflow into DB-2 is 913 cfs, while outflow is restricted to a maximum of 11 cfs. Direct inflow into DB-3 will be 515 cfs (plus outflow from DB-2), while release from DB-3 is restricted to 10 cfs.

Detention Basin No. 4 (DB-4). DB-4 is located over a depressed area where runoff now collects before passing beneath Drennan Road to the south through an existing 8-foot by

6-foot box culvert. DB-4 will be required when the north business park in subbasin 900 is developed, or when DB-1 is constructed. Runoff from subbasin 900 will flow directly into DB-4. Partially attenuated flows from DB-1 will flow into DB-1 through the proposed 72-inch culvert (conveyance element 42) under Airport Entrance Road. DB-4 will receive 485 cfs peak flows at buildout, and will restrict outflow to 28 cfs. Outflow from DB-4 will be conveyed downstream to DB-6 through elements 63B and 63A. When DB-4 is constructed, the existing 8-foot by 6-foot box culvert passing beneath Drennan Road to the south should be plugged and abandoned.

Detention Basin No. 5 (DB-5). DB-5 is located along an existing drainage path that conveys runoff from the terminal parking area to a 36-inch culvert beneath Drennan Road. DB-5 will be constructed when Sikorsky Grove is built because Sikorsky Grove will cross the drainageway. DB-5 will also be required at such time that further development occurs in any of the tributary subbasins, 750, 825, 830, or 875. Piped outflow from DB-5 will combine with element 52 flow at the intersection of Sikorsky Grove and Boeing Heights and eventually flow into DB-6 through a storm drain beneath Boeing Heights. Peak inflow to DB-5 from the four tributary basins totals 1,167 cfs. Basin outflow will be restricted to 25 cfs.

Detention Basin No. 6 (DB-6). DB-6 is located just west of an existing detention area, labeled WG-4b in Exhibit A-6 in Appendix A. WG-4b has an existing 36-inch culvert outlet beneath Drennan Road. Construction of Boeing Heights north of Drennan Road will disrupt the function of WG-4b and the culvert and will require DB-6 to be constructed in its place. Construction of DB-6 will also be required when development occurs in any of the subbasins that are directly tributary to it (subbasins 625, 700, or 800). When DB-6 is constructed, the 36-inch culvert should be plugged and abandoned and conveyance element 71C constructed in its place. Element 71C includes a new culvert under Drennan Road and an open channel along the margin of the proposed golf course that will connect to the existing drainageway running southwest towards Powers Boulevard and DB-7. Peak inflow to DB-6 is 727 cfs, while peak outflow is limited to 29 cfs.

DB-7. DB-7 is located at DBPS design point 11 (J), just east of Powers Boulevard at the Airport property boundary. Runoff from all Airport property north of Drennan Road will eventually pass through DB-7 prior to being released from the site. However, DB-7 only serves to detain runoff from subbasin 500 which includes much of the proposed golf course. Runoff from north of Drennan Road will already have been detained at upstream detention facilities and is simply passed through DB-7 to limit the size of DB-7 in order to minimize the facility's potential impact on the golf course. On-site detention/water quality facilities will be required for the office and commercial parcels within subbasin 500. These individual on-site facilities will manage runoff release to historic rates at the individual parcel boundaries. Peak inflow to DB-7 from subbasin 500 is calculated to be 648 cfs from the golf course and including the historic releases from the office and commercial parcels. The "pass-through" peak flow rate from upstream basins totals only 53 cfs. Design of DB-7 will be intimately tied to golf course design, and it is recommended that construction of DB-7 be done concurrently with golf course development.

Detention Basin No. 10 (DB-10). DB-10 will be required when development begins in subbasin 550. Should construction of Airbus Point precede development of subbasin 550, the 24-inch culvert (conveyance element 82C) through which DB-10 will discharge should be constructed at that time. Downstream of the outlet pipe, a small channel is proposed to convey DB-10 discharge through the Open Space before collecting into a larger storm drain and discharging into DB-11. The CUHP and UDSWM modeling determined a 382 cfs peak inflow into DB-10 from subbasin 500. Peak discharge from the facility will be 21 cfs.

Detention Basin No. 11 (DB-11). DB-11 is located in an Open Space parcel just west of Boeing Heights and south of a commercial parcel. DB-11 will detain runoff from subbasins 551 and 600 and will pass through the attenuated discharge from DB-10. DB-11 and its downstream conveyance system (elements 81B, 81A and 84A-D) are necessary when development occurs in subbasins 551 and 600. The downstream conveyance elements should be constructed at the time Boeing Heights and lower Embrauer Heights are constructed, if road construction precedes development in those subbasins.

Detention Basin No. 8 (DB-8). DB-8 is located at DBPS design point 7 (I), just north of Powers Boulevard at the Airport property boundary. Runoff release from DB-10 and DB-11 will eventually pass through DB-7 prior to being released from the site. DB-8 serves to detain runoff from subbasins 400 and 450. These subbasins include office/commercial parcels, as well as portions of the proposed golf course. DB-8 was originally conceived as a much larger facility. But, in order to minimize the facility's potential impact on the golf course and to reduce the size of the upstream conveyance elements that would be required, DB-10 and DB-11 were added and the size of DB-8 was reduced. Construction of DB-8 will be tied to development in the directly tributary subbasins, however, construction of some of the upstream conveyance elements may be required as noted in the discussion of DB-10 and DB-11. Peak inflow to DB-8 is calculated to be 969 cfs and is proposed to be conveyed by open channel through the golf course. While ultimate design of DB-8 will be tied to golf course design, an interim basin configuration may be necessary if office and commercial development in subbasins 400 and 450 precedes golf course development.

Detention Basin No. 13 (DB-13). DB-13 is located in the northwest quadrant of the Drennan Road and Powers Boulevard intersection. DB-13 is proposed to collect, detain, and redirect runoff from subbasin 725 located southwest of Runway 17R/35L. Currently, runoff from this subbasin crosses Powers Boulevard north of Drennan Road through four 24-inch by 38-inch horizontal elliptical reinforced concrete pipe (HERCP) culverts that were installed during the Powers Boulevard improvements in the early 1990s. However, as outlined in the Windmill Gulch DBPS, the long-range plan is to redirect runoff from this basin southward before discharging it from Airport property at DBPS design point 11 (J). The DBPS proposed detention of subbasin 725 flows at a facility to be located at the site of DB-7. This MDDP revises that concept to propose subbasin 725 runoff be detained at DB-13, where the peak inflow of 285 cfs would be reduced to an outflow of 25 cfs. As shown in Exhibit A-9 in Appendix A, the attenuated flow would pass through a new culvert beneath Drennan and then through open swales in the golf course to DB-7. Detaining runoff at DB-13 would have the benefit of reducing the size of downstream conveyance features and would reduce the potential impact of higher runoff flows through the golf course. Future development in subbasin 725 includes improvements to the Powers Boulevard/Drennan Road intersection (where a grade-separated interchange is proposed) and a small taxiway extension at the north end of the subbasin. It is recommended that the design and construction of DB-13 and the proposed downstream conveyance be performed during planning and design of the interchange.

7.3.2 Big Johnson Basin

Drainage design within the Big Johnson Basin has the objectives of: 1) minimizing detention requirements and land disturbance in the Open Space area which will be preserved between Powers Boulevard on the south and proposed development on the north, and 2) creation of a contiguous 65-acre parcel for development, northwest of the intersection of Embrauer Heights and Canadair Point. The preserved Open Space area is considered to have high ecological value and, thus, it is a goal of the Business Park Concept Plan to preserve those natural values as much as possible. To accomplish these objectives, the drainage approach within the Big Johnson Basin is to promote a combination of on-site and off-site detention for development.

On-Site Detention to Historic Release Rates at A/DACG. On-site detention will be required upon development of subbasin 280, the parcel currently scheduled for development by Fort Carson as a rapid deployment facility, referred to as A/DACG. At the time of the MDDP, the degree of on-site storage available within the A/DACG parcel had not been determined by Fort Carson. Through discussions with Fort Carson, it was agreed that the MDDP analysis would proceed assuming that the A/DACG parcel discharges at historic rates. As such, the permissible peak discharge from the A/DACG during the 100-year storm is 335 cfs. The MDDP analysis assumes the A/DACG releases at or below this peak flow during the 100 year storm.

Detention Basin No. 900 (DB-900). This detention facility will be required upon development within subbasin 275. When DB-900 is built, conveyance element 6 is required, to convey the outflow of DB-900 to DB-700. In addition, if construction of Canadair Point precedes that in subbasin 275, conveyance element 6 should be constructed at that time, because it must cross under the new roadway. Peak inflow to DB-900 is 93 cfs, and peak discharge is 11 cfs.

Detention Basin No. 700 (DB-700). DB-700 detains runoff from subbasins 250, 260, and 270, and will be required when development is initiated in any of these subbasins. Outflow from DB-700 will be carried in conveyance elements 4B and 4A, to DB-500 and eventually through conveyance elements 2B and 2A to the outfall at the Airport property boundary. If timing dictates, conveyance element 7 should be constructed earlier when Embrauer Heights is constructed. Also, if Canadair Point is constructed before development in the A/DACG, conveyance element should be installed when Canadair Point roadway is built. All conveyance elements downstream from DB-700 will be needed when DB-700 is constructed. In addition, if Boeing Heights is constructed prior to development in subbasins 250, 260, and 270, conveyance element 4B should be constructed, as it will need to cross under Boeing Heights. As shown in Exhibit A-9 in Appendix A, DB-700 outflow is directed to Detention Basin No. 500 (DB-500), where flow is further attenuated. Peak inflow to DB-700 is 785 cfs and peak discharge is 46 cfs.

DB-500. DB-500 serves to further attenuate flows detained by upstream detention facilities, and to detain flows from the Open Space in subbasin 200, to meet allowable discharge at the property boundary. DB-500 collects outflow from the previously described detention facilities that discharge to conveyance element 4A, as well as inflow from subbasin 200. The attenuated outflow from upstream facilities that enters DB-500 has a peak rate of 57 cfs, but the peak inflow from Open Space subbasin 200 is 429 cfs. Because the allowable discharge at Design Point 1002 is only 85 cfs, considerable attenuation of undeveloped flow will be required. Peak discharge from DB-500 will be 38 cfs, which when combined with outflow from DB-200 described below, will comply with the 85 cfs property boundary discharge limitation. DB-500 should be constructed at such time that attenuation of runoff from undeveloped areas of the Airport is considered necessary.

Detention Basin No. 200 (DB-200). DB-200 detains runoff associated with a portion of the Airbus Point roadway and a small area of land to be preserved as Open Space (subbasin 215). DB-200 should be constructed when Alpha Avenue is constructed. Peak flow into to DB-200 is 151 cfs and peak discharge is 42 cfs. Depending upon relative timing, DB-200 should be integrated into the design of the future Powers Boulevard and Airbus Point interchange. In addition, for the purposes of the MDDP, it is assumed that the existing outfall (in fair condition) under Powers will remain functional for discharges. If, during the construction of the future interchange, the existing outfall is destroyed, it must be replaced so that flows can be discharged from DB-200 and DB-500 from the site at this location.

Detention Basins No. 400 (DB-400) and No. 100 (DB-100). DB-400 is an on-site detention facility for subbasin 150 and is required when development occurs in that subbasin. Peak inflow is 93 cfs and peak discharge is 22 cfs. DB-400 will discharge through conveyance element 1 to DB-100. DB-100 is located just upstream from property boundary design point 1001 which has a DBPS allowable discharge of 50 cfs. DB-100 will provide detention for runoff from the undeveloped subbasin 100. Inflow to DB-100 is 107 cfs from subbasin 100 and 22 cfs from DB-400. Outflow is 48 cfs, which complies with the allowable discharge of 50 cfs. DB-100 will discharge through the existing 36-inch CMP culvert (in good condition) under Powers at the Airport property boundary. If during construction of future improvements to Powers Boulevard in this area, the existing culvert is destroyed, it must be replaced so that DB-100 will have an outfall.

Open Space Subbasin 300. Subbasin 300 is currently undeveloped and no development is planned for this subbasin in the future. The Big Johnson DBPS modeled a historic peak flow of only 25 cfs to design point, while the hydrologic modeling conducted in this MDDP calculates a peak runoff of 335 cfs. Detention for this subbasin should only be constructed if it becomes necessary to detain undeveloped runoff to this design point.

SECTION 8.0

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EXHIBITS

APPENDIX A

Exhibits

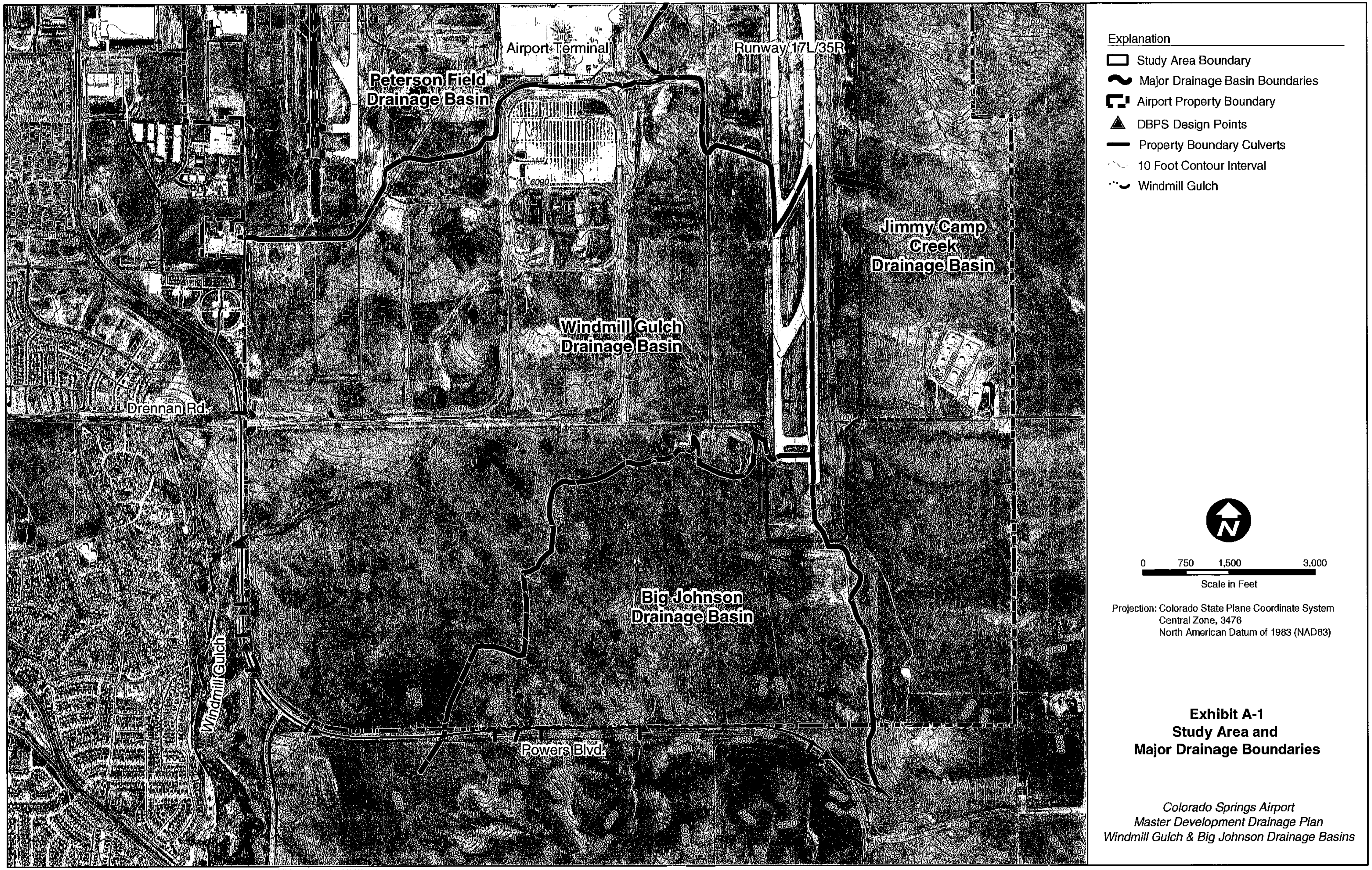
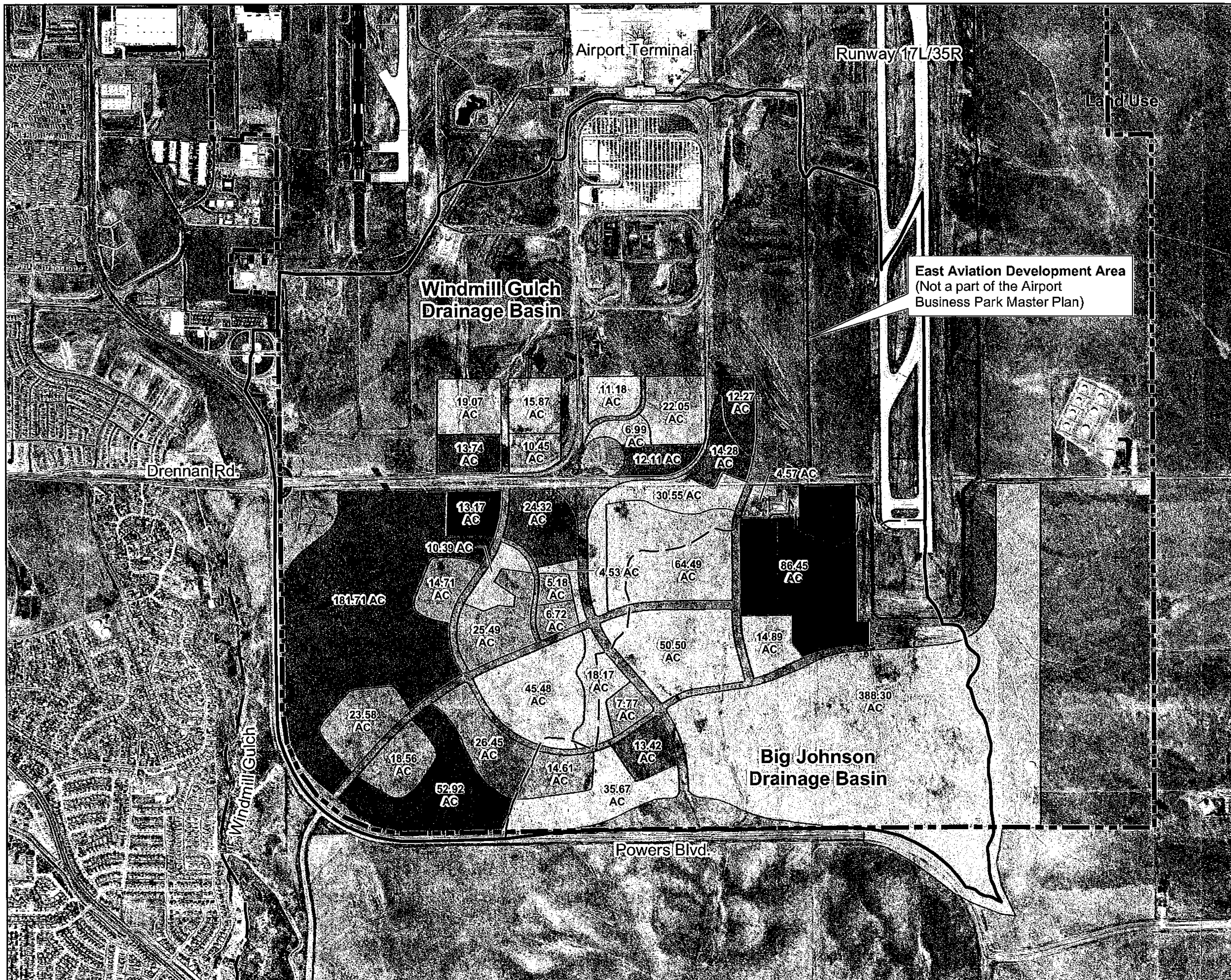


Exhibit A-1
Study Area and
Major Drainage Boundaries

Colorado Springs Airport
Master Development Drainage Plan
Windmill Gulch & Big Johnson Drainage Basins

CH2MHILL DEN \\cobra\gis\projects\COS-Airport-MDP\Report-figs\Exhibit_A-1.mxd 01/24/2005



Explanation

Land Use

- Office
- Office-Industrial Park/R & D
- Community/Commercial
- Hospitality/Commercial
- Public Facility: Airport/MIlitary
- Golf Course
- Open Space
- Open Space/Detention Pond
- Study Area Boundary
- Major Basin Boundary Within Study Area
- Airport Property Boundary
- Windmill Gulch

Source: City of Colorado Springs, Department of Planning

N

0 750 1,500 3,000

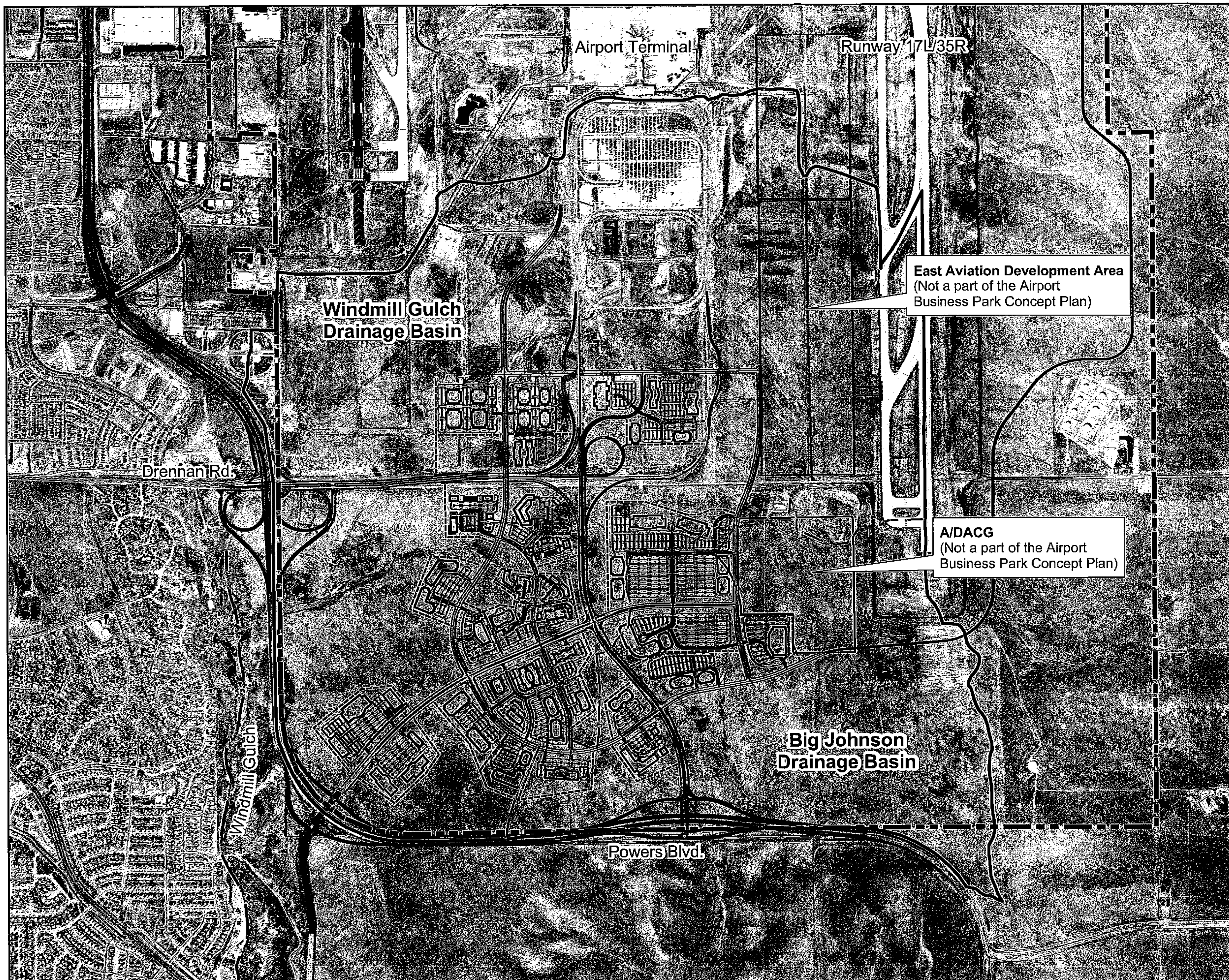
Scale in Feet

Projection: Colorado State Plane Coordinate System
Central Zone, 3476
North American Datum of 1983 (NAD83)

Exhibit A-2
Colorado Springs Airport
Business Park Master Plan

Colorado Springs Airport
Master Development Drainage Plan
Windmill Gulch & Big Johnson Drainage Basins

CH2MHILL DEN cobra gis projects COS-Airport-MDP Report-figs Report-figs_0505 Exhibit_A-2.mxd



Explanation

- Proposed Development Elements
- Study Area Boundary
- Major Basin Boundary Within Study Area
- Airport Property Boundary
- Windmill Gulch

0 750 1,500 3,000

Scale in Feet

Projection: Colorado State Plane Coordinate System
Central Zone, 3476
North American Datum of 1983 (NAD83)

Exhibit A-3
Colorado Springs Airport
Concept Plan

Colorado Springs Airport
Master Development Drainage Plan
Windmill Gulch & Big Johnson Drainage Basins

EXHIBIT A-4. Table of Key Historic Drainage- and Master-Planning-Related Documents for the Colorado Springs Airport (Study No. Corresponds to Exhibit 2-1)

Study No.	Bibliographic Information	Summary/Highlights
1	Greiner. 1988. Master Drainage Study,	
2	CH2M HILL. August 1989. Final Drainage Report for Powers Blvd (From Drennan Road to Fountain Boulevard)	Plans for construction of the culvert flowing from east to west beneath Powers, immediately north of Drennan. Does not acknowledge the Windmill Gulch DBPS.
3	Wilson and Company. January 1991. ***Windmill Gulch Drainage Basin Planning Study.*** Prepared for El Paso County Department of Public Works. Rev. 6/1991 and 2/1992.	♦ *SCS TR-20* used to determine peak runoff flows and volumes for 10-yr and 100-yr, 2hr and 24-hour storms for existing and future basin conditions. ♦ US ACOE *HEC-2* used to model existing and future condition hydraulics. ♦ Provides detailed preliminary design for proposed improvements to blue line channel from Drennan Road to outfall at Fountain Creek.

4 Kiowa Engineering Corporation. September 1991. ***Big Johnson Reservoir/Crews Gulch Drainage Basin Planning Study.*** Prepared for El Paso Department of Public Works.

Hydrology

- Future condition accounted for proposed commercial/business development on the Colorado Springs Municipal Airport property in hydrologic model.
- City/County DCM used to calculate curve numbers.
- Subbasins 47-51 are possibly partially or fully within Airport property.
- *SCS TR-20* used to determine peak runoff flows and volumes for 10-yr and 100-yr, 2hr and 24-hour storms for developed basin conditions.

Hydraulics

- US ACOE *HEC-2* was used to define 100-year floodplain and floodway considering no improvements to the major drainageway facilities.
- Area above Big Johnson Reservoir is Reach 5; no floodplains were delineated for drainageways above the reservoir.
- Assumed future development would be required to provide adequate facilities to safely convey storm flows.
- Recommends/Assumes detention will be constructed north of Powers Blvd, to maintain discharges to historic condition, *100-yr, 24-hour storm*.

Other

- Major irrigation facilities exist within the basin and play a role in basin hydrology. 2. Reservoir has lost half its capacity due to sedimentation.

5 Isbill and Associates. July 1992. ***Windmill Gulch Master Drainage Study.***

9a (Cited in Drexel Barrell MDDP) Weiss Consulting Engineers. September 1994. Colorado Springs Industrial Park Filing No. 1.

-- October 1994. City of Colorado Springs/ El Paso County Drainage Criteria Manual Changes

By City Council Resolution 170-94, the following changes to the 1987, revised 1991 City of Colorado Springs drainage criteria will be effective for use in the City on October 12, 1994:

1) The storm frequency for the design of the initial drainage system shall be the **FIVE YEAR** storm.

2) Allowable flow depth in Type 1 (8 inch vertical) curb shall be 6 inches.

3) Maximum allowable flow rates, per side, for the initial storm shall be as follows:
   a. Hillside Residential, ramp curb..........15 cubic feet per second
   b. Hillside Residential, vertical curb..........25 cubic feet per second
   c. Residential, ramp curb..........20 cubic feet per second
   d. Residential, vertical curb..........34 cubic feet per second
   e. Collector, vertical curb..........34 cubic feet per second
   f. Arterial, vertical curb..........34 cubic feet per second, and must have one ten foot lane free of water in each direction

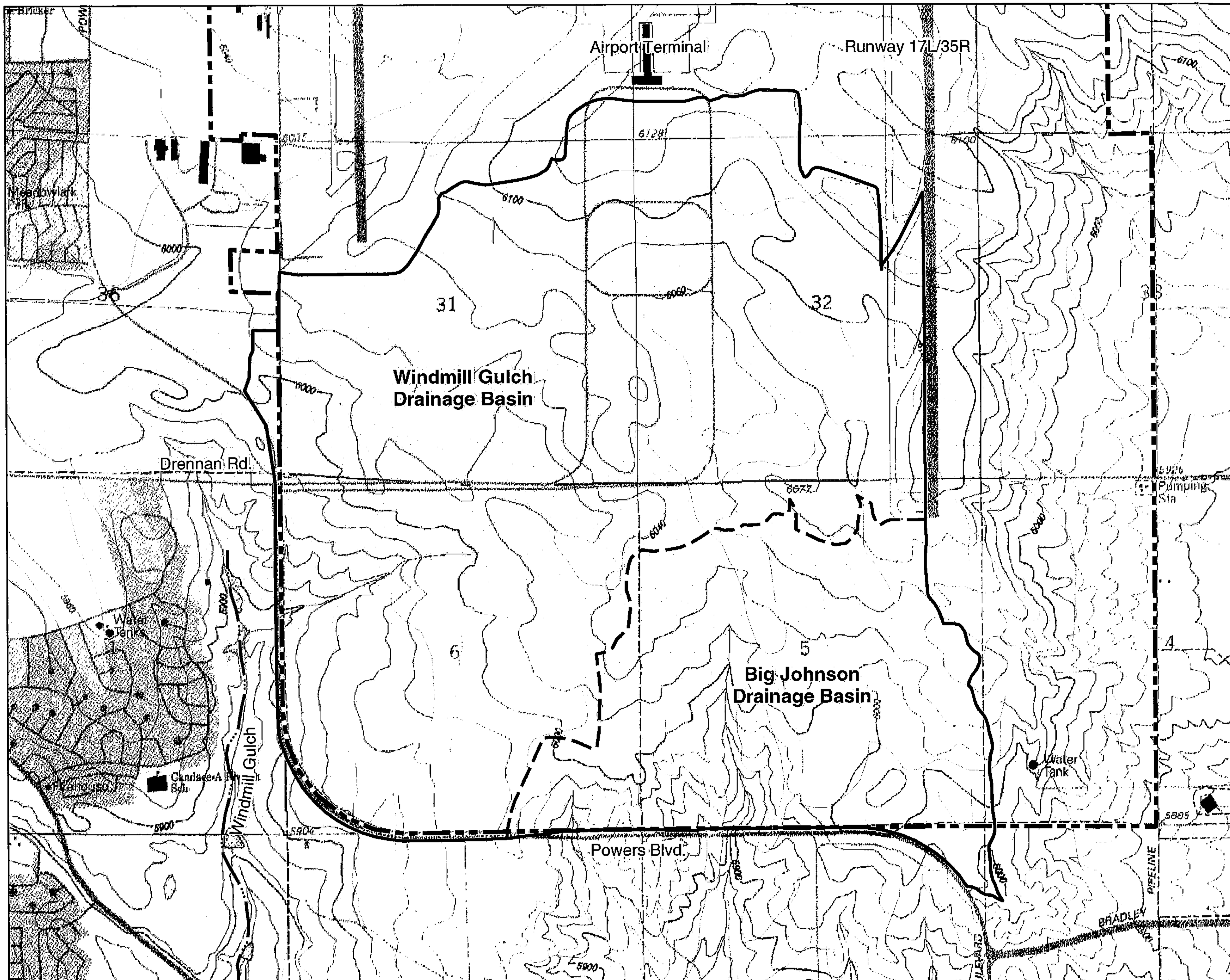
4) Allowable 100 year crossflow in Arterial streets at a low point shall be the lesser of:
   a. 12 inches depth at the gutter flowline
   b. 4 inches depth at the crown

6 CH2M HILL. March 1998. ***Colorado Springs Municipal Airport Peterson Drainage Study.*** Technical Memorandum.

7	CH2M HILL. May 1998. ***Colorado Springs Airport Drainage Master Plan – Volume 1.*** Prepared for City of Colorado Springs and Colorado Springs Airport, in support of The Colorado Springs Airport Master Plan.	**Land Use Basis:** -*Existing* - Isbill 1995 ALP, BD&C provided aerial photos and other data -*Future* - BD&C ALD 1997, -*% Impervious* assigned using City/County DCM and SCS. **Rainfall Method:** -*RF Depths* (100y/2h, 100y/24h, 10y/2hr, 10y/24h) taken from DCM isopluvials (2hr derived from 1hr). -*SCS* Type IIa distribution for 24hr -*CUHP* for 2hr storm RF distribution **Storm runoff routing:** UDSWMM **Design Criteria:** -*Big Johnson*-Maintain future discharge at or below existing 100y/24h discharge of 350-400 cfs -*Windmill Gulch*-Maintain future discharge at or below existing 100y/24h discharge of 219 cfs **Results:** -*Big Johnson* - Future 100y/24h peak discharge (without detention) = 3250 cfs -*Windmill Gulch* - Future 100y/24h peak discharge (without detention) = 2780 cfs **Recommended Improvements:** -*Big Johnson* – Construct new detention facility with 52.5 AF capacity. Construct earthen ditches. -*Windmill Gulch* – Construct new detention facility with 44 AF capacity. Construct earthen ditches.
8	Barnard Dunkelberg and Company et al. November 1998. Master Plan-Colorado Springs Airport. FAA Project No. AIP 3-08-0010-22	**Recommends:** • No addition of a general aviation runway. • Ultimate 1800 foot extension of Runway 17R/35L. • A full parallel taxiway system on the east side of the west runway. • The provision of a parallel taxiway system on the west side of the west runway. • Protection of the capability to provide a dual-parallel taxiway system, adjacent to areas on the airport where aircraft access needs are anticipated to be the greatest (west side of 17L/35R (East Runway) and west side of Runway 17R/35L (West Runway). • Program for development of a partial parallel taxiway on the east side of runway 17L/35R (East Runway).

9	Drexel Barrell and Co. 2000. ***Master Development Drainage Plan for Colorado Springs Airport.*** Prepared for City of Colorado Springs Department of Planning and Development, Engineering Division.	**Hydrology:** No new analysis. Simply summarizes others and plots outfall flows on map. **Land Use:** *-Existing* – taken from 'existing plats, reports, zoning maps, and site visits' *-Future* – 'majority' taken from CH2M HILL Drainage Master Plan **Hydraulics**: *-Existing* - Simply summarizes CH2M HILL 1998 *-Proposed* – Simply summarizes CH2M HILL 1998 and recommends future modifications to retention ponds (convert to detention ponds). Recommends additional analysis of the site as it develops. Does not cite/refer to the Big Johnson or Windmill Gulch DBPSs at all. Floodplain analysis only studied *Big Johnson*. Map shows major storm drainage system for terminal parking area along the northern portion of the north-south sub-basin boundary between WG-4 and WG-5.
10	Barnard Dunkelberg and Company. February 2001. **Colorado Springs Airport Business Park Master Plan.**	Section One of the Business Park Plan provides analysis and conceptual planning for Phase One of the development, which consists of approximately 760 acres. Through the land suitability analysis, no constraints were identified that would limit development in Phase One. The delineation of Phase One and Two is the drainage basin boundary, which is the most prominent physical feature on the site. The Land Use Plan identifies general uses for the property including private aviation related industrial areas, office/industrial use, commercial areas for a hotel and related activities, open space/golf course, and street rights-of-way preservation areas. The drainage basin boundary, which delineates Phase One and Two, also provides for preservation of that 300 - 400 acre area for open space for a minimum of 20 years. This is based upon discussions with the Parks and Recreation Department/TOPS Committee and Airport Administration. This is a logical boundary because development on the other side of this line requires significant infrastructure investments. Section Two provides direction for the design of the business park through the use of development guidelines. These guidelines provide direction for the aspects related to actual design and construction of projects within this area. Guidelines for site design landscape design, architectural design, and signage are enclosed to ensure quality development for this strategic location within the City.

11	URS (Cartwright). 2001. ***Colorado Springs Airport, Business Park, Drainage.*** Memorandum prepared for City of Colorado Springs Engineering Department and Colorado Springs Airport, dated 8/20/01.	This memorandum is a summary of a preliminary analysis of the storm water drainage of the Business Park located at Colorado Springs Airport. This investigation identified that the proposed development is in substantial compliance with MDDP. The runoffs from the proposed Business Park will be very similar to the proposed flows in the MDDP. the (Referring to the CH2M HILL 1998 MDDP, Item 7 above.)
12	URS. September 2004. Peterson Field Drainage Basin Master Development Drainage Plan.	This Peterson Basin MDDP details the hydrology and hydraulics for the Peterson Basin within the COSA property boundary. Adjacent properties along Aviation Way are also considered since major drainage facilities are shared, but no improvements are shown on properties not within the COSA since these developments are outside of the limits of study. This Peterson Basin MDDP does not cover Peterson AFB upstream of the COSA, which is detailed in the Peterson Air Force Base, Type "A" Report, Basewide Storm Drainage Study (Peterson AFB Drainage Study) (Reference 13). Offsite subbasins that are adjacent to Powers Boulevard and drain into the existing pond at Powers Boulevard and Zeppelin Road are also not covered in this Peterson Basin MDDP since this is not part of the COSA, but the offsite subbasins are modeled to verify that the COSA improvements will not affect compliance by the COSA with the 1984 DBPS.



Explanation

Hydrologic Soil Group

- A
- B
- C
- D
- Study Area Boundary
- Major Basin Boundary Within Study Area
- Airport Property Boundary
- Windmill Gulch

Source: NRCS - Soil Data Mart
http://soildatamart.nrcs.usda.gov
El Paso County Area, Colorado
Soil Report CO625

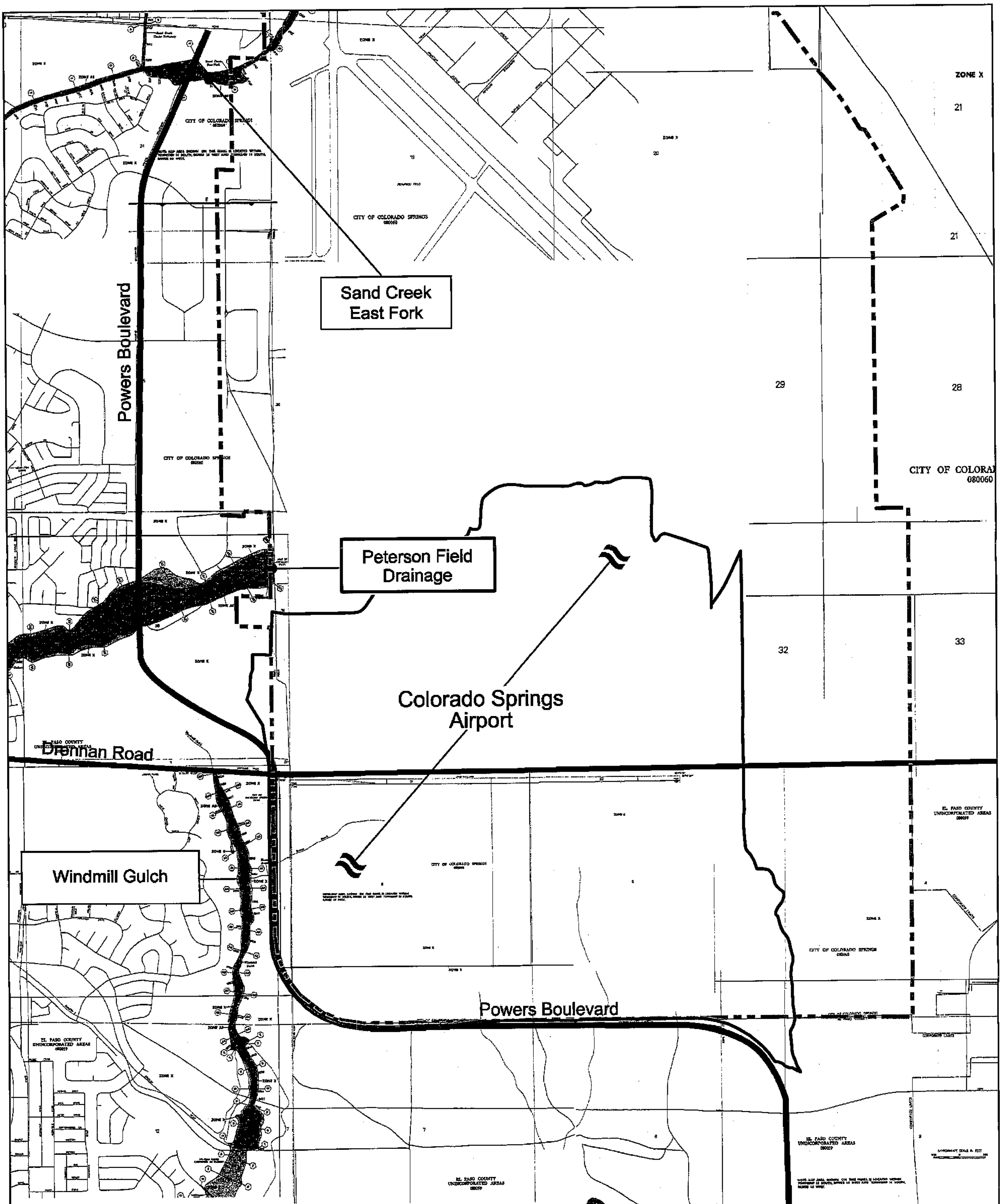
0 750 1,500 3,000
Scale in Feet

Projection: Colorado State Plane Coordinate System
Central Zone, 3476
North American Datum of 1983 (NAD83)

Exhibit A-5
SCS Hydrologic Soil Group Distribution

Colorado Springs Airport
Master Development Drainage Plan
Windmill Gulch & Big Johnson Drainage Basins

CH2MHILL DEN \\cobra\gis\projects\COS-Airport-MDP\Report-figs\Exhibit_A-5.mxd 01/24/2005



Source: The FEMA MSC Digital Post Office
Panels - 08041C0753F, 08041C0754F,
08041C0760F, 08041C0761F, 08041C0763F,
08041C0764F, 08041C0768F, 08041C0770F

Explanation

Study Area Boundary

Airport Property Boundary

Note: Boundary registration to floodplain mapping is approximate

Exhibit A-7
FEMA Floodplains

Colorado Springs Airport
Master Development Drainage Plan
Windmill Gulch & Big Johnson Drainage Basins

CH2MHILL DEN \\cobra\gis\projects\COS-Airport-MDP\Report-figs\Exhibit_A-7.mxd 01/24/2005

SUMMARY OF APRIL 2004 MEETING, CH2M HILL AND CITY OF COLORADO SPRINGS SUBDIVISION ENGINEERING

Appendix B

APPENDIX B

Summary of April 2004 Meeting, CH2M HILL and City Subdivision Engineering

COLORADO SPRINGS AIRPORT

MEETING SUMMARY

CH2MHILL

Colorado Springs Airport Business Park Subdivision Engineering Coordination Meeting

ATTENDEES	Brad Lovell/Subdivision Engineering Steve Kuehster/Subdivision Engineering Barbara Chongtoua/CH2M Hill Mark Rosser/CH2M Hill
LOCATION:	Colorado Springs Subdivision Engineering
MEETING DATE:	April 22, 2004
SUBJECT:	Colorado Springs Airport Business Park
PROJECT:	184050

INTRODUCTION

These meeting notes reflect the decisions and action items agreed on at this meeting. Please advise **Barbara Chongtoua** as soon as possible if your meeting notes reflect any substantial differences from these notes.

ACTION ITEMS

The following summarizes the action items identified in this meeting:

- CH2M Hill (Barbara) will contact Brian Kelly to obtain the subdivision filing for the Adult Sports Complex.
- CH2M Hill (Barbara) will copy and return the URS and Drexel Barrell reports loaned by Subdivision Engineering.

OVERVIEW

Mark Rosser gave a brief overview of the four development areas (East and West aviation areas, and North and South business parks) and stated the purpose of this project was to develop concept plans for each area and obtain environmental clearances as required.

SCHEDULE

The schedule for each of the concept plans and the Master Development Drainage Plan (MDDP) was reviewed. It was noted that the West and East aviation development areas (ADAs) are the highest priority as the Colorado Springs Municipal Airport (Airport) already has interest in those areas. The concept plan for West ADA is scheduled to be submitted in June while the concept plan for East ADA is scheduled to be submitted in late July. Concept plans for the North and South business parks (BP) should be largely developed by late summer, but submittal to the City of Colorado Springs will await the findings of the Environmental Assessment (EA). The EA should be submitted to the FAA in September, and a decision is expected by the end of the year.

MASTER DEVELOPMENT DRAINAGE PLAN (MDDP) REQUIREMENTS

Requirements for the MDDP were reviewed and confirmed with the City of Colorado Springs Subdivision Engineering (Subdivision Engineering). The MDDP should include discussion regarding the following:

- Proposed development and land use within the Colorado Springs Municipal Airport (Airport).
- Hydrologic characteristics of the area tributary to the Airport and how the offsite stormwater flows are managed.
- Hydrology for existing and future developed conditions for the Airport.
- Discussion of the existing and planned drainage infrastructure. Planned drainage infrastructures that will be developed, as part of the MDDP shall include regional conveyance and detention facilities. Storm sewer and local open channel systems servicing specific parcels will not be developed as part of the MDDP. Proposed systems should integrate existing storm sewer system outfalls at the airport.
- Drainage Basin Boundary Maps
- Drawings containing general location of planned regional conveyance and detention facilities.

Subdivision Engineering would like to have an approved MDDP that will serve as the guidance document for planning, management and development of drainage facilities within the Airport. Subdivision Engineering is acceptable to separate MDDPs for each of the watersheds encompassed by the Airport. CH2M Hill will prepare the MDDP for the Windmill Gulch and Big Johnson watersheds. URS is currently under separate contract to prepare the MDDP for Peterson Field watershed. Only a very small area of the Jimmy Camp Creek watershed may potentially be impacted by the proposed East ADA development, and that will be treated as described later in this summary.

ROLE OF DRAINAGE BASIN PLANNING STUDIES

Subdivision Engineering confirmed that the Windmill Gulch and Big Johnson Drainage Basin Planning Studies govern allowable stormwater discharges from the Airport at its property boundary. Compliance with the allowable releases defined within the studies is acceptable without additional investigation to the capacity of downstream facilities. The drainage basin planning studies (DBPS) that will be referenced by the study include the following:

- Windmill Gulch Drainage Basin Planning Study (Revised February 1992) prepared by Wilson and Company.
- Big Johnson Reservior/Crews Gulch Drainage Basin Planning Study (September 1991) prepared by Kiowa Engineering Corporation.

A DBPS for Jimmy Camp Creek is currently being prepared by Drexell Barrell in association with Banning-Lewis Ranch planned development. It is expected that the report will not be finalized in time to be used by this project.

DESIGN CRITERIA

Requirements for the hydrologic and hydraulic analysis were reviewed and confirmed with Subdivision Engineering. The discussion included the following criteria:

- Hydrology

  Subdivision Engineering is accepting of the proposed hydrologic software packages. Colorado Unit Hydrograph Procedure (CUHP) will be used for generating storm hydrographs. Urban Drainage Stormwater Management Model (UDSWMM) will provide for flood routing through the conveyance and detention system.

  The 2-hour storm will be used for the design of conveyance systems. Sizing of detention facilities will be based on the 24-hour duration storm. Subdivision Engineering is acceptable of this approach, which was previously used in the Colorado Springs Airport Drainage Master Plan and Peterson Drainage Study Technical Memorandum.

- Hydraulics

  StormCad Software package will be used for modeling the hydraulic capacity of storm sewers. HY-8 software package will be used to define hydraulic capacity of culverts. Subdivision Engineering is acceptable of this approach.

- Water quality best management practices (BMPs) prescribed by the City of Colorado Spring's Drainage Criteria Manual, Volume II will be incorporated into the proposed drainage system. The details for the BMPs will be modified to minimize significant, extended ponding of water in order to discourage bird attractants that may pose a safety risk for takeoffs and landings on Runway 35L, directly north of the South BP. Subdivision Engineering is acceptable of this approach.

MDDP FOR THE AIRPORT

Subdivision Engineering indicated that several MDDPs have been developed for the Airport but there is not an approved MDDP. Previous MDDPs prepared for the Airport consist of the following:

- Master Drainage Study (July 1988) prepared by Greiner, Inc.
- Master Drainage Study, Windmill Gulch Drainage Basin (July 1992) prepared by Isbill Associates.
- Colorado Springs Airport Drainage Master Plan (May 1998) prepared by CH2M Hill.
- Colorado Springs Municipal Airport Peterson Drainage Study Technical Memorandum (March 1998) prepared by CH2M Hill.
- Master Development Drainage Plan for Colorado Springs Airport (January 2000), prepared by Drexell Barell and Company.
- Colorado Springs Airport Business Park, Drainage Memo (August 2001) prepared by URS.

CH2M Hill was provided with copies of the reports by Drexell Barrell and URS. The reports will be copied and returned.

In addition to criteria described previously, the MDDP shall address the following:

- Existing condition hydrology developed by the previous MDDP can be incorporated in the current MDDP provided it is fully documented. Simply referencing the previous studies will not be acceptable.
- Existing and proposed projects within the upper Windmill Gulch watershed should be integrated into the current MDDP. Examples

include the rental car relocation at the airport and the Adult Sports Complex.

- Planned drainage improvements do not need to be included in the current MDDP for the Big Johnson watershed since development in that watershed will not be proposed in this concept plan. MDDP will require an update if and when development is planned there. Minor drainage improvements should be included to limit stormwater discharges and control stormwater quality for runoff from the probable arterial connection to Powers Boulevard that will extend into the Big Johnson watershed.
- Development in the East BP that affects the Jimmy Camp Creek watershed must show that stormwater discharges from the Airport are maintained to existing condition, otherwise onsite detention will be required.
- Stabilization shall be designated and identified for all the outfalls from the Airport, including those at the culvert outfalls along the west side of Powers Boulevard.

MISCELLANEOUS TOPICS

Other topics that were discussed in the meeting are summarized in the following:

- Subdivision Engineering is not positive whether Drennan Road is within a public or private easement. Sam Schneiter should be contacted regarding this.
- Soaring Eagle Estates has recently constructed a detention facility in the northwest quadrant of the Powers and Drennan Road intersection consistent with the Windmill Gulch Drainage Basin Planning Study.
- Other than the need for outfall stabilization for the culverts west of Powers Blvd, Subdivision Engineering was not aware of any other specific problem areas that would need to be addressed by the MDDP.
- To the extent that is practicable, Subdivision Engineering would prefer to see a more "regional" approach to stormwater detention and particularly, stormwater quality BMPs.

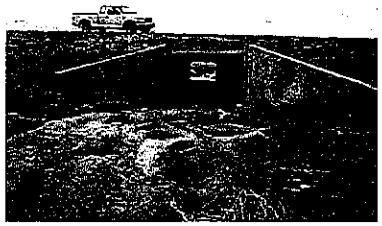
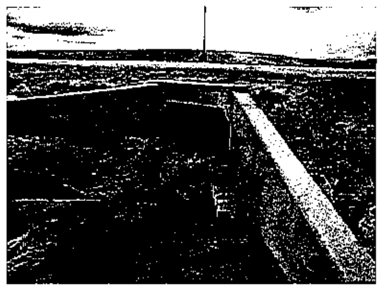
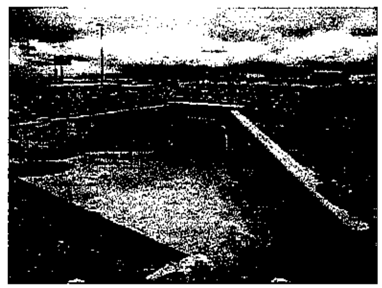
Site Photographs and Existing Hydraulic Structure Inventory

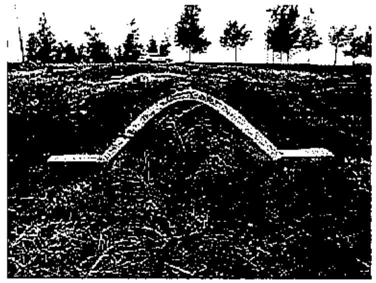
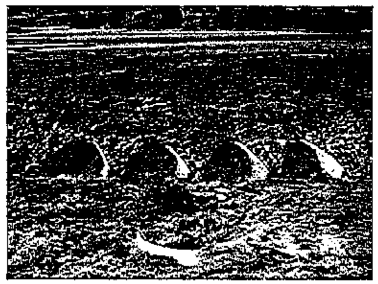
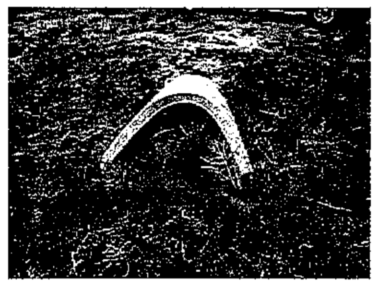
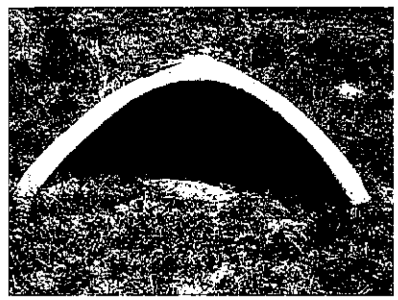
Appendix C

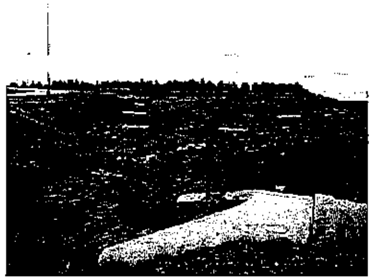
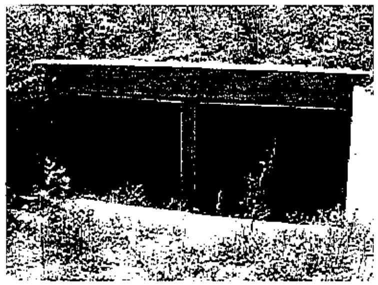
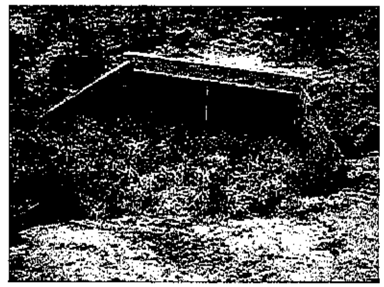
APPENDIX C

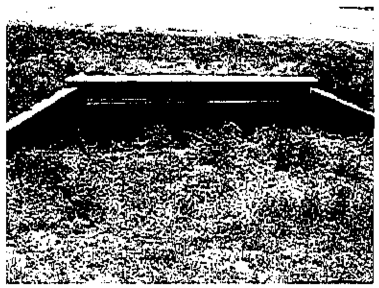
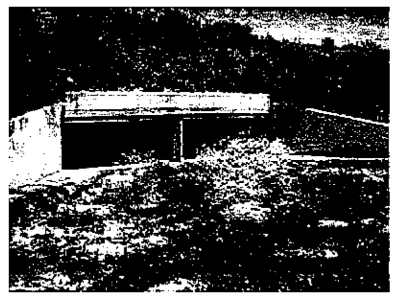
Site Photographs and Existing Hydraulic Structure Inventory

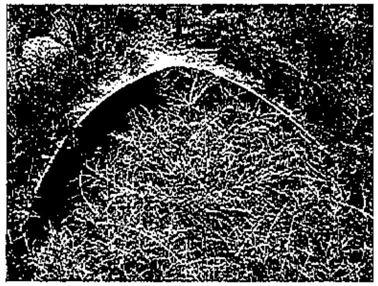
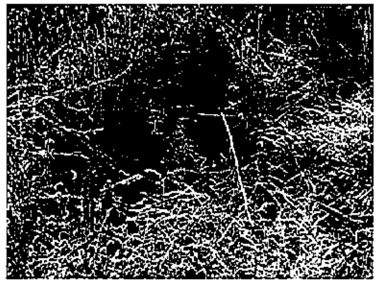
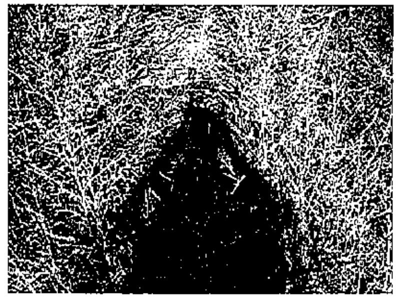
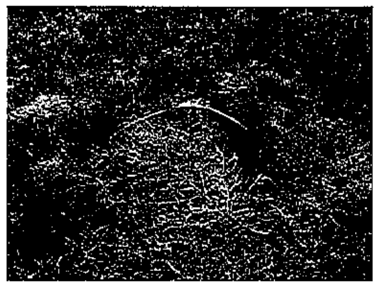
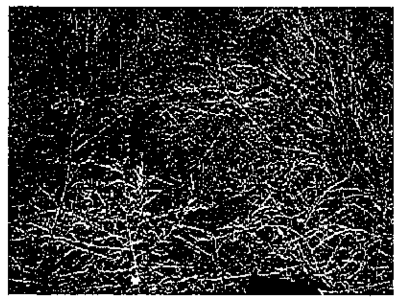
STRUCTURE CROSSING INVENTORY
Drainage Structure Crossings
____ = APPROXIMATE, ESTIMATED FROM TOPOGRAPHY

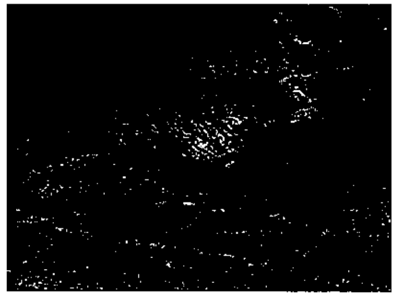
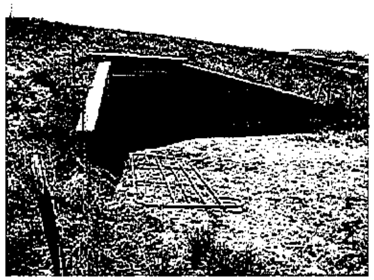
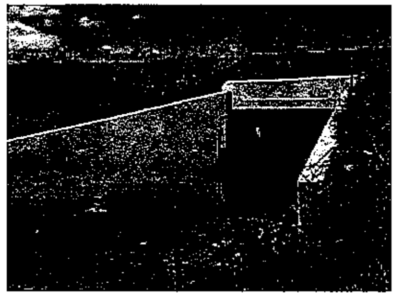
ID No.	Location	Type (Box or Pipe)	Size	Tributary Sub-basin (s)	Inv. In (ft)	Inv. Out (ft)	Length (ft)	S (ft/ft)	Top of Rd (ft)	Photo (s)	
										Inlet	Outlet
95	Flows from north to south under the 'Return to Terminal' road, approximately 600' west of the 'Airport Entrance' road	CBC	11'W x 7'H	950	6048	6047	84	0.012	6060		
86	Flows from north to south under the 'Return to Terminal' road, approximately 300 feet east of 'Airport Exit' road	CBC	71" W x 35"H	850	6053	6052	69	0.014	6058		
85	Flows from east to west under the 'Airport Exit' road, approximately 200 feet south of 'Return to Terminal' road	CBC	72" W x 51"H	825, 850	6051	6050	105	0.0095	6058		

80	Flows from north to south under Drennan Road, approximately 550 feet east of Air Cargo Access Road	RCP	36" ---> 60"	750, 800	6007 .5	6000	495	0.015	6016		
72	Flows from east to west under Powers Blvd just north of the intersection between Drennan Rd and Powers Blvd	HERC P	4- 24"x 38"	725 (in existi ng condit ion)	5970	5962	240	0.033	5974		
70	Flows from north to south under Drennan road, approximately 2100 feet east of Powers Blvd	RCP	18"	700	6011	6010	312	0.003	6017		
65	Flows from east to west under Airport Entrance Road, approximately 1000 feet south of Return to Terminal Road	RCP	60"	650, 675	6044	6044	148	0.0	6054		

62	Flows from north to south under Drennan Road, at intersection with Airport Exit Road	RCP	54"	625	6023	6022	115	0.0087	6030		
61	Flows from north to south under Drennan Road, approximately 1000' feet west of Airport Entrance Road	CBC	8'W x 6'H	900, 925, 950, 650, 675	6042	6041	101	0.0099	6051		
50	Flows from east to west under Powers Boulevard, approximately 2000 feet south of Drennan Road	Double CBC	Two, side by side, 8'W x 6'H's	500, 625 650, 660, 675, 700, 750, 800, 825, 850, 875 900, 950	5895	5887	206	0.019	5906		

45 A	Flows from east to west under Powers Blvd approximately 2560 feet from the intersection between Grinnell Blvd and Powers Blvd	CMP	60”	525	5906	5902	220	0.018	5910		
45 B	Flows from east to west under Powers Blvd approximately 2050 feet North of the intersection between Grinnell Blvd and Powers Blvd	CMP	18”	?Pow ers Media n	5900 ?	5892	210	0.009	5902		
45 C	Flows from east to west under Powers Blvd approximately 2480 feet North of the intersection between Grinnell Blvd and Powers Blvd	2 CMPs	42”, 36”	525	5896	5900	200	0.030	5900		
40	Flows from north south under Powers Boulevard, approximately 5200’ south of Drennan	Double CBC	Two, side by side, 8’ x 3’s	400, 450, 451, 550, 551, 600	5928	5926	170	0.012	5931		

10 A	Flows from north to south under Powers Blvd 3850 feet from the intersection between Grinnell Blvd and Powers Blvd	CMP	36”	100, 150	5932	5930	192	0.010	5949	 	 
10 B	Flows from north to south under Powers Blvd 4250 feet from the intersection between Grinnell Blvd and Powers Blvd	CMP	24”	100, 150	5940	5936	202	0.020	5944		
10 C	Flows from north to south under Powers Blvd, approximately 4660 feet from the intersection between Grinnell Blvd and Powers Blvd	CMP	42”	100, 150	5932	5926	194	0.031	5936		

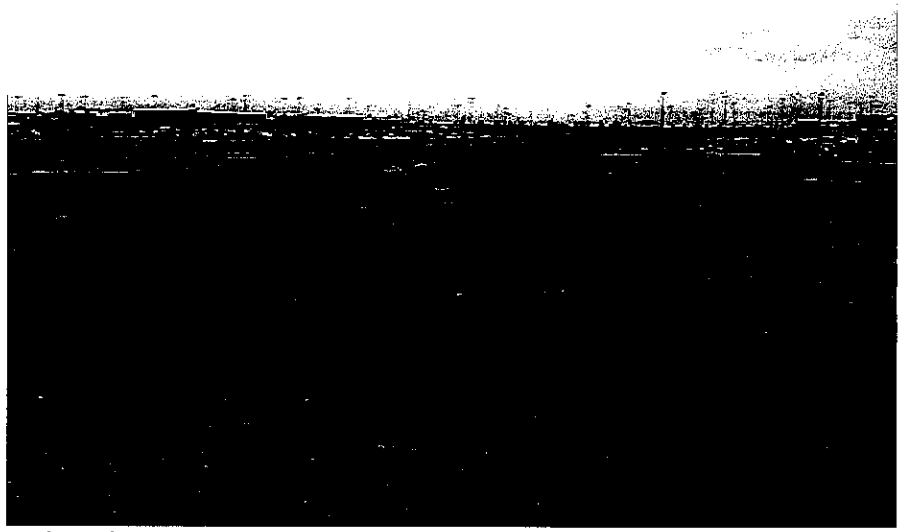
20	Flows from North to South under Powers Road along the southern end of the airport property	CMP (?)	60"	200-280	5898.5	5889	186	0.051	5921		
30	Flows from north to south under Powers Road where it curves from east-west to north south at the very south end of the airport property	RCB	10'x 6'	300	5974	5972	148	0.014	5982		

MISCELLANEOUS SITE PHOTOS. PHOTO NUMBERING IS NOT CONSECUTVIE BECAUSE ONLY A SAMPLING OF SITE PHOTOS IS INCLUDED HERE. (SUBJECTS ALREADY COVERED IN CULVERT INVENTORY ARE NOT SHOWN HERE, TO AVOID REDUNDANCY)

05_Field_Downstream_of_54in_outlet_apron

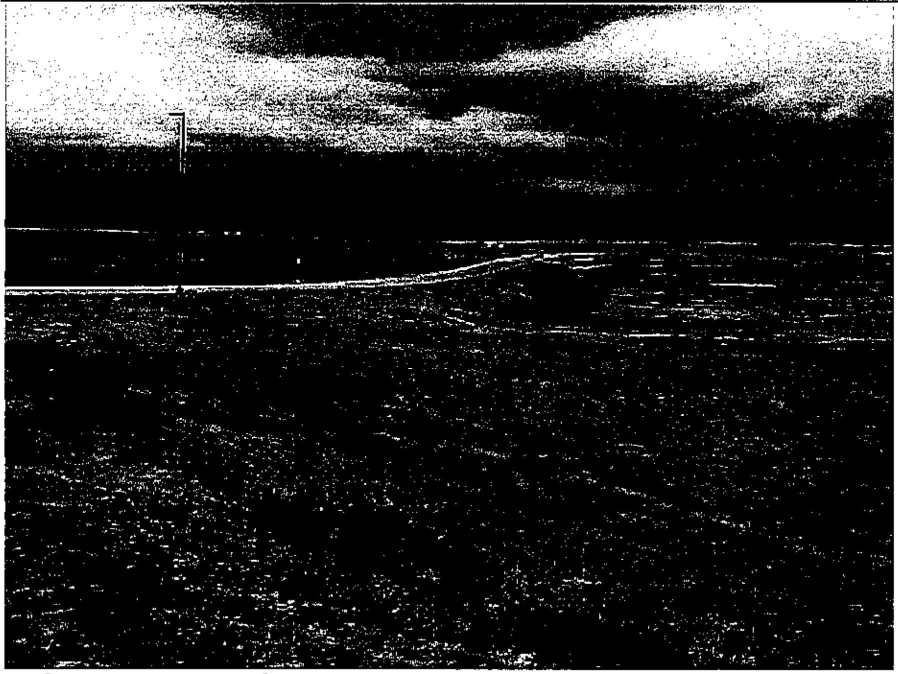
08_Basin_upstream_of_36in_Culvert Under Drennan

06_LookingW_along Drennan_from_54in Storm Sewer Pipe Inlet



11_RentalCar_Area_and Field_south

MISCELLANEOUS SITE PHOTOS. PHOTO NUMBERING IS NOT CONSECUTVIE BECAUSE ONLY A SAMPLING OF SITE PHOTOS IS INCLUDED HERE. (SUBJECTS ALREADY COVERED IN CULVERT INVENTORY ARE NOT SHOWN HERE, TO AVOID REDUNDANCY)

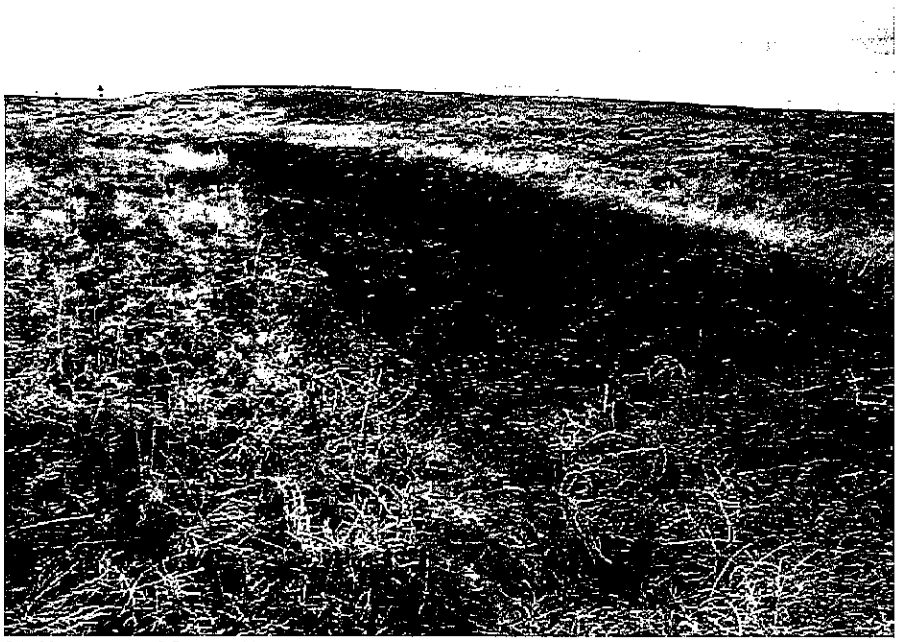


12_Culvert_draining_field_South

16_Channel_South_of_Rental Car Area

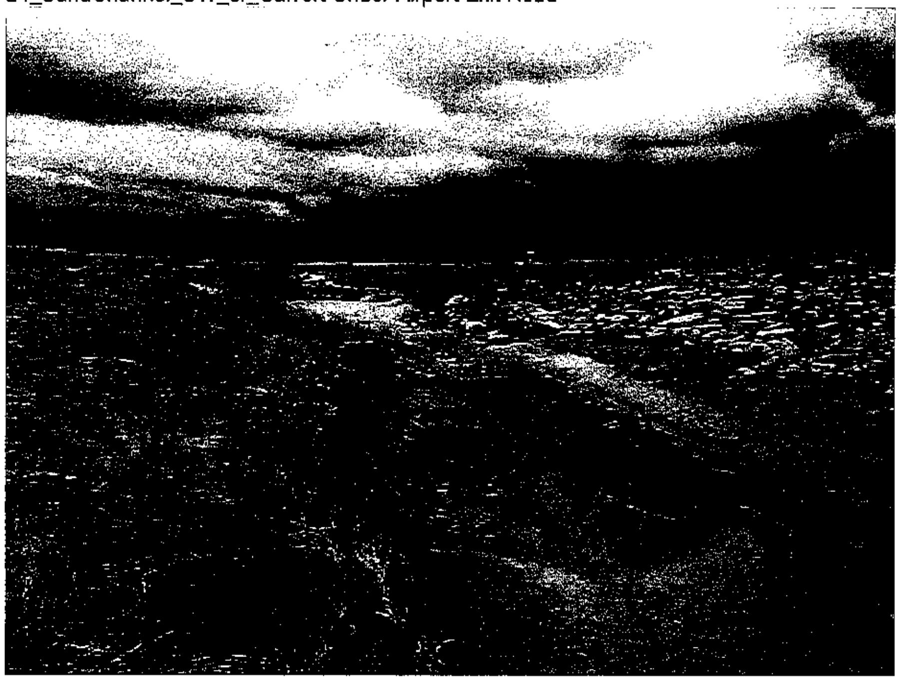
15_Field_South_of_7x11 Culvert

18_Upstream_of Culvert Under Airport Exit Road


21_Upstream_of Culvert Under Airport Exit Road


24_SandChannel_SW_of_Culvert Under Airport Exit Road


23_Channel_downstream_of Culvert Under Airport Exit Road


25_SandChannel


26_Bank_of_Sand_Channel


28_SandChannel_further_South


27_SandChannel_RipRap


29_SandChannel_furtherSouth

MISCELLANEOUS SITE PHOTOS. PHOTO NUMBERING IS NOT CONSECUTVIE BECAUSE ONLY A SAMPLING OF SITE PHOTOS IS INCLUDED HERE. (SUBJECTS ALREADY COVERED IN CULVERT INVENTORY ARE NOT SHOWN HERE, TO AVOID REDUNDANCY)


33_Field_South_of_OutletApron_for_18in_Culvert_Under_Drennan


43_PondArea_S_of_Drennan


41_PondArea_S_of_Drennan

FUTURE CONDITION HYDROLOGY - CUHP INPUT DOCUMENTATION AND SUPPORT

Appendix D

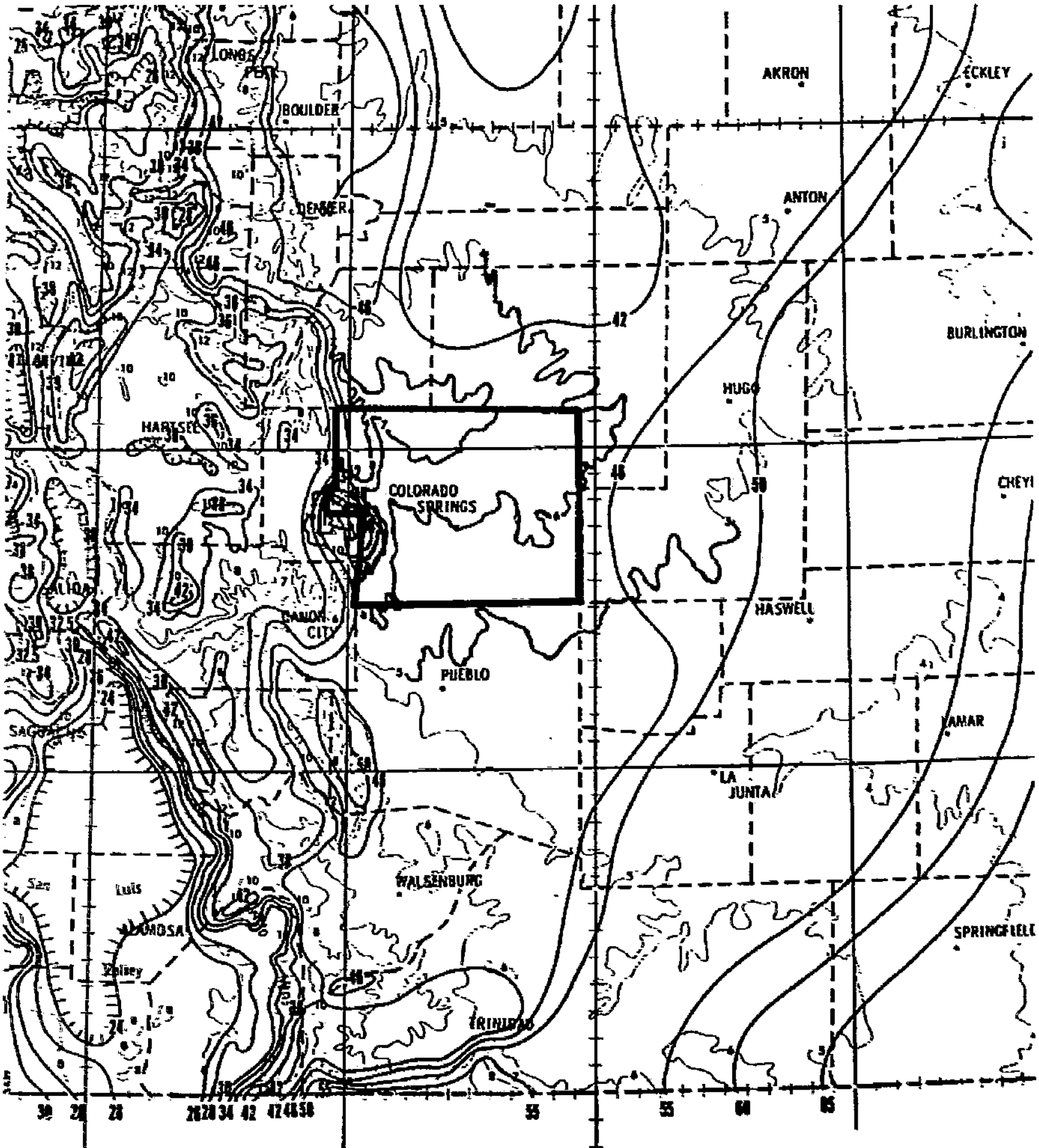
APPENDIX D

Future Conditions Hydrology – CUHP Input Documentation Support

Basin Geometric Parameters-Measured Using GIS

Basin	% Imp	Channel Length (ft)	Dist. To Centroid (ft)	Basin Area (Square Miles)	Basin Area (Acres)
Big Johnson Basins					
100	0.15	859	462	0.05	32
150	0.95	1064	615	0.03	19
200	0.07	6509	3089	0.37	237
215	0.33	1207	506	0.05	32
225	0.88	984	529	0.03	19
230	0.96	948	509	0.03	19
250	0.94	2218	915	0.06	38
260	0.84	2271	924	0.07	45
270	1.00	1853	891	0.07	45
275	0.95	1100	520	0.03	19
280	1.00	2175	1001	0.06	38
300	0.02	2945	1517	0.14	90

Basin	% Imp	Channel Length (ft)	Dist. To Centroid (ft)	Basin Area (Square Miles)	Basin Area (Acres)
Windmill Gulch Basins					
South System (Tributary to Detention 8)					
400	0.51	2399	1446	0.18	115
450	0.74	2024	941	0.13	83
451	0.85	1088	542	0.04	26
500	0.31	3318	1473	0.39	250
550	0.61	2983	1238	0.14	90
551	0.76	1563	1003	0.06	38
600	0.69	1921	1047	0.06	38
South System (Tributary to Separate Design Point-3 Culverts Under Powers)					
525	0.27	927	214	0.05	32
North System (Tributary to Detention 7)					
625	0.75	873	52	0.03	19
650	0.71	3075	1486	0.20	128
660	0.93	3394	2080	0.31	198
675	0.45	4986	2165	0.11	70
700	0.17	3610	1606	0.11	70
725	0.06	3415	1124	0.19	122
750	0.82	3897	1625	0.10	64
800	0.88	1414	649	0.12	77
825	1.00	1119	498	0.02	13
850	1.00	3334	1910	0.13	83
875	0.94	3132	858	0.14	90
900	0.91	1886	924	0.07	45
925	1.00	1658	763	0.05	32
950	1.00	3303	1525	0.12	77



NOAA ATLAS 2, Volume III

Prepared by U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service, Office of Hydrology

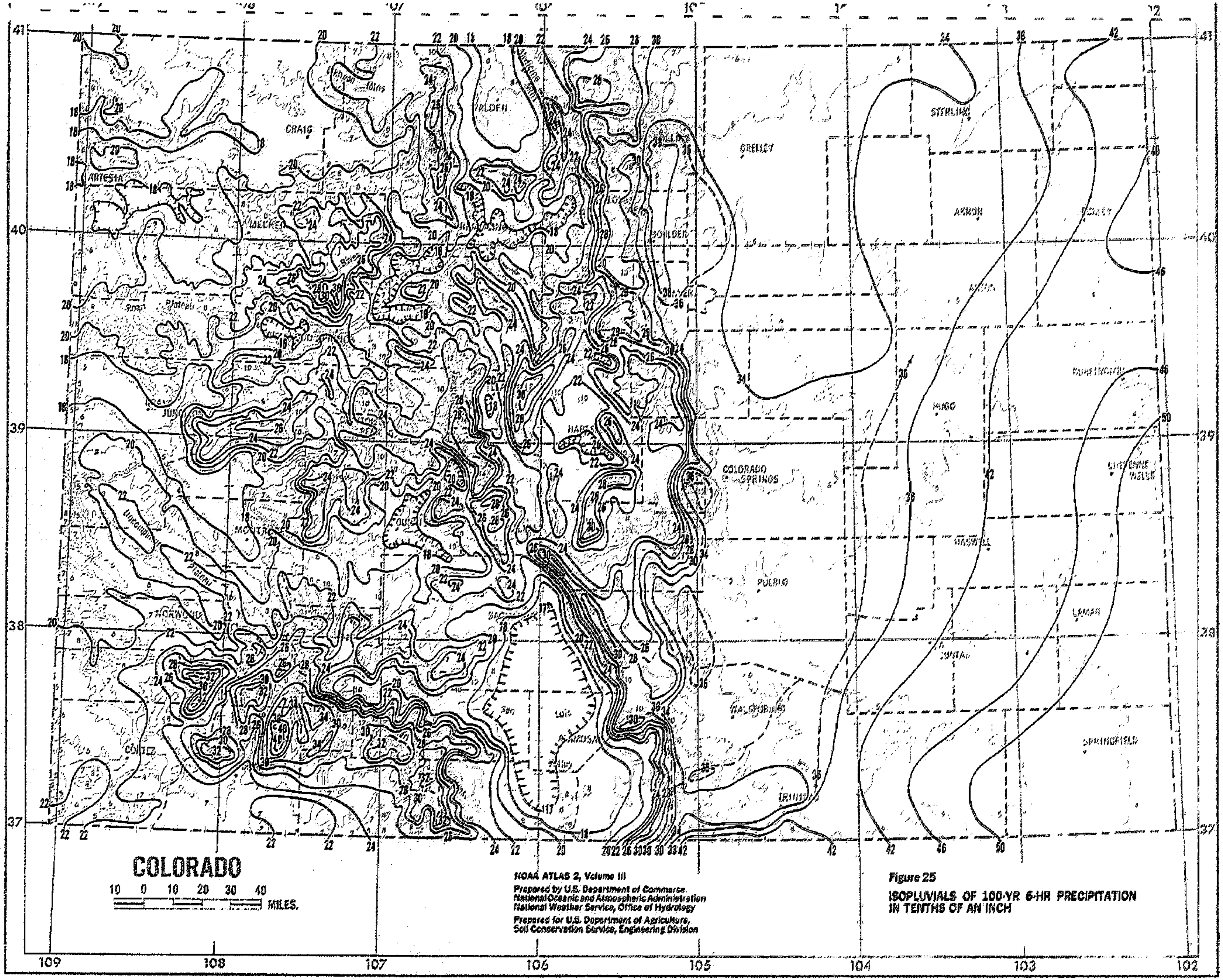
Prepared for U.S. Department of Agriculture,
Soil Conservation Service, Engineering Division

ISOPLUVIALS OF 100-YR 24-HR PRECIPITATION IN TENTHS OF AN INCH

HDR Infrastructure, Inc.
A Centerra Company

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

Date	Figure
OCT. 1987	5-4e



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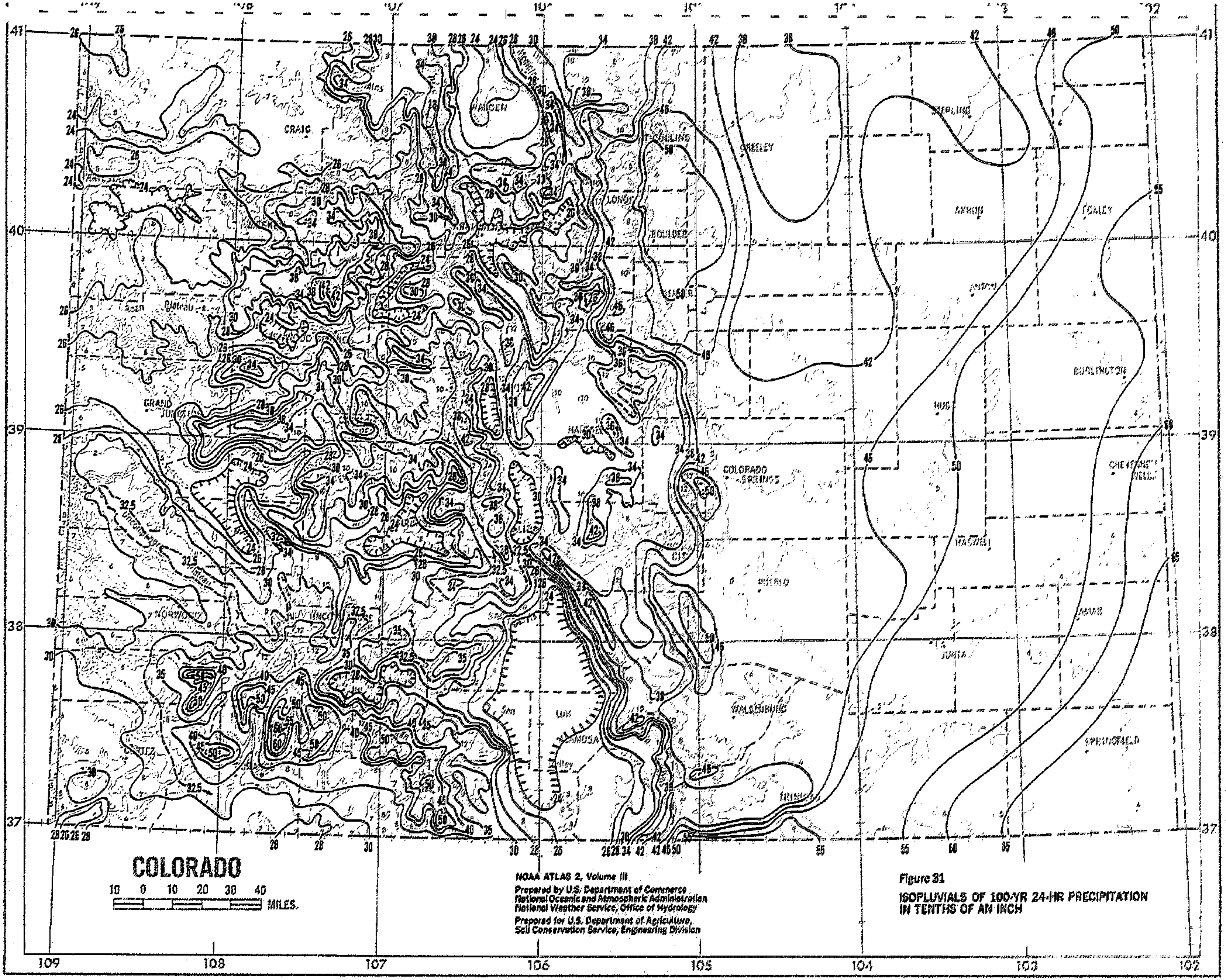
National Oceanic and Atmospheric Administration
National Weather Service, Office of Hydrology
Prepared for U.S. Department of Agriculture,
Soil Conservation Service, Engineering Division

Figure 25
ISOPLUVIALS OF 100-YR 6-HR PRECIPITATION IN TENTHS OF AN INCH



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Prepared by U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service, Office of Hydrology
Prepared for U.S. Department of Agriculture,
Soil Conservation Service, Engineering Division

Figure 31
ISOPLUVIALS OF 100-YR 24-HR PRECIPITATION
IN TENTHS OF AN INCH

SCS Type IIA Storm Distribution (Adopted from City DCM)

100-Year Rainfall Depth = 4.4 inches (Adopted from Figure 4e of the City DCM)

	5 Minute Intervals								
	Cumulative			Incremental					
Hour	min	Cumulative	inches	min	Increment	inches		Added Depth	Modified Tails Hyetograph
1	5	0.0002	*0.001*	5	0.0002	*0.0007*			
	10	0.0003	*0.001*	10	0.0002	*0.0007*			
	15	0.0005	*0.002*	15	0.0002	*0.0007*			
	20	0.0008	*0.004*	20	0.0003	*0.0015*			
	25	0.0012	*0.005*	25	0.0003	*0.0015*			
	30	0.0015	*0.007*	30	0.0003	*0.0015*			
	35	0.0020	*0.009*	35	0.0005	*0.0022*			
	40	0.0025	*0.011*	40	0.0005	*0.0022*			
	45	0.003	*0.013*	45	0.0005	*0.0022*			
	50	0.0035	*0.015*	50	0.0005	*0.0022*			
	55	0.0040	*0.018*	55	0.0005	*0.0022*			
	60	0.0045	*0.020*	60	0.0005	*0.0022*			
2	65	0.0050	*0.022*	65	0.0005	*0.0022*			
	70	0.0055	*0.024*	70	0.0005	*0.0022*			
	75	0.006	*0.026*	75	0.0005	*0.0022*			
	80	0.0067	*0.029*	80	0.0007	*0.0029*			
	85	0.0073	*0.032*	85	0.0007	*0.0029*			
	90	0.008	*0.035*	90	0.0007	*0.0029*			
	95	0.0087	*0.038*	95	0.0007	*0.0029*			
	100	0.0093	*0.041*	100	0.0007	*0.0029*			
	105	0.01	*0.044*	105	0.0007	*0.0029*			
	110	0.0107	*0.047*	110	0.0007	*0.0029*			
	115	0.0113	*0.050*	115	0.0007	*0.0029*			
	120	0.012	*0.053*	120	0.0007	*0.0029*			
3	125	0.0128	*0.056*	125	0.0008	*0.0034*			
	130	0.0135	*0.060*	130	0.0008	*0.0034*			
	135	0.0143	*0.063*	135	0.0008	*0.0034*			
	140	0.0150	*0.066*	140	0.0007	*0.0032*			
	145	0.0158	*0.069*	145	0.0007	*0.0032*			
	150	0.0165	*0.073*	150	0.0007	*0.0032*			
	155	0.0173	*0.076*	155	0.0008	*0.0034*			
	160	0.0180	*0.079*	160	0.0008	*0.0034*			
	165	0.0188	*0.083*	165	0.0008	*0.0034*			
	170	0.0195	*0.086*	170	0.0007	*0.0032*			
	175	0.0203	*0.089*	175	0.0007	*0.0032*			
	180	0.021	*0.092*	180	0.0007	*0.0032*			
4	185	0.0218	*0.096*	185	0.0008	*0.0034*			
	190	0.0225	*0.099*	190	0.0008	*0.0034*			
	195	0.0233	*0.103*	195	0.0008	*0.0034*			
	200	0.0240	*0.106*	200	0.0007	*0.0032*			
	205	0.0248	*0.109*	205	0.0007	*0.0032*			
	210	0.0255	*0.112*	210	0.0007	*0.0032*			
	215	0.0263	*0.116*	215	0.0008	*0.0034*			
	220	0.0270	*0.119*	220	0.0008	*0.0034*			
	225	0.0278	*0.122*	225	0.0008	*0.0034*			
	230	0.0292	*0.128*	230	0.0014	*0.0062*	*start*	0.0068	**0.0130**
	235	0.0306	*0.135*	235	0.0014	*0.0062*		0.0068	**0.0130**
	240	0.032	*0.141*	240	0.0014	*0.0062*		0.0068	**0.0130**
5	245	0.0343	*0.151*	245	0.0023	*0.0103*		0.0068	**0.0171**
	250	0.0367	*0.161*	250	0.0023	*0.0103*		0.0068	**0.0171**
	255	0.039	*0.172*	255	0.0023	*0.0103*		0.0068	**0.0171**
	260	0.0413	*0.182*	260	0.0023	*0.0103*		0.0068	**0.0171**
	265	0.0437	*0.192*	265	0.0023	*0.0103*		0.0068	**0.0171**
	270	0.046	*0.202*	270	0.0023	*0.0103*		0.0068	**0.0171**
	275	0.0483	*0.213*	275	0.0023	*0.0103*		0.0068	**0.0171**
	280	0.0507	*0.223*	280	0.0023	*0.0103*		0.0068	**0.0171**
	285	0.053	*0.233*	285	0.0023	*0.0103*		0.0068	**0.0171**
	290	0.0553	*0.243*	290	0.0023	*0.0103*		0.0068	**0.0171**
	295	0.0577	*0.254*	295	0.0023	*0.0103*		0.0068	**0.0171**
	300	0.06	*0.264*	300	0.0023	*0.0103*		0.0068	**0.0171**
6	305	0.0650	*0.286*	305	0.0050	*0.0220*		0.0068	**0.0288**
	310	0.0700	*0.308*	310	0.0050	*0.0220*		0.0068	**0.0288**
	315	0.075	*0.330*	315	0.0050	*0.0220*		0.0068	**0.0288**
	320	0.0833	*0.367*	320	0.0083	*0.0367*			**0.0367**
	325	0.0917	*0.403*	325	0.0083	*0.0367*			**0.0367**
	330	0.1	*0.440*	330	0.0083	*0.0367*			**0.0367**
	335	0.2000	*0.880*	335	0.1000	*0.4400*			**0.4400**
	340	0.3000	*1.320*	340	0.1000	*0.4400*			**0.4400**

	345	0.4	*1.760*	345	0.1000	*0.4400*	middle		**0.4400**
	350	0.5000	*2.200*	350	0.1000	*0.4400*			**0.4400**
	355	0.6000	*2.640*	355	0.1000	*0.4400*			**0.4400**
	360	0.7	*3.080*	360	0.1000	*0.4400*			**0.4400**
7	365	0.7083	*3.117*	365	0.0083	*0.0367*		0.0142	**0.0508**
	370	0.7167	*3.153*	370	0.0083	*0.0367*		0.0142	**0.0508**
	375	0.725	*3.190*	375	0.0083	*0.0367*		0.0142	**0.0508**
	380	0.7333	*3.227*	380	0.0083	*0.0367*		0.0142	**0.0508**
	385	0.7417	*3.263*	385	0.0083	*0.0367*		0.0142	**0.0508**
	390	0.75	*3.300*	390	0.0083	*0.0367*		0.0142	**0.0508**
	395	0.7550	*3.322*	395	0.0050	*0.0220*		0.0142	**0.0362**
	400	0.7600	*3.344*	400	0.0050	*0.0220*		0.0142	**0.0362**
	405	0.765	*3.366*	405	0.0050	*0.0220*		0.0142	**0.0362**
	410	0.7700	*3.388*	410	0.0050	*0.0220*		0.0142	**0.0362**
	415	0.7750	*3.410*	415	0.0050	*0.0220*		0.0142	**0.0362**
	420	0.78	*3.432*	420	0.0050	*0.0220*		0.0142	**0.0362**
8	425	0.7833	*3.447*	425	0.0033	*0.0147*		0.0142	**0.0288**
	430	0.7867	*3.461*	430	0.0033	*0.0147*		0.0142	**0.0288**
	435	0.79	*3.476*	435	0.0033	*0.0147*		0.0142	**0.0288**
	440	0.7933	*3.491*	440	0.0033	*0.0147*		0.0142	**0.0288**
	445	0.7967	*3.505*	445	0.0033	*0.0147*		0.0142	**0.0288**
	450	0.8	*3.520*	450	0.0033	*0.0147*		0.0142	**0.0288**
	455	0.8033	*3.535*	455	0.0033	*0.0147*		0.0142	**0.0288**
	460	0.8067	*3.549*	460	0.0033	*0.0147*		0.0142	**0.0288**
	465	0.81	*3.564*	465	0.0033	*0.0147*		0.0142	**0.0288**
	470	0.8133	*3.579*	470	0.0033	*0.0147*		0.0142	**0.0288**
	475	0.8167	*3.593*	475	0.0033	*0.0147*		0.0142	**0.0288**
	480	0.82	*3.608*	480	0.0033	*0.0147*		0.0142	**0.0288**
9	485	0.8217	*3.615*	485	0.0017	*0.0073*		0.0142	**0.0215**
	490	0.8233	*3.623*	490	0.0017	*0.0073*		0.0142	**0.0215**
	495	0.825	*3.630*	495	0.0017	*0.0073*		0.0142	**0.0215**
	500	0.8267	*3.637*	500	0.0017	*0.0073*		0.0142	**0.0215**
	505	0.8283	*3.645*	505	0.0017	*0.0073*		0.0142	**0.0215**
	510	0.83	*3.652*	510	0.0017	*0.0073*		0.0142	**0.0215**
	515	0.8317	*3.659*	515	0.0017	*0.0073*		0.0142	**0.0215**
	520	0.8333	*3.667*	520	0.0017	*0.0073*		0.0142	**0.0215**
	525	0.835	*3.674*	525	0.0017	*0.0073*		0.0142	**0.0215**
	530	0.8367	*3.681*	530	0.0017	*0.0073*		0.0142	**0.0215**
	535	0.8383	*3.689*	535	0.0017	*0.0073*		0.0142	**0.0215**
	540	0.84	*3.696*	540	0.0017	*0.0073*		0.0142	**0.0215**
10	545	0.8417	*3.703*	545	0.0017	*0.0073*		0.0142	**0.0215**
	550	0.8433	*3.711*	550	0.0017	*0.0073*		0.0142	**0.0215**
	555	0.845	*3.718*	555	0.0017	*0.0073*		0.0142	**0.0215**
	560	0.8467	*3.725*	560	0.0017	*0.0073*		0.0142	**0.0215**
	565	0.8483	*3.733*	565	0.0017	*0.0073*		0.0142	**0.0215**
	570	0.85	*3.740*	570	0.0017	*0.0073*		0.0142	**0.0215**
	575	0.8517	*3.747*	575	0.0017	*0.0073*		0.0142	**0.0215**
	580	0.8533	*3.755*	580	0.0017	*0.0073*		0.0142	**0.0215**
	585	0.855	*3.762*	585	0.0017	*0.0073*	stop	0.0142	**0.0215**
	590	0.8567	*3.769*	590	0.0017	*0.0073*			
	595	0.8583	*3.777*	595	0.0017	*0.0073*			
	600	0.86	*3.784*	600	0.0017	*0.0073*			
11	605	0.8613	*3.790*	605	0.0013	*0.0056*			
	610	0.8625	*3.795*	610	0.0013	*0.0056*			
	615	0.8638	*3.801*	615	0.0013	*0.0056*			
	620	0.8650	*3.806*	620	0.0012	*0.0054*			
	625	0.8663	*3.812*	625	0.0012	*0.0054*			
	630	0.8675	*3.817*	630	0.0012	*0.0054*			
	635	0.8688	*3.823*	635	0.0013	*0.0056*			
	640	0.8700	*3.828*	640	0.0013	*0.0056*			
	645	0.8713	*3.834*	645	0.0013	*0.0056*			
	650	0.8725	*3.839*	650	0.0012	*0.0054*			
	655	0.8738	*3.845*	655	0.0012	*0.0054*			
	660	0.875	*3.850*	660	0.0012	*0.0054*			
12	665	0.8763	*3.856*	665	0.0013	*0.0056*			
	670	0.8775	*3.861*	670	0.0013	*0.0056*			
	675	0.8788	*3.867*	675	0.0013	*0.0056*			
	680	0.8800	*3.872*	680	0.0012	*0.0054*			
	685	0.8813	*3.878*	685	0.0012	*0.0054*			
	690	0.8825	*3.883*	690	0.0012	*0.0054*			
	695	0.8838	*3.889*	695	0.0013	*0.0056*			
	700	0.8850	*3.894*	700	0.0013	*0.0056*			
	705	0.8863	*3.900*	705	0.0013	*0.0056*			
	710	0.8875	*3.905*	710	0.0012	*0.0054*			
	715	0.8888	*3.911*	715	0.0012	*0.0054*			
	720	0.89	*3.916*	720	0.0012	*0.0054*			
13	725	0.8913	*3.922*	725	0.0013	*0.0056*			
	730	0.8925	*3.927*	730	0.0013	*0.0056*			
	735	0.8938	*3.933*	735	0.0013	*0.0056*			

	740	0.8950	3.938	740	0.0012	0.0054
	745	0.8963	3.944	745	0.0012	0.0054
	750	0.8975	3.949	750	0.0012	0.0054
	755	0.8988	3.955	755	0.0013	0.0056
	760	0.9000	3.960	760	0.0013	0.0056
	765	0.9013	3.966	765	0.0013	0.0056
	770	0.9025	3.971	770	0.0012	0.0054
	775	0.9038	3.977	775	0.0012	0.0054
	780	0.905	3.982	780	0.0012	0.0054
14	785	0.9061	3.987	785	0.0011	0.0048
	790	0.9072	3.992	790	0.0011	0.0048
	795	0.9083	3.997	795	0.0011	0.0048
	800	0.9094	4.001	800	0.0011	0.0047
	805	0.9104	4.006	805	0.0011	0.0047
	810	0.9115	4.011	810	0.0011	0.0047
	815	0.9126	4.015	815	0.0011	0.0048
	820	0.9137	4.020	820	0.0011	0.0048
	825	0.9148	4.025	825	0.0011	0.0048
	830	0.9159	4.030	830	0.0011	0.0047
	835	0.9169	4.035	835	0.0011	0.0047
	840	0.918	4.039	840	0.0011	0.0047
15	845	0.9190	4.044	845	0.0010	0.0044
	850	0.9200	4.048	850	0.0010	0.0044
	855	0.921	4.052	855	0.0010	0.0044
	860	0.9220	4.057	860	0.0010	0.0044
	865	0.9230	4.061	865	0.0010	0.0044
	870	0.924	4.066	870	0.0010	0.0044
	875	0.9250	4.070	875	0.0010	0.0044
	880	0.9260	4.074	880	0.0010	0.0044
	885	0.927	4.079	885	0.0010	0.0044
	890	0.9280	4.083	890	0.0010	0.0044
	895	0.9290	4.088	895	0.0010	0.0044
	900	0.93	4.092	900	0.0010	0.0044
16	905	0.9308	4.096	905	0.0008	0.0037
	910	0.9317	4.099	910	0.0008	0.0037
	915	0.9325	4.103	915	0.0008	0.0037
	920	0.9333	4.107	920	0.0008	0.0037
	925	0.9342	4.110	925	0.0008	0.0037
	930	0.935	4.114	930	0.0008	0.0037
	935	0.9358	4.118	935	0.0008	0.0037
	940	0.9367	4.121	940	0.0008	0.0037
	945	0.9375	4.125	945	0.0008	0.0037
	950	0.9383	4.129	950	0.0008	0.0037
	955	0.9392	4.132	955	0.0008	0.0037
	960	0.94	4.136	960	0.0008	0.0037
17	965	0.9408	4.140	965	0.0008	0.0037
	970	0.9417	4.143	970	0.0008	0.0037
	975	0.9425	4.147	975	0.0008	0.0037
	980	0.9433	4.151	980	0.0008	0.0037
	985	0.9442	4.154	985	0.0008	0.0037
	990	0.945	4.158	990	0.0008	0.0037
	995	0.9458	4.162	995	0.0008	0.0037
	1000	0.9467	4.165	1000	0.0008	0.0037
	1005	0.9475	4.169	1005	0.0008	0.0037
	1010	0.9483	4.173	1010	0.0008	0.0037
	1015	0.9492	4.176	1015	0.0008	0.0037
	1020	0.95	4.180	1020	0.0008	0.0037
18	1025	0.9508	4.184	1025	0.0008	0.0037
	1030	0.9517	4.187	1030	0.0008	0.0037
	1035	0.9525	4.191	1035	0.0008	0.0037
	1040	0.9533	4.195	1040	0.0008	0.0037
	1045	0.9542	4.198	1045	0.0008	0.0037
	1050	0.955	4.202	1050	0.0008	0.0037
	1055	0.9558	4.206	1055	0.0008	0.0037
	1060	0.9567	4.209	1060	0.0008	0.0037
	1065	0.9575	4.213	1065	0.0008	0.0037
	1070	0.9583	4.217	1070	0.0008	0.0037
	1075	0.9592	4.220	1075	0.0008	0.0037
	1080	0.96	4.224	1080	0.0008	0.0037
19	1085	0.9608	4.228	1085	0.0008	0.0037
	1090	0.9617	4.231	1090	0.0008	0.0037
	1095	0.9625	4.235	1095	0.0008	0.0037
	1100	0.9633	4.239	1100	0.0008	0.0037
	1105	0.9642	4.242	1105	0.0008	0.0037
	1110	0.965	4.246	1110	0.0008	0.0037
	1115	0.9658	4.250	1115	0.0008	0.0037
	1120	0.9667	4.253	1120	0.0008	0.0037
	1125	0.9675	4.257	1125	0.0008	0.0037
	1130	0.9683	4.261	1130	0.0008	0.0037

	1135	0.9692	*4.264*	1135	0.0008	*0.0037*
	1140	0.97	*4.268*	1140	0.0008	*0.0037*
20	1145	0.9708	*4.272*	1145	0.0008	*0.0037*
	1150	0.9717	*4.275*	1150	0.0008	*0.0037*
	1155	0.9725	*4.279*	1155	0.0008	*0.0037*
	1160	0.9733	*4.283*	1160	0.0008	*0.0037*
	1165	0.9742	*4.286*	1165	0.0008	*0.0037*
	1170	0.975	*4.290*	1170	0.0008	*0.0037*
	1175	0.9758	*4.294*	1175	0.0008	*0.0037*
	1180	0.9767	*4.297*	1180	0.0008	*0.0037*
	1185	0.9775	*4.301*	1185	0.0008	*0.0037*
	1190	0.9783	*4.305*	1190	0.0008	*0.0037*
	1195	0.9792	*4.308*	1195	0.0008	*0.0037*
	1200	0.98	*4.312*	1200	0.0008	*0.0037*
21	1205	0.9804	*4.314*	1205	0.0004	*0.0019*
	1210	0.9809	*4.316*	1210	0.0004	*0.0019*
	1215	0.9813	*4.318*	1215	0.0004	*0.0019*
	1220	0.9817	*4.319*	1220	0.0004	*0.0018*
	1225	0.9821	*4.321*	1225	0.0004	*0.0018*
	1230	0.9825	*4.323*	1230	0.0004	*0.0018*
	1235	0.9829	*4.325*	1235	0.0004	*0.0019*
	1240	0.9834	*4.327*	1240	0.0004	*0.0019*
	1245	0.9838	*4.329*	1245	0.0004	*0.0019*
	1250	0.9842	*4.330*	1250	0.0004	*0.0018*
	1255	0.9846	*4.332*	1255	0.0004	*0.0018*
	1260	0.985	*4.334*	1260	0.0004	*0.0018*
22	1265	0.9854	*4.336*	1265	0.0004	*0.0019*
	1270	0.9859	*4.338*	1270	0.0004	*0.0019*
	1275	0.9863	*4.340*	1275	0.0004	*0.0019*
	1280	0.9867	*4.341*	1280	0.0004	*0.0018*
	1285	0.9871	*4.343*	1285	0.0004	*0.0018*
	1290	0.9875	*4.345*	1290	0.0004	*0.0018*
	1295	0.9879	*4.347*	1295	0.0004	*0.0019*
	1300	0.9884	*4.349*	1300	0.0004	*0.0019*
	1305	0.9888	*4.351*	1305	0.0004	*0.0019*
	1310	0.9892	*4.352*	1310	0.0004	*0.0018*
	1315	0.9896	*4.354*	1315	0.0004	*0.0018*
	1320	0.99	*4.356*	1320	0.0004	*0.0018*
23	1325	0.9904	*4.358*	1325	0.0004	*0.0019*
	1330	0.9909	*4.360*	1330	0.0004	*0.0019*
	1335	0.9913	*4.362*	1335	0.0004	*0.0019*
	1340	0.9917	*4.363*	1340	0.0004	*0.0018*
	1345	0.9921	*4.365*	1345	0.0004	*0.0018*
	1350	0.9925	*4.367*	1350	0.0004	*0.0018*
	1355	0.9929	*4.369*	1355	0.0004	*0.0019*
	1360	0.9934	*4.371*	1360	0.0004	*0.0019*
	1365	0.9938	*4.373*	1365	0.0004	*0.0019*
	1370	0.9942	*4.374*	1370	0.0004	*0.0018*
	1375	0.9946	*4.376*	1375	0.0004	*0.0018*
	1380	0.995	*4.378*	1380	0.0004	*0.0018*
24	1385	0.9954	*4.380*	1385	0.0004	*0.0019*
	1390	0.9959	*4.382*	1390	0.0004	*0.0019*
	1395	0.9963	*4.384*	1395	0.0004	*0.0019*
	1400	0.9967	*4.385*	1400	0.0004	*0.0018*
	1405	0.9971	*4.387*	1405	0.0004	*0.0018*
	1410	0.9975	*4.389*	1410	0.0004	*0.0018*
	1415	0.9979	*4.391*	1415	0.0004	*0.0019*
	1420	0.9984	*4.393*	1420	0.0004	*0.0019*
	1425	0.9988	*4.395*	1425	0.0004	*0.0019*
	1430	0.9992	*4.396*	1430	0.0004	*0.0018*
	1435	0.9996	*4.398*	1435	0.0004	*0.0018*
	1440	1	*4.400*	1440	0.0004	*0.0018*
						4.40

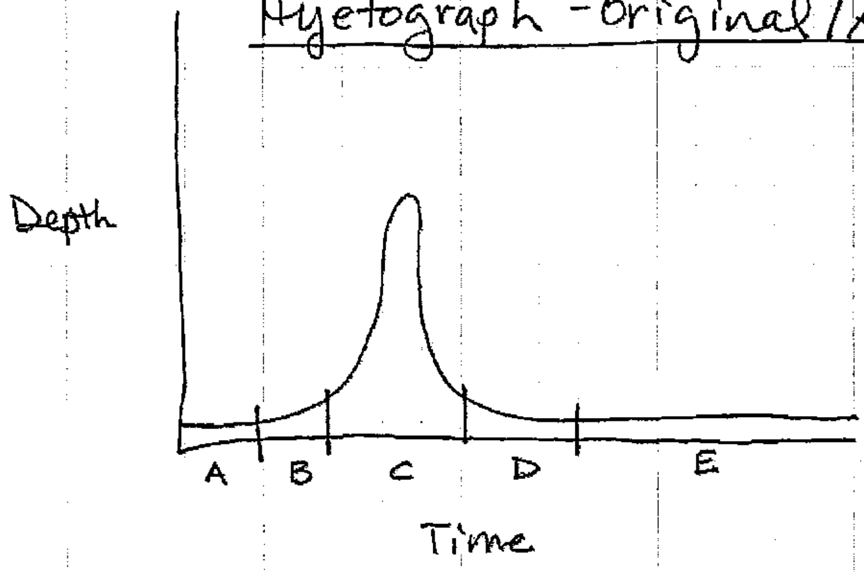
4.40

SHEET NO. ____ of ____ DATE 12/23/04

PROJECT NO. ____

"Modified Tails" Hyetograph Adjustment Procedure:

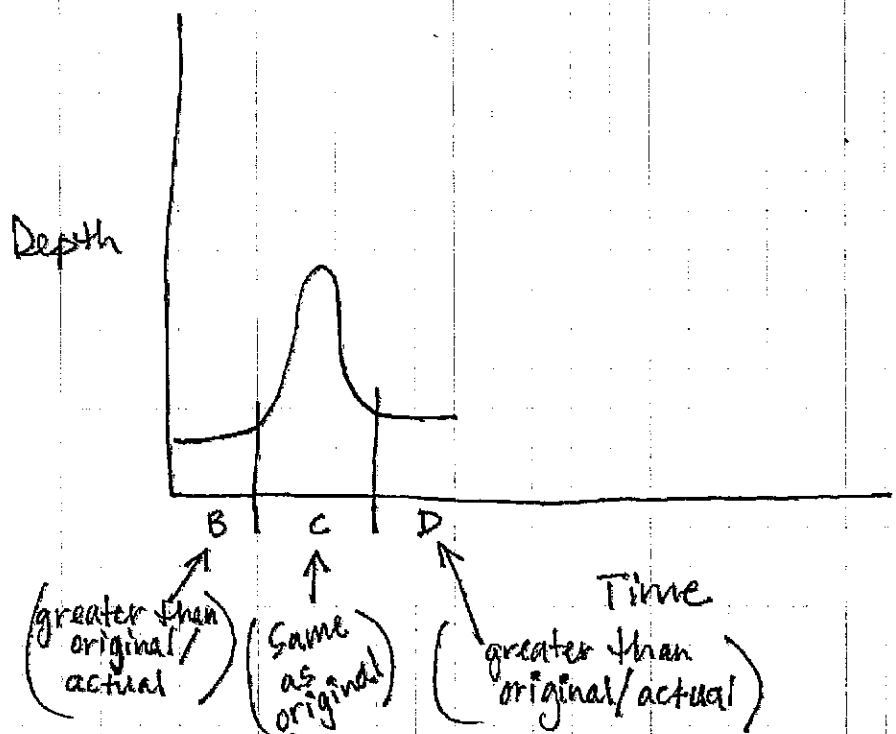
Hyetograph - Original/Actual



Evenly distribute the depth of rainfall occurring in time A (0.12") over the increments in time B (incr.)

Evenly distribute the depth of rainfall occurring in time E over the increments in time D.

Hyetograph - Modeled



CALCULATION OF A PEAK RUNOFF USING RATIONAL METHOD

Project Title: COSA
Catchment ID: 100

I. Catchment Hydrologic Data

Catchment ID = 100
Area = 32.00 Acres
Percent Imperviousness = 16.66 %
NRCS Soil Type = B A, B, C, or D

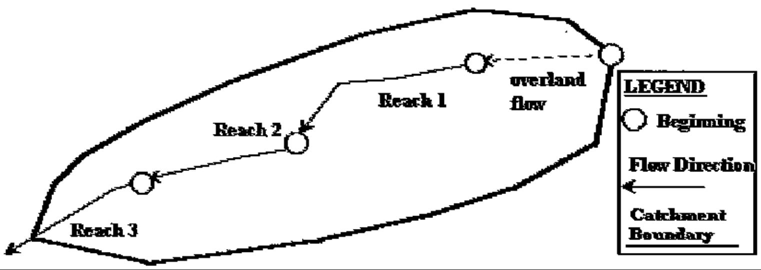
II. Rainfall Information I (inch/hr) = C1 * P1 /(C2 + Td)^C3

Design Storm Return Period, Tr = 5 years (input return period for design storm)
C1 = 28.50 (input the value of C1)
C2= 10.00 (input the value of C2)
C3= 0.786 (input the value of C3)
P1= 1.55 inches (input one-hr precipitation--see Sheet "Design Info")

III. Analysis of Flow Time (Time of Concentration) for a Catchment

Runoff Coefficient, C = 0.18
Overide Runoff Coefficient, C = ______ (enter an overide C value if desired, or leave blank to accept calculated C.)
5-yr. Runoff Coefficient, C-5 = 0.18
Overide 5-yr. Runoff Coefficient, C = ______ (enter an overide C-5 value if desired, or leave blank to accept calculated C-5.)

Illustration



NRCS Land Type	Heavy Meadow	Tillage/ Field	Short Pasture/ Lawns	Nearly Bare Ground	Grassed Swales/ Waterways	Paved Areas & Shallow Paved Swales (Sheet Flow)
Conveyance	2.5	5	7	10	15	20

Calculations:

Reach ID	Slope S ft/ft input	Length L ft input	5-yr Runoff Coeff C-5 output	NRCS Convey-ance input	Flow Velocity V fps output	Flow Time Tf minutes output
Overland	0.0730	300	0.18		0.33	14.96
1	0.0720	559		7.00	1.88	4.96
2						
3						
4						
5						
Sum		859				

Computed Tc = 19.92
Regional Tc = 14.77

IV.

Peak Runoff Prediction using Computed Tc	ediction using Regional Tc
Rainfall Intensity at Tc, I = 3.06 inch/hr	Rainfall Intensity at Tc, I = 3.54 inch/hr
Peak Flowrate, Qp = 17.42 cfs	Peak Flowrate, Qp = 20.20 cfs

CALCULATION OF A PEAK RUNOFF USING RATIONAL METHOD

Project Title: COSA
Catchment ID: 150

I. Catchment Hydrologic Data

Catchment ID = 150
Area = 19.20 Acres
Percent Imperviousness = 90.54 %
NRCS Soil Type = B A, B, C, or D

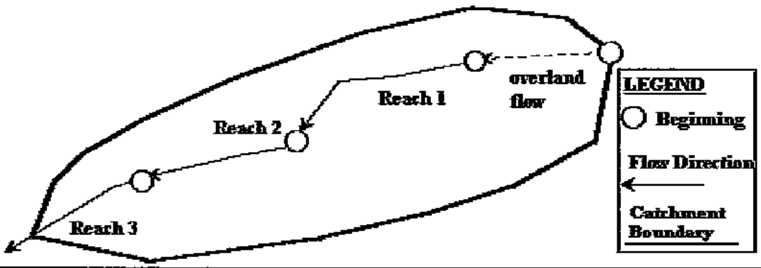
II. Rainfall Information I (inch/hr) = C1 * P1 /(C2 + Td)^C3

Design Storm Return Period, Tr = 5 years (input return period for design storm)
C1 = 28.50 (input the value of C1)
C2= 10.00 (input the value of C2)
C3= 0.786 (input the value of C3)
P1= 1.55 inches (input one-hr precipitation--see Sheet "Design Info")

III. Analysis of Flow Time (Time of Concentration) for a Catchment

Runoff Coefficient, C = 0.73
Overide Runoff Coefficient, C = ______ (enter an overide C value if desired, or leave blank to accept calculated C.)
5-yr. Runoff Coefficient, C-5 = 0.73
Overide 5-yr. Runoff Coefficient, C = ______ (enter an overide C-5 value if desired, or leave blank to accept calculated C-5.)

Illustration



NRCS Land Type	Heavy Meadow	Tillage/ Field	Short Pasture/ Lawns	Nearly Bare Ground	Grassed Swales/ Waterways	Paved Areas & Shallow Paved Swales (Sheet Flow)
Conveyance	2.5	5	7	10	15	20

Calculations:

Reach ID	Slope S ft/ft input	Length L ft input	5-yr Runoff Coeff C-5 output	NRCS Convey-ance input	Flow Velocity V fps output	Flow Time Tf minutes output
Overland	0.0530	300	0.73		0.76	6.59
1	0.0212	764		20.00	2.91	4.37
2						
3						
4						
5						
Sum		1,064			Computed Tc =	10.96
					Regional Tc =	15.91

IV.

Peak Runoff Prediction using Computed Tc		ediction using Regional Tc	
Rainfall Intensity at Tc, I =	4.04 inch/hr	Rainfall Intensity at Tc, I =	3.42 inch/hr
Peak Flowrate, Qp =	57.03 cfs	Peak Flowrate, Qp =	48.27 cfs

CALCULATION OF A PEAK RUNOFF USING RATIONAL METHOD

Project Title: COSA
Catchment ID: 215

I. Catchment Hydrologic Data

Catchment ID = 215
Area = 32.00 Acres
Percent Imperviousness = 33.80 %
NRCS Soil Type = B A, B, C, or D

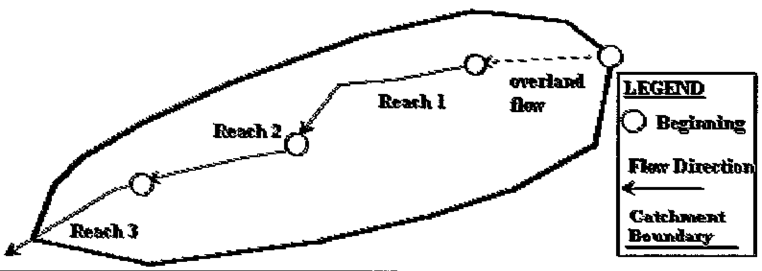
II. Rainfall Information I (inch/hr) = C1 * P1 /(C2 + Td)^C3

Design Storm Return Period, Tr = 5 years (input return period for design storm)
C1 = 28.50 (input the value of C1)
C2= 10.00 (input the value of C2)
C3= 0.786 (input the value of C3)
P1= 1.55 inches (input one-hr precipitation--see Sheet "Design Info")

III. Analysis of Flow Time (Time of Concentration) for a Catchment

Runoff Coefficient, C = 0.27
Overide Runoff Coefficient, C = (enter an overide C value if desired, or leave blank to accept calculated C.)
5-yr. Runoff Coefficient, C-5 = 0.27
Overide 5-yr. Runoff Coefficient, C = (enter an overide C-5 value if desired, or leave blank to accept calculated C-5.)

Illustration



NRCS Land Type	Heavy Meadow	Tillage/ Field	Short Pasture/ Lawns	Nearly Bare Ground	Grassed Swales/ Waterways	Paved Areas & Shallow Paved Swales (Sheet Flow)
Conveyance	2.5	5	7	10	15	20

Calculations:

Reach ID	Slope S	Length L	5-yr Runoff Coeff C-5	NRCS Convey-ance	Flow Velocity V	Flow Time Tf
	ft/ft	ft			fps	minutes
	input	input	output	input	output	output
Overland	0.0330	300	0.27		0.28	17.57
1	0.0560	1,703		15.00	3.55	8.00
2						
3						
4						
5						
Sum		2,003				

Computed Tc = 25.56
Regional Tc = 21.13

IV.

Peak Runoff Prediction using Computed Tc	ediction using Regional Tc
Rainfall Intensity at Tc, I = 2.67 inch/hr	Rainfall Intensity at Tc, I = 2.96 inch/hr
Peak Flowrate, Qp = 22.78 cfs	Peak Flowrate, Qp = 25.30 cfs

CALCULATION OF A PEAK RUNOFF USING RATIONAL METHOD

Project Title: COSA
Catchment ID: 225

I. Catchment Hydrologic Data

Catchment ID = 2258
Area = 19.20 Acres
Percent Imperviousness = 87.56 %
NRCS Soil Type = B A, B, C, or D

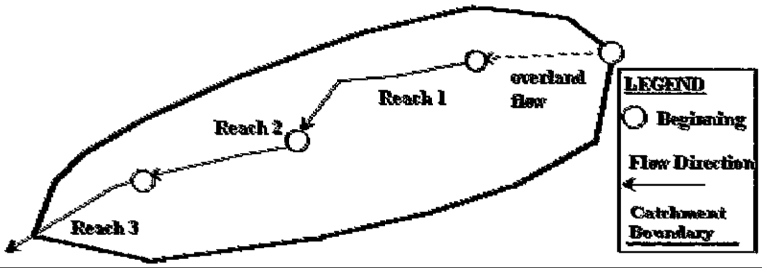
II. Rainfall Information I (inch/hr) = C1 * P1 /(C2 + Td)^C3

Design Storm Return Period, Tr = 5 years (input return period for design storm)
C1 = 28.50 (input the value of C1)
C2= 10.00 (input the value of C2)
C3= 0.786 (input the value of C3)
P1= 1.55 inches (input one-hr precipitation--see Sheet "Design Info")

III. Analysis of Flow Time (Time of Concentration) for a Catchment

Runoff Coefficient, C = 0.69
Overide Runoff Coefficient, C = ______ (enter an overide C value if desired, or leave blank to accept calculated C.)
5-yr. Runoff Coefficient, C-5 = 0.69
Overide 5-yr. Runoff Coefficient, C = ______ (enter an overide C-5 value if desired, or leave blank to accept calculated C-5.)

Illustration



NRCS Land Type	Heavy Meadow	Tillage/ Field	Short Pasture/ Lawns	Nearly Bare Ground	Grassed Swales/ Waterways	Paved Areas & Shallow Paved Swales (Sheet Flow)
Conveyance	2.5	5	7	10	15	20

Calculations:

Reach ID	Slope S	Length L	5-yr Runoff Coeff	NRCS Convey-ance	Flow Velocity V	Flow Time Tf
			C-5			
	ft/ft	ft			fps	minutes
	input	input	output	input	output	output
Overland	0.0400	300	0.69		0.62	8.09
1	0.0713	685		20.00	5.34	2.14
2						
3						
4						
5						
Sum		985				

Computed Tc = 10.23
Regional Tc = 15.47

IV.

Peak Runoff Prediction using Computed Tc	ediction using Regional Tc
Rainfall Intensity at Tc, I = 4.16 inch/hr	Rainfall Intensity at Tc, I = 3.47 inch/hr
Peak Flowrate, Qp = 55.17 cfs	Peak Flowrate, Qp = 46.03 cfs

CALCULATION OF A PEAK RUNOFF USING RATIONAL METHOD

Project Title: COSA
Catchment ID: 250

I. Catchment Hydrologic Data

Catchment ID = 250
Area = 57.60 Acres
Percent Imperviousness = 95.74 %
NRCS Soil Type = B A, B, C, or D

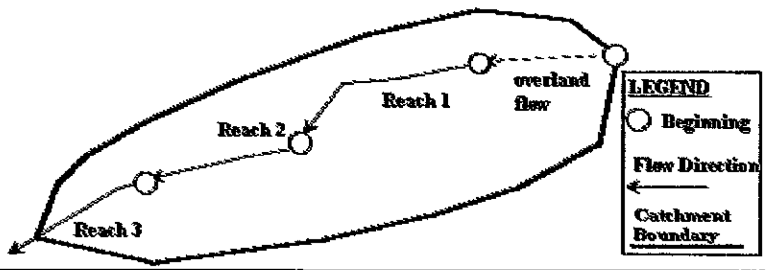
II. Rainfall Information   I (inch/hr) = C1 * P1 /(C2 + Td)^C3

Design Storm Return Period, Tr = 5 years (input return period for design storm)
C1 = 28.50 (input the value of C1)
C2= 10.00 (input the value of C2)
C3= 0.786 (input the value of C3)
P1= 1.55 inches (input one-hr precipitation--see Sheet "Design Info")

III. Analysis of Flow Time (Time of Concentration) for a Catchment

Runoff Coefficient, C = 0.82
Overide Runoff Coefficient, C = ______ (enter an overide C value if desired, or leave blank to accept calculated C.)
5-yr. Runoff Coefficient, C-5 = 0.82
Overide 5-yr. Runoff Coefficient, C = ______ (enter an overide C-5 value if desired, or leave blank to accept calculated C-5.)

Illustration



NRCS Land Type	Heavy Meadow	Tillage/ Field	Short Pasture/ Lawns	Nearly Bare Ground	Grassed Swales/ Waterways	Paved Areas & Shallow Paved Swales (Sheet Flow)
Conveyance	2.5	5	7	10	15	20

Calculations:

Reach ID	Slope S	Length L	5-yr Runoff Coeff C-5	NRCS Convey-ance	Flow Velocity V	Flow Time Tf
	ft/ft	ft			fps	minutes
	input	input	output	input	output	output
Overland	0.0670	300	0.82		1.06	4.69
1	0.0200	747		20.00	2.83	4.40
2	0.0650	409		20.00	5.10	1.34
3						
4						
5						
Sum		1,456				

Computed Tc = 10.43
Regional Tc = 18.09

IV.

Peak Runoff Prediction using Computed Tc	**ediction using Regional Tc**
Rainfall Intensity at Tc, I = 4.12 inch/hr	Rainfall Intensity at Tc, I = 3.21 inch/hr
Peak Flowrate, Qp = 194.46 cfs	Peak Flowrate, Qp = 151.43 cfs

CALCULATION OF A PEAK RUNOFF USING RATIONAL METHOD

Project Title: COSA
Catchment ID: 260

I. Catchment Hydrologic Data

Catchment ID = 260
Area = 39.68 Acres
Percent Imperviousness = 95.53 %
NRCS Soil Type = B A, B, C, or D

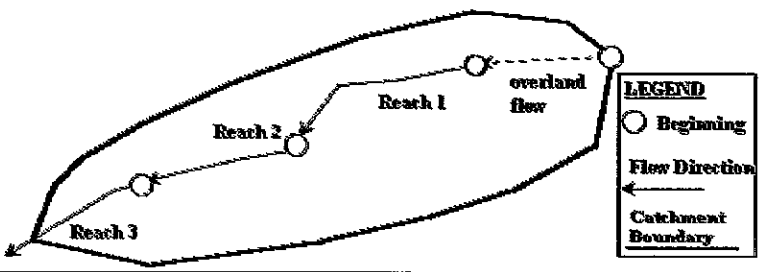
II. Rainfall Information I (inch/hr) = C1 * P1 /(C2 + Td)^C3

Design Storm Return Period, Tr = 5 years (input return period for design storm)
C1 = 28.50 (input the value of C1)
C2= 10.00 (input the value of C2)
C3= 0.786 (input the value of C3)
P1= 1.55 inches (input one-hr precipitation--see Sheet "Design Info")

III. Analysis of Flow Time (Time of Concentration) for a Catchment

Runoff Coefficient, C = 0.82
Overide Runoff Coefficient, C = ______ (enter an overide C value if desired, or leave blank to accept calculated C.)
5-yr. Runoff Coefficient, C-5 = 0.82
Overide 5-yr. Runoff Coefficient, C = ______ (enter an overide C-5 value if desired, or leave blank to accept calculated C-5.)

Illustration



NRCS Land Type	Heavy Meadow	Tillage/ Field	Short Pasture/ Lawns	Nearly Bare Ground	Grassed Swales/ Waterways	Paved Areas & Shallow Paved Swales (Sheet Flow)
Conveyance	2.5	5	7	10	15	20

Calculations:

Reach ID	Slope S ft/ft input	Length L ft input	5-yr Runoff Coeff C-5 output	NRCS Conveyance input	Flow Velocity V fps output	Flow Time Tf minutes output
Overland	0.0230	300	0.82		0.74	6.77
1	0.0090	1,186		20.00	1.90	10.42
2				20.00		
3						
4						
5						
Sum		1,486				

Computed Tc = 17.18
Regional Tc = 18.26

IV.

Peak Runoff Prediction using Computed Tc	ediction using Regional Tc
Rainfall Intensity at Tc, I = 3.29 inch/hr	Rainfall Intensity at Tc, I = 3.20 inch/hr
Peak Flowrate, Qp = 106.57 cfs	Peak Flowrate, Qp = 103.38 cfs

CALCULATION OF A PEAK RUNOFF USING RATIONAL METHOD

Project Title: COSA
Catchment ID: 270

I. Catchment Hydrologic Data

Catchment ID = 270
Area = 89.60 Acres
Percent Imperviousness = 2.00 %
NRCS Soil Type = B A, B, C, or D

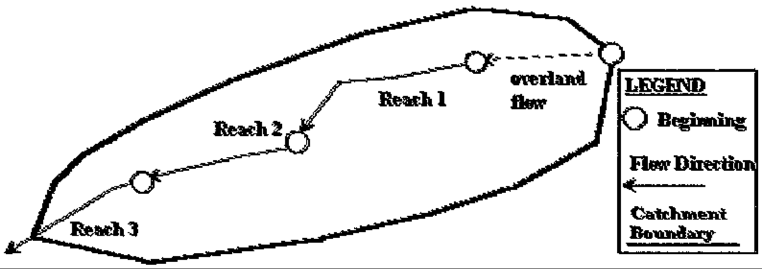
II. Rainfall Information I (inch/hr) = C1 * P1 /(C2 + Td)^C3

Design Storm Return Period, Tr =	5 years	(input return period for design storm)
C1 =	28.50	(input the value of C1)
C2=	10.00	(input the value of C2)
C3=	0.786	(input the value of C3)
P1=	1.55 inches	(input one-hr precipitation--see Sheet "Design Info")

III. Analysis of Flow Time (Time of Concentration) for a Catchment

Runoff Coefficient, C = 0.08
Overide Runoff Coefficient, C = ______ (enter an overide C value if desired, or leave blank to accept calculated C.)
5-yr. Runoff Coefficient, C-5 = 0.08
Overide 5-yr. Runoff Coefficient, C = ______ (enter an overide C-5 value if desired, or leave blank to accept calculated C-5.)

Illustration



NRCS Land Type	Heavy Meadow	Tillage/ Field	Short Pasture/ Lawns	Nearly Bare Ground	Grassed Swales/ Waterways	Paved Areas & Shallow Paved Swales (Sheet Flow)
Conveyance	2.5	5	7	10	15	20

Calculations:

Reach ID	Slope S ft/ft input	Length L ft input	5-yr Runoff Coeff C-5 output	NRCS Convey-ance input	Flow Velocity V fps output	Flow Time Tf minutes output
Overland	0.0130	300	0.08		0.17	29.21
1	0.0270	1,773		20.00	3.29	8.99
2						
3						
4						
5						
Sum		2,073			Computed Tc =	38.20
					Regional Tc =	21.52

IV.

Peak Runoff Prediction using Computed Tc	ediction using Regional Tc
Rainfall Intensity at Tc, I = 2.10 inch/hr	Rainfall Intensity at Tc, I = 2.93 inch/hr
Peak Flowrate, Qp = 15.35 cfs	Peak Flowrate, Qp = 21.44 cfs

CALCULATION OF A PEAK RUNOFF USING RATIONAL METHOD

Project Title: COSA
Catchment ID: 275

I. Catchment Hydrologic Data

Catchment ID = 275
Area = 19.20 Acres
Percent Imperviousness = 95.75 %
NRCS Soil Type = B A, B, C, or D

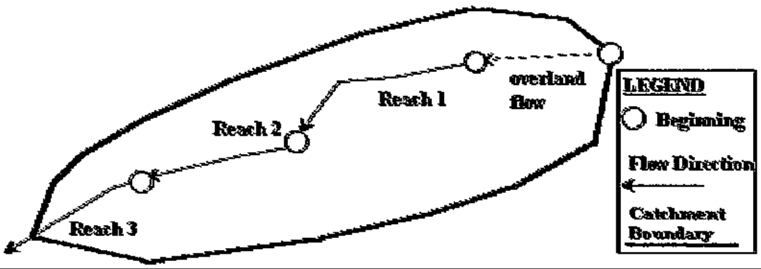
II. Rainfall Information I (inch/hr) = C1 * P1 /(C2 + Td)^C3

Design Storm Return Period, Tr =	5 years	(input return period for design storm)
C1 =	28.50	(input the value of C1)
C2=	10.00	(input the value of C2)
C3=	0.786	(input the value of C3)
P1=	1.55 inches	(input one-hr precipitation--see Sheet "Design Info")

III. Analysis of Flow Time (Time of Concentration) for a Catchment

Runoff Coefficient, C = 0.82
Overide Runoff Coefficient, C = ______ (enter an overide C value if desired, or leave blank to accept calculated C.)
5-yr. Runoff Coefficient, C-5 = 0.82
Overide 5-yr. Runoff Coefficient, C = ______ (enter an overide C-5 value if desired, or leave blank to accept calculated C-5.)

Illustration



NRCS Land Type	Heavy Meadow	Tillage/ Field	Short Pasture/ Lawns	Nearly Bare Ground	Grassed Swales/ Waterways	Paved Areas & Shallow Paved Swales (Sheet Flow)
Conveyance	2.5	5	7	10	15	20

Calculations:

Reach ID	Slope S ft/ft input	Length L ft input	5-yr Runoff Coeff C-5 output	NRCS Convey-ance input	Flow Velocity V fps output	Flow Time Tf minutes output
Overland	0.0230	300	0.82		0.75	6.68
1	0.0130	702		20.00	2.28	5.13
2						
3						
4						
5						
Sum		1,002			Computed Tc =	11.81
					Regional Tc =	15.57

IV.

Peak Runoff Prediction using Computed Tc	ediction using Regional Tc
Rainfall Intensity at Tc, I = 3.92 inch/hr	Rainfall Intensity at Tc, I = 3.46 inch/hr
Peak Flowrate, Qp = 61.60 cfs	Peak Flowrate, Qp = 54.36 cfs

CALCULATION OF A PEAK RUNOFF USING RATIONAL METHOD

Project Title: COSA
Catchment ID: 300

I. Catchment Hydrologic Data

Catchment ID = 300
Area = 89.60 Acres
Percent Imperviousness = 2.08 %
NRCS Soil Type = B A, B, C, or D

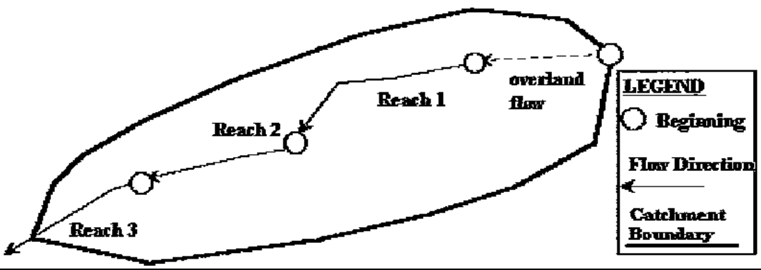
II. Rainfall Information I (inch/hr) = C1 * P1 /(C2 + Td)^C3

Design Storm Return Period, Tr = 5 years (input return period for design storm)
C1 = 28.50 (input the value of C1)
C2= 10.00 (input the value of C2)
C3= 0.786 (input the value of C3)
P1= 1.55 inches (input one-hr precipitation--see Sheet "Design Info")

III. Analysis of Flow Time (Time of Concentration) for a Catchment

Runoff Coefficient, C = 0.08
Overide Runoff Coefficient, C = (enter an overide C value if desired, or leave blank to accept calculated C.)
5-yr. Runoff Coefficient, C-5 = 0.08
Overide 5-yr. Runoff Coefficient, C = (enter an overide C-5 value if desired, or leave blank to accept calculated C-5.)

Illustration



NRCS Land Type	Heavy Meadow	Tillage/ Field	Short Pasture/ Lawns	Nearly Bare Ground	Grassed Swales/ Waterways	Paved Areas & Shallow Paved Swales (Sheet Flow)
Conveyance	2.5	5	7	10	15	20

Calculations:

Reach ID	Slope S ft/ft	Length L ft	5-yr Runoff Coeff C-5	NRCS Convey-ance	Flow Velocity V fps	Flow Time Tf minutes
	input	input	output	input	output	output
Overland	0.0400	300	0.08		0.25	20.15
1	0.0206	2,645		7.00	1.00	43.88
2						
3						
4						
5						
Sum		2,945			Computed Tc =	64.03
					Regional Tc =	26.36

IV.

Peak Runoff Prediction using Computed Tc	edliction using Regional Tc
Rainfall Intensity at Tc, I = 1.50 inch/hr	Rainfall Intensity at Tc, I = 2.62 inch/hr
Peak Flowrate, Qp = 10.99 cfs	Peak Flowrate, Qp = 19.22 cfs

CALCULATION OF A PEAK RUNOFF USING RATIONAL METHOD

Project Title: COSA
Catchment ID: 450

I. Catchment Hydrologic Data

Catchment ID = 450
Area = 83.20 Acres
Percent Imperviousness = 74.47 %
NRCS Soil Type = B A, B, C, or D

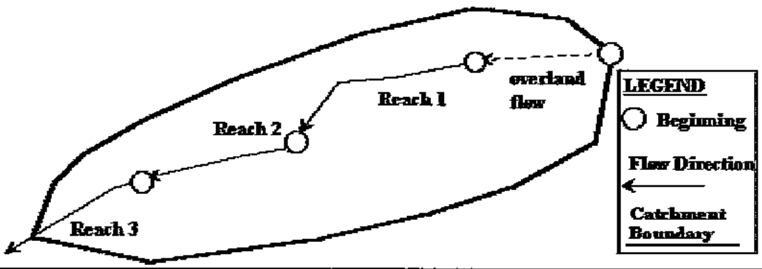
II. Rainfall Information I (inch/hr) = C1 * P1 /(C2 + Td)^C3

Design Storm Return Period, Tr = 5 years (input return period for design storm)
C1 = 28.50 (input the value of C1)
C2= 10.00 (input the value of C2)
C3= 0.786 (input the value of C3)
P1= 1.55 inches (input one-hr precipitation--see Sheet "Design Info")

III. Analysis of Flow Time (Time of Concentration) for a Catchment

Runoff Coefficient, C = 0.53
Overide Runoff Coefficient, C = (enter an overide C value if desired, or leave blank to accept calculated C.)
5-yr. Runoff Coefficient, C-5 = 0.53
Overide 5-yr. Runoff Coefficient, C = (enter an overide C-5 value if desired, or leave blank to accept calculated C-5.)

Illustration



NRCS Land Type	Heavy Meadow	Tillage/ Field	Short Pasture/ Lawns	Nearly Bare Ground	Grassed Swales/ Waterways	Paved Areas & Shallow Paved Swales (Sheet Flow)
Conveyance	2.5	5	7	10	15	20

Calculations:

Reach ID	Slope S ft/ft input	Length L ft input	5-yr Runoff Coeff C-5 output	NRCS Convey- ance input	Flow Velocity V fps output	Flow Time Tf minutes output
Overland	0.0270	300	0.53		0.39	12.75
1	0.0270	710		7.00	1.15	10.29
2	0.0150	1,014		20.00	2.45	6.90
3						
4						
5						
Sum		2,024			Computed Tc =	29.94
					Regional Tc =	21.24

IV.

Peak Runoff Prediction using Computed Tc	ediction using Regional Tc
Rainfall Intensity at Tc, I = 2.44 inch/hr	Rainfall Intensity at Tc, I = 2.95 inch/hr
Peak Flowrate, Qp = 108.23 cfs	Peak Flowrate, Qp = 131.26 cfs

CALCULATION OF A PEAK RUNOFF USING RATIONAL METHOD

Project Title: COSA
Catchment ID: 451

I. Catchment Hydrologic Data

Catchment ID = 451
Area = 25.60 Acres
Percent Imperviousness = 83.31 %
NRCS Soil Type = B A, B, C, or D

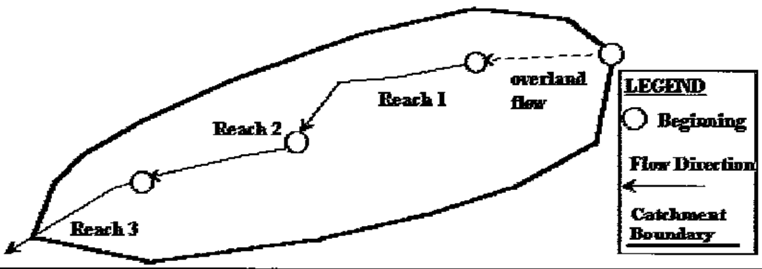
II. Rainfall Information I (inch/hr) = C1 * P1 /(C2 + Td)^C3

Design Storm Return Period, Tr = 5 years (input return period for design storm)
C1 = 28.50 (input the value of C1)
C2= 10.00 (input the value of C2)
C3= 0.786 (input the value of C3)
P1= 1.55 inches (input one-hr precipitation--see Sheet "Design Info")

III. Analysis of Flow Time (Time of Concentration) for a Catchment

Runoff Coefficient, C = 0.63
Overide Runoff Coefficient, C = (enter an overide C value if desired, or leave blank to accept calculated C.)
5-yr. Runoff Coefficient, C-5 = 0.63
Overide 5-yr. Runoff Coefficient, C = (enter an overide C-5 value if desired, or leave blank to accept calculated C-5.)

Illustration



NRCS Land Type	Heavy Meadow	Tillage/ Field	Short Pasture/ Lawns	Nearly Bare Ground	Grassed Swales/ Waterways	Paved Areas & Shallow Paved Swales (Sheet Flow)
Conveyance	2.5	5	7	10	15	20

Calculations:

Reach ID	Slope S	Length L	5-yr Runoff Coeff	NRCS Convey- ance	Flow Velocity V	Flow Time Tf
	ft/ft	ft	C-5		fps	minutes
	input	input	output	input	output	output
Overland	0.0400	300	0.63		0.54	9.21
1	0.0400	788		20.00	4.00	3.28
2						
3						
4						
5						
Sum		1,088				

Computed Tc = 12.50
Regional Tc = 16.04

IV.

Peak Runoff Prediction using Computed Tc	ediction using Regional Tc
Rainfall Intensity at Tc, I = 3.82 inch/hr	Rainfall Intensity at Tc, I = 3.41 inch/hr
Peak Flowrate, Qp = 62.10 cfs	Peak Flowrate, Qp = 55.35 cfs

CALCULATION OF A PEAK RUNOFF USING RATIONAL METHOD

Project Title: COSA
Catchment ID: 525

I. Catchment Hydrologic Data

Catchment ID = 525
Area = 32.00 Acres
Percent Imperviousness = 27.24 %
NRCS Soil Type = B A, B, C, or D

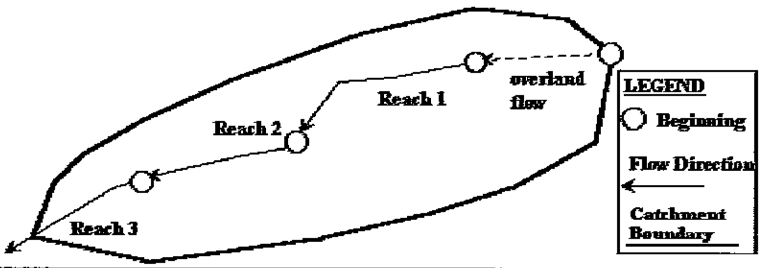
II. Rainfall Information I (inch/hr) = C1 * P1 /(C2 + Td)^C3

Design Storm Return Period, Tr = 5 years (input return period for design storm)
C1 = 28.50 (input the value of C1)
C2= 10.00 (input the value of C2)
C3= 0.786 (input the value of C3)
P1= 1.55 inches (input one-hr precipitation--see Sheet "Design Info")

III. Analysis of Flow Time (Time of Concentration) for a Catchment

Runoff Coefficient, C = 0.23
Overide Runoff Coefficient, C = (enter an overide C value if desired, or leave blank to accept calculated C.)
5-yr. Runoff Coefficient, C-5 = 0.23
Overide 5-yr. Runoff Coefficient, C = (enter an overide C-5 value if desired, or leave blank to accept calculated C-5.)

Illustration



NRCS Land Type	Heavy Meadow	Tillage/ Field	Short Pasture/ Lawns	Nearly Bare Ground	Grassed Swales/ Waterways	Paved Areas & Shallow Paved Swales (Sheet Flow)
Conveyance	2.5	5	7	10	15	20

Calculations:

Reach ID	Slope S ft/ft input	Length L ft input	5-yr Runoff Coeff C-5 output	NRCS Convey-ance input	Flow Velocity V fps output	Flow Time Tf minutes output
Overland	0.0120	300	0.23		0.20	25.48
1	0.0260	628		7.00	1.13	9.27
2						
3						
4						
5						
Sum		928			Computed Tc =	34.75
					Regional Tc =	15.16

IV.

Peak Runoff Prediction using Computed Tc	ediction using Regional Tc
Rainfall Intensity at Tc, I = 2.23 inch/hr	Rainfall Intensity at Tc, I = 3.50 inch/hr
Peak Flowrate, Qp = 16.73 cfs	Peak Flowrate, Qp = 26.31 cfs

CALCULATION OF A PEAK RUNOFF USING RATIONAL METHOD

Project Title: COSA
Catchment ID: 550

I. Catchment Hydrologic Data

Catchment ID = 550
Area = 83.20 Acres
Percent Imperviousness = 46.60 %
NRCS Soil Type = B A, B, C, or D

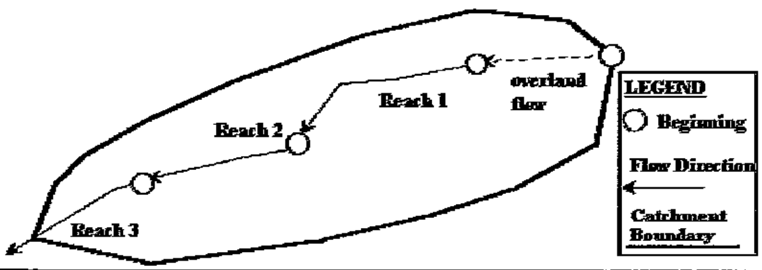
II. Rainfall Information I (inch/hr) = C1 * P1 /(C2 + Td)^C3

Design Storm Return Period, Tr =	5	years	(input return period for design storm)
C1 =	28.50		(input the value of C1)
C2=	10.00		(input the value of C2)
C3=	0.786		(input the value of C3)
P1=	1.55	inches	(input one-hr precipitation--see Sheet "Design Info")

III. Analysis of Flow Time (Time of Concentration) for a Catchment

Runoff Coefficient, C = 0.33
Overide Runoff Coefficient, C = ______ (enter an overide C value if desired, or leave blank to accept calculated C.)
5-yr. Runoff Coefficient, C-5 = 0.33
Overide 5-yr. Runoff Coefficient, C = ______ (enter an overide C-5 value if desired, or leave blank to accept calculated C-5.)

Illustration



NRCS Land Type	Heavy Meadow	Tillage/ Field	Short Pasture/ Lawns	Nearly Bare Ground	Grassed Swales/ Waterways	Paved Areas & Shallow Paved Swales (Sheet Flow)
Conveyance	2.5	5	7	10	15	20

Calculations:

Reach ID	Slope S ft/ft input	Length L ft input	5-yr Runoff Coeff C-5 output	NRCS Convey-ance input	Flow Velocity V fps output	Flow Time Tf minutes output
Overland	0.0330	300	0.33		0.31	16.22
1	0.0214	2,401		20.00	2.93	13.68
2	0.0519	270		20.00	4.56	0.99
3						
4						
5						
Sum		2,971			Computed Tc =	30.89
					Regional Tc =	26.51

IV.

Peak Runoff Prediction using Computed Tc		edicton using Regional Tc	
Rainfall Intensity at Tc, I =	2.39 inch/hr	Rainfall Intensity at Tc, I =	2.61 inch/hr
Peak Flowrate, Qp =	65.80 cfs	Peak Flowrate, Qp =	71.93 cfs

CALCULATION OF A PEAK RUNOFF USING RATIONAL METHOD

Project Title: COSA
Catchment ID: 551

I. Catchment Hydrologic Data

Catchment ID = 551
Area = 38.40 Acres
Percent Imperviousness = 79.10 %
NRCS Soil Type = B A, B, C, or D

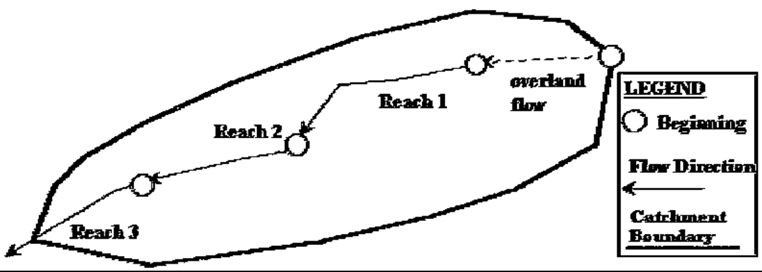
II. Rainfall Information I (inch/hr) = C1 * P1 /(C2 + Td)^C3

Design Storm Return Period, Tr = 5 years (input return period for design storm)
C1 = 28.50 (input the value of C1)
C2= 10.00 (input the value of C2)
C3= 0.786 (input the value of C3)
P1= 1.55 inches (input one-hr precipitation--see Sheet "Design Info")

III. Analysis of Flow Time (Time of Concentration) for a Catchment

Runoff Coefficient, C = 0.58
Overide Runoff Coefficient, C = (enter an overide C value if desired, or leave blank to accept calculated C.)
5-yr. Runoff Coefficient, C-5 = 0.58
Overide 5-yr. Runoff Coefficient, C = (enter an overide C-5 value if desired, or leave blank to accept calculated C-5.)

Illustration



NRCS Land Type	Heavy Meadow	Tillage/ Field	Short Pasture/ Lawns	Nearly Bare Ground	Grassed Swales/ Waterways	Paved Areas & Shallow Paved Swales (Sheet Flow)
Conveyance	2.5	5	7	10	15	20

Calculations:

Reach ID	Slope S	Length L	5-yr Runoff Coeff	NRCS Convey-ance	Flow Velocity V	Flow Time Tf
	ft/ft	ft	C-5		fps	minutes
	input	input	output	input	output	output
Overland	0.0080	300	0.58		0.29	17.37
1	0.0200	750		20.00	2.83	4.42
2	0.0200	513		7.00	0.99	8.64
3						
4						
5						
Sum		1,563			Computed Tc =	30.43
					Regional Tc =	18.68

IV.

Peak Runoff Prediction using Computed Tc	ediction using Regional Tc
Rainfall Intensity at Tc, I = 2.41 inch/hr	Rainfall Intensity at Tc, I = 3.16 inch/hr
Peak Flowrate, Qp = 54.08 cfs	Peak Flowrate, Qp = 70.82 cfs

CALCULATION OF A PEAK RUNOFF USING RATIONAL METHOD

Project Title: COSA
Catchment ID: 600

I. Catchment Hydrologic Data

Catchment ID = 600
Area = 38.40 Acres
Percent Imperviousness = 72.35 %
NRCS Soil Type = B A, B, C, or D

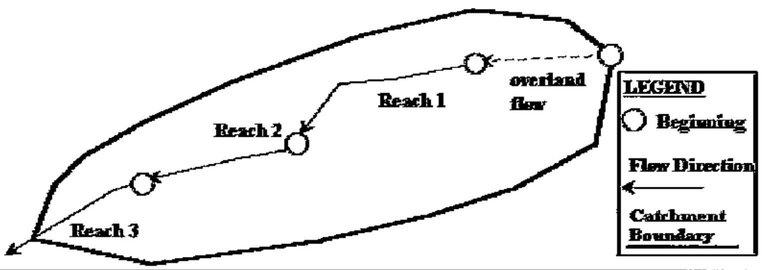
II. Rainfall Information I (inch/hr) = C1 * P1 /(C2 + Td)^C3

Design Storm Return Period, Tr =	5	years	(input return period for design storm)
C1 =	28.50		(input the value of C1)
C2=	10.00		(input the value of C2)
C3=	0.786		(input the value of C3)
P1=	1.55	inches	(input one-hr precipitation--see Sheet "Design Info")

III. Analysis of Flow Time (Time of Concentration) for a Catchment

Runoff Coefficient, C = 0.51
Overide Runoff Coefficient, C = (enter an overide C value if desired, or leave blank to accept calculated C.)
5-yr. Runoff Coefficient, C-5 = 0.51
Overide 5-yr. Runoff Coefficient, C = (enter an overide C-5 value if desired, or leave blank to accept calculated C-5.)

Illustration



NRCS Land Type	Heavy Meadow	Tillage/ Field	Short Pasture/ Lawns	Nearly Bare Ground	Grassed Swales/ Waterways	Paved Areas & Shallow Paved Swales (Sheet Flow)
Conveyance	2.5	5	7	10	15	20

Calculations:

Reach ID	Slope S ft/ft input	Length L ft input	5-yr Runoff Coeff C-5 output	NRCS Convey-ance input	Flow Velocity V fps output	Flow Time Tf minutes output
Overland	0.0670	300	0.51		0.51	9.79
1	0.0100	1,461		20.00	2.00	12.18
2	0.0100	160		7.00	0.70	3.81
3						
4						
5						
Sum		1,921			Computed Tc =	25.78
					Regional Tc =	20.67

IV.

Peak Runoff Prediction using Computed Tc		ediction using Regional Tc	
Rainfall Intensity at Tc, I =	2.65 inch/hr	Rainfall Intensity at Tc, I =	3.00 inch/hr
Peak Flowrate, Qp =	52.34 cfs	Peak Flowrate, Qp =	59.07 cfs

CALCULATION OF A PEAK RUNOFF USING RATIONAL METHOD

Project Title: COSA
Catchment ID: 625

I. Catchment Hydrologic Data

Catchment ID = 625
Area = 19.20 Acres
Percent Imperviousness = 76.02 %
NRCS Soil Type = B A, B, C, or D

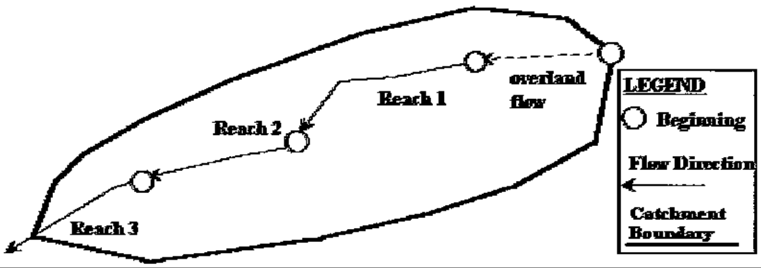
II. Rainfall Information I (inch/hr) = C1 * P1 /(C2 + Td)^C3

Design Storm Return Period, Tr = 5 years (input return period for design storm)
C1 = 28.50 (input the value of C1)
C2= 10.00 (input the value of C2)
C3= 0.786 (input the value of C3)
P1= 1.55 inches (input one-hr precipitation--see Sheet "Design Info")

III. Analysis of Flow Time (Time of Concentration) for a Catchment

Runoff Coefficient, C = 0.55
Overide Runoff Coefficient, C = (enter an overide C value if desired, or leave blank to accept calculated C.)
5-yr. Runoff Coefficient, C-5 = 0.55
Overide 5-yr. Runoff Coefficient, C = (enter an overide C-5 value if desired, or leave blank to accept calculated C-5.)

Illustration



NRCS Land Type	Heavy Meadow	Tillage/ Field	Short Pasture/ Lawns	Nearly Bare Ground	Grassed Swales/ Waterways	Paved Areas & Shallow Paved Swales (Sheet Flow)
Conveyance	2.5	5	7	10	15	20

Calculations:

Reach ID	Slope S ft/ft input	Length L ft input	5-yr Runoff Coeff C-5 output	NRCS Convey-ance input	Flow Velocity V fps output	Flow Time Tf minutes output
Overland	0.0400	300	0.55		0.46	10.88
1	0.0100	573		20.00	2.00	4.78
2						
3						
4						
5						
Sum		873				

Computed Tc = 15.66
Regional Tc = 14.85

IV.

Peak Runoff Prediction using Computed Tc	**ediction using Regional Tc**
Rainfall Intensity at Tc, I = 3.45 inch/hr	Rainfall Intensity at Tc, I = 3.54 inch/hr
Peak Flowrate, Qp = 36.42 cfs	Peak Flowrate, Qp = 37.35 cfs

CALCULATION OF A PEAK RUNOFF USING RATIONAL METHOD

Project Title: COSA
Catchment ID: 675

I. Catchment Hydrologic Data

Catchment ID = 675
Area = 70.40 Acres
Percent Imperviousness = 46.14 %
NRCS Soil Type = B A, B, C, or D

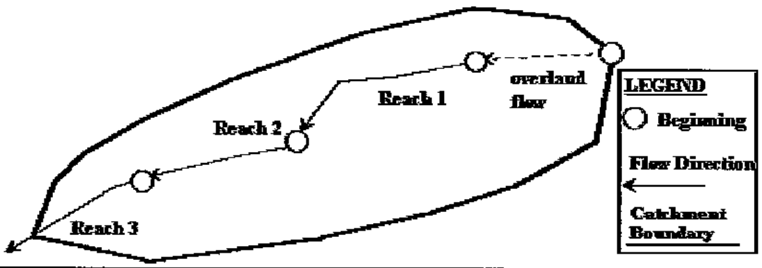
II. Rainfall Information I (inch/hr) = C1 * P1 /(C2 + Td)^C3

Design Storm Return Period, Tr = 5 years (input return period for design storm)
C1 = 28.50 (input the value of C1)
C2= 10.00 (input the value of C2)
C3= 0.786 (input the value of C3)
P1= 1.55 inches (input one-hr precipitation--see Sheet "Design Info")

III. Analysis of Flow Time (Time of Concentration) for a Catchment

Runoff Coefficient, C = 0.33
Overide Runoff Coefficient, C = ______ (enter an overide C value if desired, or leave blank to accept calculated C.)
5-yr. Runoff Coefficient, C-5 = 0.33
Overide 5-yr. Runoff Coefficient, C = ______ (enter an overide C-5 value if desired, or leave blank to accept calculated C-5.)

Illustration



NRCS Land Type	Heavy Meadow	Tillage/ Field	Short Pasture/ Lawns	Nearly Bare Ground	Grassed Swales/ Waterways	Paved Areas & Shallow Paved Swales (Sheet Flow)
Conveyance	2.5	5	7	10	15	20

Calculations:

Reach ID	Slope S ft/ft input	Length L ft input	5-yr Runoff Coeff C-5 output	NRCS Convey-ance input	Flow Velocity V fps output	Flow Time Tf minutes output
Overland	0.0100	300	0.33		0.21	24.13
1	0.0085	3,840		15.00	1.38	46.28
2				pipe		
3						
4						
5						
Sum		4,140				

Computed Tc = 70.41
Regional Tc = 33.00

IV.

Peak Runoff Prediction using Computed Tc	edliction using Regional Tc
Rainfall Intensity at Tc, I = 1.40 inch/hr	Rainfall Intensity at Tc, I = 2.30 inch/hr
Peak Flowrate, Qp = 32.48 cfs	Peak Flowrate, Qp = 53.12 cfs

CALCULATION OF A PEAK RUNOFF USING RATIONAL METHOD

Project Title: COSA
Catchment ID: 685

I. Catchment Hydrologic Data

Catchment ID = 685
Area = 57.60 Acres
Percent Imperviousness = 20.97 %
NRCS Soil Type = B A, B, C, or D

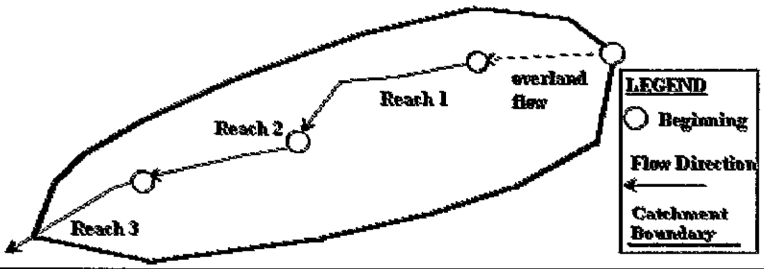
II. Rainfall Information I (inch/hr) = C1 * P1 /(C2 + Td)^C3

Design Storm Return Period, Tr = 5 years (input return period for design storm)
C1 = 28.50 (input the value of C1)
C2= 10.00 (input the value of C2)
C3= 0.786 (input the value of C3)
P1= 1.55 inches (input one-hr precipitation--see Sheet "Design Info")

III. Analysis of Flow Time (Time of Concentration) for a Catchment

Runoff Coefficient, C = 0.20
Overide Runoff Coefficient, C = (enter an overide C value if desired, or leave blank to accept calculated C.)
5-yr. Runoff Coefficient, C-5 = 0.20
Overide 5-yr. Runoff Coefficient, C = (enter an overide C-5 value if desired, or leave blank to accept calculated C-5.)

Illustration



NRCS Land Type	Heavy Meadow	Tillage/ Field	Short Pasture/ Lawns	Nearly Bare Ground	Grassed Swales/ Waterways	Paved Areas & Shallow Paved Swales (Sheet Flow)
Conveyance	2.5	5	7	10	15	20

Calculations:

Reach ID	Slope S ft/ft input	Length L ft input	5-yr Runoff Coeff C-5 output	NRCS Convey-ance input	Flow Velocity V fps output	Flow Time Tf minutes output
Overland	0.0200	300	0.20		0.22	22.33
1	0.0056	4,696		15.00	1.12	69.73
2						
3						
4						
5						
Sum		4,996				

Computed Tc = 92.06
Regional Tc = 37.76

IV.

Peak Runoff Prediction using Computed Tc	**ediction using Regional Tc**
Rainfall Intensity at Tc, I = 1.16 inch/hr	Rainfall Intensity at Tc, I = 2.12 inch/hr
Peak Flowrate, Qp = 13.57 cfs	Peak Flowrate, Qp = 24.66 cfs

CALCULATION OF A PEAK RUNOFF USING RATIONAL METHOD

Project Title: COSA
Catchment ID: 700

I. Catchment Hydrologic Data

Catchment ID = 700
Area = 70.40 Acres
Percent Imperviousness = 18.44 %
NRCS Soil Type = B A, B, C, or D

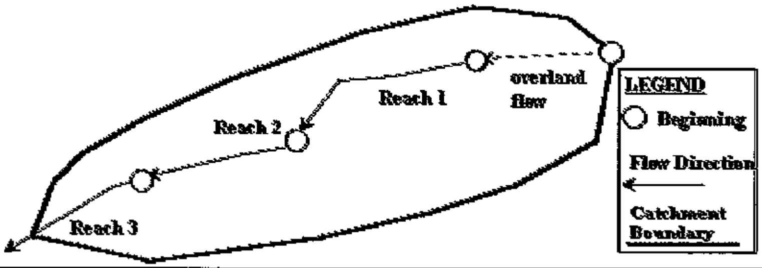
II. Rainfall Information I (inch/hr) = C1 * P1 /(C2 + Td)^C3

Design Storm Return Period, Tr =	5 years	(input return period for design storm)
C1 =	28.50	(input the value of C1)
C2=	10.00	(input the value of C2)
C3=	0.786	(input the value of C3)
P1=	1.55 inches	(input one-hr precipitation--see Sheet "Design Info")

III. Analysis of Flow Time (Time of Concentration) for a Catchment

Runoff Coefficient, C = 0.19
Overide Runoff Coefficient, C = (enter an overide C value if desired, or leave blank to accept calculated C.)
5-yr. Runoff Coefficient, C-5 = 0.19
Overide 5-yr. Runoff Coefficient, C = (enter an overide C-5 value if desired, or leave blank to accept calculated C-5.)

Illustration



NRCS Land Type	Heavy Meadow	Tillage/ Field	Short Pasture/ Lawns	Nearly Bare Ground	Grassed Swales/ Waterways	Paved Areas & Shallow Paved Swales (Sheet Flow)
Conveyance	2.5	5	7	10	15	20

Calculations:

Reach ID	Slope S	Length L	5-yr Runoff Coeff	NRCS Convey-ance	Flow Velocity V	Flow Time Tf
	ft/ft	ft	C-5		fps	minutes
	input	input	output	input	output	output
Overland	0.0130	300	0.19		0.19	26.14
1	0.0220	3,310		7.00	1.04	53.13
2						
3						
4						
5						
Sum		3,610			Computed Tc =	79.28
					Regional Tc =	30.06

IV.

Peak Runoff Prediction using Computed Tc	**ediction using Regional Tc**
Rainfall Intensity at Tc, I = 1.29 inch/hr	Rainfall Intensity at Tc, I = 2.43 inch/hr
Peak Flowrate, Qp = 17.16 cfs	Peak Flowrate, Qp = 32.21 cfs

CALCULATION OF A PEAK RUNOFF USING RATIONAL METHOD

Project Title: COSA
Catchment ID: 750

I. Catchment Hydrologic Data

Catchment ID = 750
Area = 64.00 Acres
Percent Imperviousness = 82.43 %
NRCS Soil Type = B A, B, C, or D

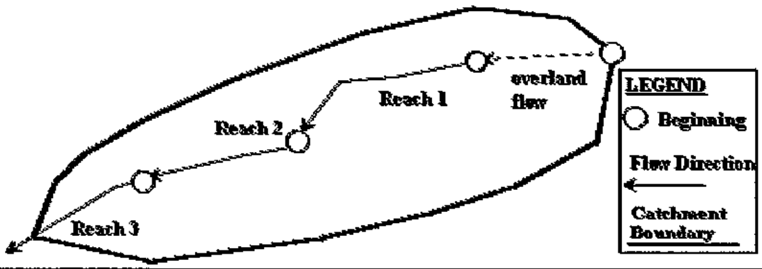
II. Rainfall Information I (inch/hr) = C1 * P1 /(C2 + Td)^C3

Design Storm Return Period, Tr = 5 years (input return period for design storm)
C1 = 28.50 (input the value of C1)
C2= 10.00 (input the value of C2)
C3= 0.786 (input the value of C3)
P1= 1.55 inches (input one-hr precipitation--see Sheet "Design Info")

III. Analysis of Flow Time (Time of Concentration) for a Catchment

Runoff Coefficient, C = 0.62
Overide Runoff Coefficient, C = ____ (enter an overide C value if desired, or leave blank to accept calculated C.)
5-yr. Runoff Coefficient, C-5 = 0.62
Overide 5-yr. Runoff Coefficient, C = ____ (enter an overide C-5 value if desired, or leave blank to accept calculated C-5.)

Illustration



NRCS Land Type	Heavy Meadow	Tillage/ Field	Short Pasture/ Lawns	Nearly Bare Ground	Grassed Swales/ Waterways	Paved Areas & Shallow Paved Swales (Sheet Flow)
Conveyance	2.5	5	7	10	15	20

Calculations:

Reach ID	Slope S ft/ft input	Length L ft input	5-yr Runoff Coeff C-5 output	NRCS Convey-ance input	Flow Velocity V fps output	Flow Time Tf minutes output
Overland	0.0130	300	0.62		0.37	13.67
1	0.0250	2,952		20.00	3.16	15.56
2	0.0250	645		7.00	1.11	9.71
3						
4						
5						
Sum		3,897			Computed Tc =	38.94
					Regional Tc =	31.65

IV.

Peak Runoff Prediction using Computed Tc	**ediction using Regional Tc**
Rainfall Intensity at Tc, I = 2.08 inch/hr	Rainfall Intensity at Tc, I = 2.36 inch/hr
Peak Flowrate, Qp = 82.82 cfs	Peak Flowrate, Qp = 94.01 cfs

CALCULATION OF A PEAK RUNOFF USING RATIONAL METHOD

Project Title: COSA
Catchment ID: 800

I. Catchment Hydrologic Data

Catchment ID = 800
Area = 76.80 Acres
Percent Imperviousness = 72.23 %
NRCS Soil Type = B A, B, C, or D

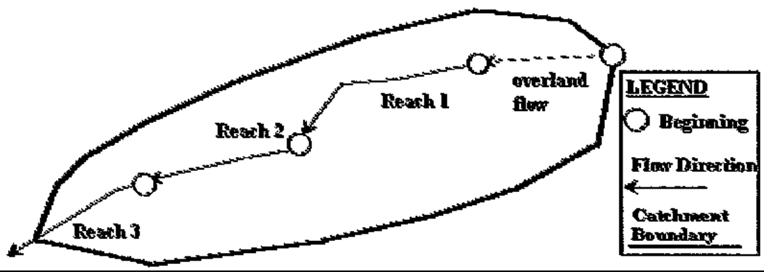
II. Rainfall Information I (inch/hr) = C1 * P1 /(C2 + Td)^C3

Design Storm Return Period, Tr = 5 years (input return period for design storm)
C1 = 28.50 (input the value of C1)
C2= 10.00 (input the value of C2)
C3= 0.786 (input the value of C3)
P1= 1.55 inches (input one-hr precipitation--see Sheet "Design Info")

III. Analysis of Flow Time (Time of Concentration) for a Catchment

Runoff Coefficient, C = 0.51
Overide Runoff Coefficient, C = (enter an overide C value if desired, or leave blank to accept calculated C.)
5-yr. Runoff Coefficient, C-5 = 0.51
Overide 5-yr. Runoff Coefficient, C = (enter an overide C-5 value if desired, or leave blank to accept calculated C-5.)

Illustration



NRCS Land Type	Heavy Meadow	Tillage/ Field	Short Pasture/ Lawns	Nearly Bare Ground	Grassed Swales/ Waterways	Paved Areas & Shallow Paved Swales (Sheet Flow)
Conveyance	2.5	5	7	10	15	20

Calculations:

Reach ID	Slope S	Length L	5-yr Runoff Coeff C-5	NRCS Convey-ance	Flow Velocity V	Flow Time Tf
	ft/ft	ft			fps	minutes
	input	input	output	input	output	output
Overland	0.0460	300	0.51		0.45	11.11
1	0.0500	1,114		20.00	4.47	4.15
2						
3						
4						
5						
Sum		1,414			Computed Tc =	15.26
					Regional Tc =	17.86

IV.

Peak Runoff Prediction using Computed Tc	ediction using Regional Tc
Rainfall Intensity at Tc, I = 3.49 inch/hr	Rainfall Intensity at Tc, I = 3.23 inch/hr
Peak Flowrate, Qp = 137.31 cfs	Peak Flowrate, Qp = 127.15 cfs

CALCULATION OF A PEAK RUNOFF USING RATIONAL METHOD

Project Title: COSA
Catchment ID: 825

I. Catchment Hydrologic Data

Catchment ID = 825
Area = 12.80 Acres
Percent Imperviousness = 100.00 %
NRCS Soil Type = B A, B, C, or D

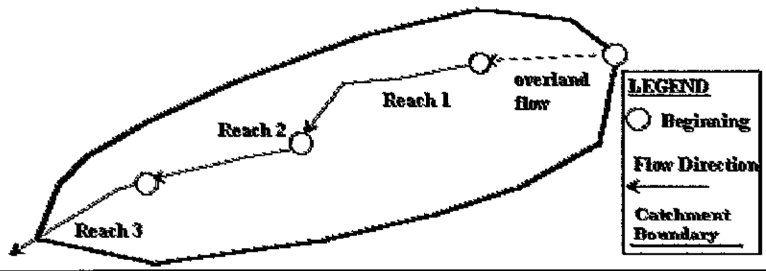
II. Rainfall Information I (inch/hr) = C1 * P1 /(C2 + Td)^C3

Design Storm Return Period, Tr = 5 years (input return period for design storm)
C1 = 28.50 (input the value of C1)
C2= 10.00 (input the value of C2)
C3= 0.786 (input the value of C3)
P1= 1.55 inches (input one-hr precipitation--see Sheet "Design Info")

III. Analysis of Flow Time (Time of Concentration) for a Catchment

Runoff Coefficient, C = 0.90
Overide Runoff Coefficient, C = (enter an overide C value if desired, or leave blank to accept calculated C.)
5-yr. Runoff Coefficient, C-5 = 0.90
Overide 5-yr. Runoff Coefficient, C = (enter an overide C-5 value if desired, or leave blank to accept calculated C-5.)

Illustration



NRCS Land Type	Heavy Meadow	Tillage/ Field	Short Pasture/ Lawns	Nearly Bare Ground	Grassed Swales/ Waterways	Paved Areas & Shallow Paved Swales (Sheet Flow)
Conveyance	2.5	5	7	10	15	20

Calculations:

Reach ID	Slope S	Length L	5-yr Runoff Coeff	NRCS Convey-ance	Flow Velocity V	Flow Time Tf
	ft/ft	ft	C-5		fps	minutes
	input	input	output	input	output	output
Overland	0.0400	300	0.90		1.24	4.05
1	0.0300	819		20.00	3.46	3.94
2						
3						
4						
5						
Sum		1,119			Computed Tc =	7.99
					Regional Tc =	16.22

IV.

Peak Runoff Prediction using Computed Tc	ediction using Regional Tc
Rainfall Intensity at Tc, I = 4.56 inch/hr	Rainfall Intensity at Tc, I = 3.39 inch/hr
Peak Flowrate, Qp = 52.24 cfs	Peak Flowrate, Qp = 38.86 cfs

CALCULATION OF A PEAK RUNOFF USING RATIONAL METHOD

Project Title: COSA
Catchment ID: 850

I. Catchment Hydrologic Data

Catchment ID = 850
Area = 83.20 Acres
Percent Imperviousness = 100.00 %
NRCS Soil Type = B A, B, C, or D

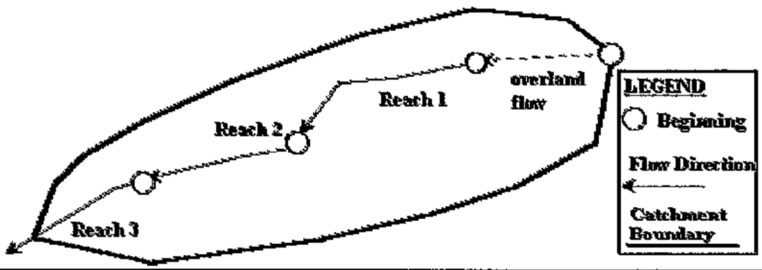
II. Rainfall Information I (inch/hr) = C1 * P1 /(C2 + Td)^C3

Design Storm Return Period, Tr = 5 years (input return period for design storm)
C1 = 28.50 (input the value of C1)
C2= 10.00 (input the value of C2)
C3= 0.786 (input the value of C3)
P1= 1.55 inches (input one-hr precipitation--see Sheet "Design Info")

III. Analysis of Flow Time (Time of Concentration) for a Catchment

Runoff Coefficient, C = 0.90
Overide Runoff Coefficient, C = (enter an overide C value if desired, or leave blank to accept calculated C.)
5-yr. Runoff Coefficient, C-5 = 0.90
Overide 5-yr. Runoff Coefficient, C = (enter an overide C-5 value if desired, or leave blank to accept calculated C-5.)

Illustration



NRCS Land Type	Heavy Meadow	Tillage/ Field	Short Pasture/ Lawns	Nearly Bare Ground	Grassed Swales/ Waterways	Paved Areas & Shallow Paved Swales (Sheet Flow)
Conveyance	2.5	5	7	10	15	20

Calculations:

Reach ID	Slope S	Length L	5-yr Runoff Coeff C-5	NRCS Convey-ance	Flow Velocity V	Flow Time Tf
	ft/ft	ft			fps	minutes
	input	input	output	input	output	output
Overland	0.0670	300	0.90		1.46	3.41
1	0.0200	3,034		20.00	2.83	17.88
2						
3						
4						
5						
Sum		3,334			Computed Tc =	21.29
					Regional Tc =	28.52

IV.

Peak Runoff Prediction using Computed Tc	**ediction using Regional Tc**
Rainfall Intensity at Tc, I = 2.95 inch/hr	Rainfall Intensity at Tc, I = 2.50 inch/hr
Peak Flowrate, Qp = 219.76 cfs	Peak Flowrate, Qp = 186.64 cfs

CALCULATION OF A PEAK RUNOFF USING RATIONAL METHOD

Project Title: COSA
Catchment ID: 875

I. Catchment Hydrologic Data

Catchment ID = 875
Area = 89.60 Acres
Percent Imperviousness = 94.14 %
NRCS Soil Type = B A, B, C, or D

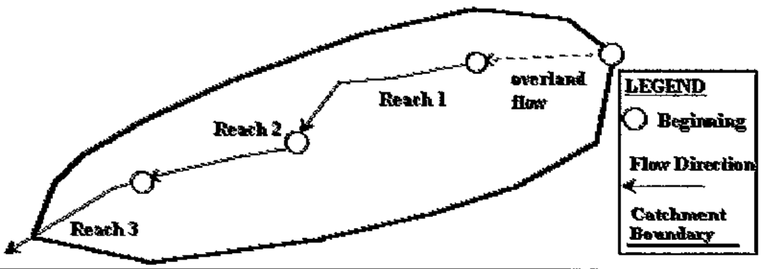
II. Rainfall Information I (inch/hr) = C1 * P1 /(C2 + Td)^C3

Design Storm Return Period, Tr = 5 years (input return period for design storm)
C1 = 28.50 (input the value of C1)
C2= 10.00 (input the value of C2)
C3= 0.786 (input the value of C3)
P1= 1.55 inches (input one-hr precipitation--see Sheet "Design Info")

III. Analysis of Flow Time (Time of Concentration) for a Catchment

Runoff Coefficient, C = 0.79
Overide Runoff Coefficient, C = ______ (enter an overide C value if desired, or leave blank to accept calculated C.)
5-yr. Runoff Coefficient, C-5 = 0.79
Overide 5-yr. Runoff Coefficient, C = ______ (enter an overide C-5 value if desired, or leave blank to accept calculated C-5.)

Illustration



NRCS Land Type	Heavy Meadow	Tillage/ Field	Short Pasture/ Lawns	Nearly Bare Ground	Grassed Swales/ Waterways	Paved Areas & Shallow Paved Swales (Sheet Flow)
Conveyance	2.5	5	7	10	15	20

Calculations:

Reach ID	Slope S ft/ft input	Length L ft input	5-yr Runoff Coeff C-5 output	NRCS Convey-ance input	Flow Velocity V fps output	Flow Time Tf minutes output
Overland	0.0130	300	0.79		0.57	8.84
1	0.0100	2,832		20.00	2.00	23.60
2						
3						
4						
5						
Sum		3,132			Computed Tc =	32.44
					Regional Tc =	27.40

IV.

Peak Runoff Prediction using Computed Tc	ediction using Regional Tc
Rainfall Intensity at Tc, I = 2.32 inch/hr	Rainfall Intensity at Tc, I = 2.56 inch/hr
Peak Flowrate, Qp = 164.71 cfs	Peak Flowrate, Qp = 181.91 cfs

CALCULATION OF A PEAK RUNOFF USING RATIONAL METHOD

Project Title: COSA
Catchment ID: 900

I. Catchment Hydrologic Data

Catchment ID = 900
Area = 44.80 Acres
Percent Imperviousness = 66.24 %
NRCS Soil Type = B A, B, C, or D

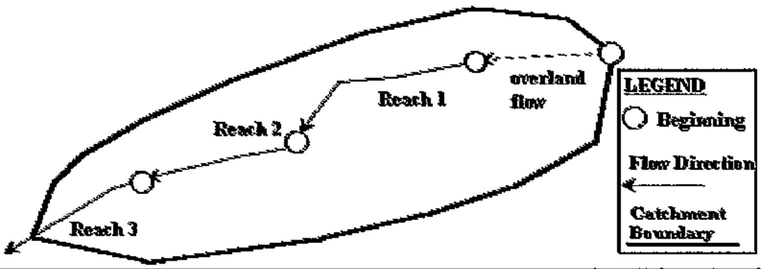
II. Rainfall Information I (inch/hr) = C1 * P1 /(C2 + Td)^C3

Design Storm Return Period, Tr = 5 years (input return period for design storm)
C1 = 28.50 (input the value of C1)
C2= 10.00 (input the value of C2)
C3= 0.786 (input the value of C3)
P1= 1.55 inches (input one-hr precipitation--see Sheet "Design Info")

III. Analysis of Flow Time (Time of Concentration) for a Catchment

Runoff Coefficient, C = 0.46
Overide Runoff Coefficient, C = ______ (enter an overide C value if desired, or leave blank to accept calculated C.)
5-yr. Runoff Coefficient, C-5 = 0.46
Overide 5-yr. Runoff Coefficient, C = ______ (enter an overide C-5 value if desired, or leave blank to accept calculated C-5.)

Illustration



NRCS Land Type	Heavy Meadow	Tillage/ Field	Short Pasture/ Lawns	Nearly Bare Ground	Grassed Swales/ Waterways	Paved Areas & Shallow Paved Swales (Sheet Flow)
Conveyance	2.5	5	7	10	15	20

Calculations:

Reach ID	Slope S	Length L	5-yr Runoff Coeff C-5	NRCS Convey-ance	Flow Velocity V	Flow Time Tf
	ft/ft	ft			fps	minutes
	input	input	output	input	output	output
Overland	0.0130	300	0.46		0.27	18.37
1	0.0275	963		20.00	3.32	4.84
2	0.0275	623		15.00	2.49	4.17
3						
4						
5						
Sum		1,886			Computed Tc =	27.39
					Regional Tc =	20.48

IV.

Peak Runoff Prediction using Computed Tc	ediction using Regional Tc
Rainfall Intensity at Tc, I = 2.56 inch/hr	Rainfall Intensity at Tc, I = 3.01 inch/hr
Peak Flowrate, Qp = 52.78 cfs	Peak Flowrate, Qp = 61.97 cfs

CALCULATION OF A PEAK RUNOFF USING RATIONAL METHOD

Project Title: COSA
Catchment ID: 925

I. Catchment Hydrologic Data

Catchment ID = 925
Area = 32.00 Acres
Percent Imperviousness = 100.00 %
NRCS Soil Type = B A, B, C, or D

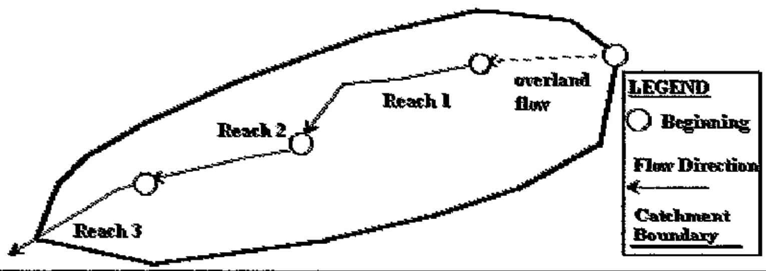
II. Rainfall Information I (inch/hr) = C1 * P1 /(C2 + Td)^C3

Design Storm Return Period, Tr = 5 years (input return period for design storm)
C1 = 28.50 (input the value of C1)
C2= 10.00 (input the value of C2)
C3= 0.786 (input the value of C3)
P1= 1.55 inches (input one-hr precipitation--see Sheet "Design Info")

III. Analysis of Flow Time (Time of Concentration) for a Catchment

Runoff Coefficient, C = 0.90
Overide Runoff Coefficient, C = ______ (enter an overide C value if desired, or leave blank to accept calculated C.)
5-yr. Runoff Coefficient, C-5 = 0.90
Overide 5-yr. Runoff Coefficient, C = ______ (enter an overide C-5 value if desired, or leave blank to accept calculated C-5.)

Illustration



NRCS Land Type	Heavy Meadow	Tillage/ Field	Short Pasture/ Lawns	Nearly Bare Ground	Grassed Swales/ Waterways	Paved Areas & Shallow Paved Swales (Sheet Flow)
Conveyance	2.5	5	7	10	15	20

Calculations:

Reach ID	Slope S	Length L	5-yr Runoff Coeff C-5	NRCS Convey-ance	Flow Velocity V	Flow Time Tf
	ft/ft	ft			fps	minutes
	input	input	output	input	output	output
Overland	0.0300	300	0.90		1.12	4.45
1	0.0120	1,358		20.00	2.19	10.33
2						
3						
4						
5						
Sum		1,658			Computed Tc =	14.78
					Regional Tc =	19.21

IV.

Peak Runoff Prediction using Computed Tc	ediction using Regional Tc
Rainfall Intensity at Tc, I = 3.54 inch/hr	Rainfall Intensity at Tc, I = 3.11 inch/hr
Peak Flowrate, Qp = 101.53 cfs	Peak Flowrate, Qp = 89.22 cfs

CALCULATION OF A PEAK RUNOFF USING RATIONAL METHOD

Project Title: COSA
Catchment ID: 950

I. Catchment Hydrologic Data

Catchment ID = 950
Area = 76.80 Acres
Percent Imperviousness = 100.00 %
NRCS Soil Type = B A, B, C, or D

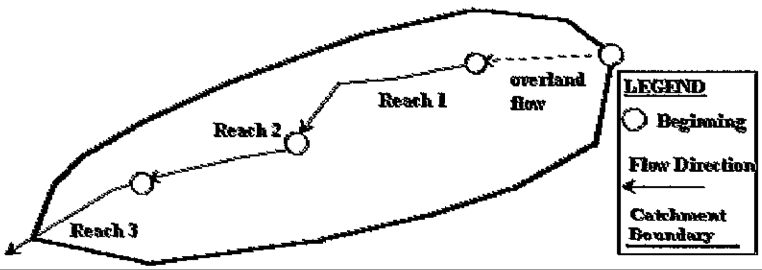
II. Rainfall Information I (inch/hr) = C1 * P1 /(C2 + Td)^C3

Design Storm Return Period, Tr = 5 years (input return period for design storm)
C1 = 28.50 (input the value of C1)
C2= 10.00 (input the value of C2)
C3= 0.786 (input the value of C3)
P1= 1.55 inches (input one-hr precipitation--see Sheet "Design Info")

III. Analysis of Flow Time (Time of Concentration) for a Catchment

Runoff Coefficient, C = 0.90
Overide Runoff Coefficient, C = (enter an overide C value if desired, or leave blank to accept calculated C.)
5-yr. Runoff Coefficient, C-5 = 0.90
Overide 5-yr. Runoff Coefficient, C = (enter an overide C-5 value if desired, or leave blank to accept calculated C-5.)

Illustration



NRCS Land Type	Heavy Meadow	Tillage/ Field	Short Pasture/ Lawns	Nearly Bare Ground	Grassed Swales/ Waterways	Paved Areas & Shallow Paved Swales (Sheet Flow)
Conveyance	2.5	5	7	10	15	20

Calculations:

Reach ID	Slope S	Length L	5-yr Runoff Coeff	NRCS Convey-ance	Flow Velocity V	Flow Time Tf
	ft/ft	ft	C-5		fps	minutes
	input	input	output	input	output	output
Overland	0.0100	300	0.90		0.78	6.40
1	0.0400	3,003		20.00	4.00	12.51
2						
3						
4						
5						
Sum		3,303			Computed Tc =	18.91
					Regional Tc =	28.35

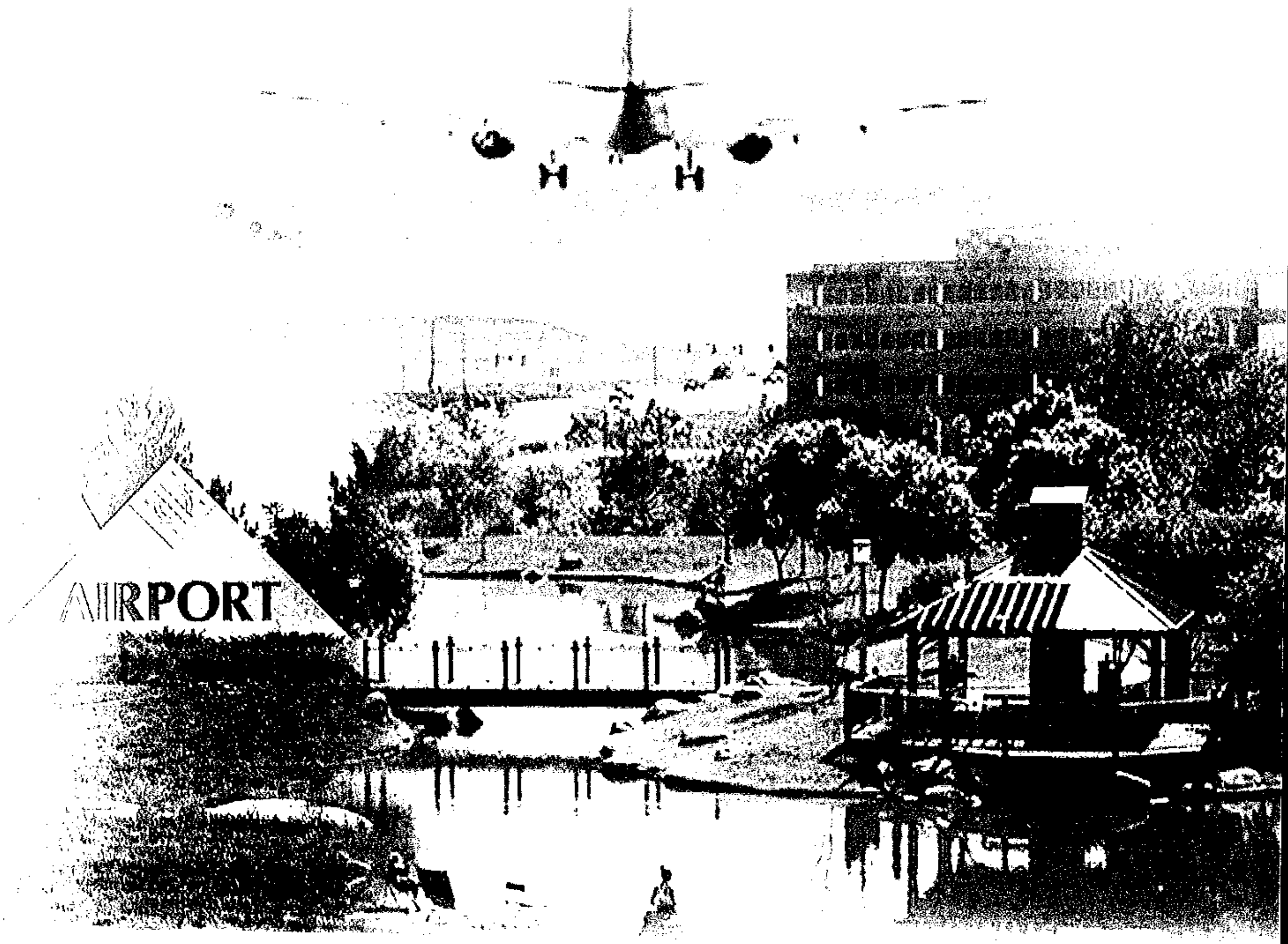
IV.

Peak Runoff Prediction using Computed Tc	ediction using Regional Tc
Rainfall Intensity at Tc, I = 3.14 inch/hr	Rainfall Intensity at Tc, I = 2.51 inch/hr
Peak Flowrate, Qp = 215.90 cfs	Peak Flowrate, Qp = 172.89 cfs

Windmill Gulch Tc Check, for basins less than 90 acres

Basin Number	Basin Length (ft)	Tc OL+Channelized flow (min)	Pipe Velocity (fps) 75% full	Pipe Length (ft)	Tc pipe flow (min)	Tc OL+S+pipe flow	Tc calculated (min)
450	2024	30.07				30.07	21.24
451	1088	12.04				12.04	16.04
525	928	34.75				34.75	15.16
550	2971	30.89				30.89	26.51
551	1563	31.49				31.49	18.68
600	1921	26.23				26.23	20.67
625	873	15.8				15.80	14.85
675	4986	70.41	9.91	846	1.4228	71.83	37.70
685	4996	92.06				92.06	37.76
700	3610	79.55				79.55	30.06
750	3897	38.99				38.99	31.65
800	1414	15.26				15.26	17.86
825	1119	7.99				7.99	16.22
850	3334	21.29				21.29	28.52
875	3132	32.51				32.51	27.40
900	1886	27.39				27.39	20.48
925	1658	14.78				14.78	19.21
950	3303	18.91				18.91	28.35

FUTURE CONDITION HYDROLOGY - CUHP INPUT AND OUTPUT



Appendix E

APPENDIX E

Future Conditions Hydrology – CUHP Input and Output

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1MOD_TAIL
1100-year, .013.013.013.017.017.017.017.017.017.017.017.017.017.017.017.029.029
1100-year, .029.037.037.037 .44 .44 .44 .44 .44 .44.051.051.051.051.051.051.036
1100-year, .036.036.036.036.036.029.029.029.029.029.029.029.029.029.029.029.029
1100-year, .022.022.022.022.022.022.022.022.022.022.022.022.022.022.022.022.022
1100-year, .022.022.022.022

81 1 1 5.        46451 aka 450B
 .04.2061.102683.31.0399 12.5   .4    .1   4.5.0018    .6
80 1 1 5.        40400
 .18.4543 .27452.14 .001        .4    .1   4.5.0018    .6
80 1 1 5.        50500
 .39.6284 .27930.59 .001        .4    .1   4.5.0018    .6
81 1 1 5.        60600
 .06.3638.198272.35.015720.67   .4    .1   4.5.0018    .6
81 1 1 5.        55550
 .13.5627.2814 46.6.025326.51   .4    .1   4.5.0018    .6
81 1 1 5.        70700
 .11.6837.294918.44.012230.06   .4    .1   4.5.0018    .6
81 1 1 5.        75750
  .1.7381.307882.43 .01531.65   .4    .1   4.5.0018    .6
81 1 1 5.        80800
 .12.2678 .12372.23.049215.26   .4    .1   4.5.0018    .6
81 1 1 5.        85850
 .13.6315.3617  98..016521.29   .4    .1   4.5.0018    .6
81 1 1 5.        90900
 .07.3572 .17566.24.012120.48   .4    .1   4.5.0018    .6
81 1 1 5.        95950
 .12.6255.2889  98..015418.91   .4    .1   4.5.0018    .6
81 1 1 5.        56551 aka 550B
 .06.2961.1899 79.1.021218.68   .4    .1   4.5.0018    .6
81 1 1 5.        87875
 .14.5931.162594.14.0188 27.4   .4    .1   4.5.0018    .6
81 1 1 5.        82825
 .02.2119.0942  98..0328 7.99   .4    .1   4.5.0018    .6
81 1 1 5.        92925
 .05.3141.1446  98..014314.78   .4    .1   4.5.0018    .6
81 1 1 5.        62625
 .03.1653.009976.02.019714.85   .4    .1   4.5.0018    .6
80 1 1 5.        65650
 .18.5824.287869.53.0157        .4    .1   4.5.0018    .6
80 1 1 5.        66660
 .31.6428.393992.74.0248        .4    .1   4.5.0018    .6
81 1 1 5.        45450
 .13.3833.178274.47.023221.24   .4    .1   4.5.0018    .6
81 1 1 5.        67675
 .11.9443.408846.14.0085 37.7   .4    .1   4.5.0018    .6
80 1 1 5.        72725
 .19.6468.2129 9.27.0101        .4    .1   4.5.0018    .6
81 1 1 5.        52525
 .05.1757.040527.24.032515.16   .4    .1   4.5.0018    .6
81 1 1 5.        68685
 .09.9462 .47220.97.006537.76   .4    .1   4.5.0018    .6
E
```

1 U.D.F.C.D. CUHP RUNOFF ANALYSIS EXECUTED ON DATE 5/23/2005 AT TIME 16:45

CUHPF/PC RELEASE 2A (32-BIT VER) SEPTEMBER 10, 1998

PRINT OPTION NUMBER SELECTED FOR THIS BASIN IS 8

IL

BASIN ID: -- BASIN COMMENT: 451 aka 450B

AREA (SQMI)	LENGTH OF BASIN (MI)	DIST TO CENTROID (MI)	IMPERV. AREA (PCT)	SLOPE (FT/FT)	UNIT DURATION (MIN)
0.04	0.21	0.10	83.31	0.0399	5.00

COEFFICIENT (REFLECTING TIME TO PEAK)	COEFFICIENT (RELATED TO PEAK RATE OF RUNOFF)
0.076	0.499

THIS BASIN USES TRADITIONAL DRAINAGE PRACTICES

FRACTION OF PERVIOUS AREA RECEIVING IMPERVIOUS DRAINAGE (DEFAULT)	FRACTION OF IMPERVIOUS AREA DIRECTLY CONNECTED TO DRAINAGE SYSTEM (DEFAULT)
R= 0.34	D= 1.00

CALCULATED UNIT HYDROGRAPH

TIME TO PEAK (MIN)	TIME OF CONCENTRATION (MIN)	PEAK RATE OF RUNOFF (CFS/SQMI)	UNIT HYDROGRAPH PEAK (CFS)	VOLUME OF RUNOFF (AF)
7.50	12.50	3833.04	153.32	2.13

*** NOTE : THE TIME TO PEAK IS CALCULATED BASED ON THE TIME OF CONCENTRATION PROVIDED BY THE USER, REPLACING THE ONE COMPUTED BY CUHPF (TP= 4.06)

WIDTH AT 50 = 8. MIN. WIDTH AT 75 = 4. MIN. K50 =0.35 K75 =0.45

RAINFALL LOSSES INPUT W/ BASIN DATA

MAX. PERVIOUS RET. =0.40 IN. MAX. IMPERVIOUS RET. =0.10 IN.
INFILTRATION = 4.50 IN./HR. DECAY = 0.00180/SECOND FNINFL = 0.60 IN./HR.

TIME	UNIT HYDROGRAPH	TIME	UNIT HYDROGRAPH	TIME	UNIT HYDROGRAPH
0.	0.	15.	55.	30.	0.
5.	86.	20.	27.	0.	0.
10.	111.	25.	14.	0.	0.

1 BASIN ID: -- BASIN COMMENT: 451 aka 450B

**** STORM NO. = 1 **** DATE OR RETURN PERIOD = 100-year,

TOTAL PRECIP. = 4.41 EXCESS PRECIP. = 3.738 INCHES
VOLUME OF EXCESS PRECIP = 7.98 ACRE-FEET
PEAK Q = 121. CFS TIME OF PEAK = 135. MIN.
INFILT.= 4.50 IN/HR DECAY =0.00180 FNINF = 0.60 IN/HR
MAX.PERV.RET.=0.40 IN. MAX.IMP.RET.=0.10 IN.

1 U.D.F.C.D. CUHP RUNOFF ANALYSIS EXECUTED ON DATE 5/23/2005 AT TIME 16:45

CUHPF/PC RELEASE 2A (32-BIT VER) SEPTEMBER 10, 1998

PRINT OPTION NUMBER SELECTED FOR THIS BASIN IS 8

IL

BASIN ID: -- BASIN COMMENT: 400

AREA (SQMI)	LENGTH OF BASIN (MI)	DIST TO CENTROID (MI)	IMPERV. AREA (PCT)	SLOPE (FT/FT)	UNIT DURATION (MIN)
0.18	0.45	0.27	52.14	0.0010	5.00

COEFFICIENT (REFLECTING TIME TO PEAK) COEFFICIENT (RELATED TO PEAK RATE OF RUNOFF)

0.087 0.496

THIS BASIN USES TRADITIONAL DRAINAGE PRACTICES

FRACTION OF PERVIOUS AREA RECEIVING IMPERVIOUS DRAINAGE (DEFAULT)	FRACTION OF IMPERVIOUS AREA DIRECTLY CONNECTED TO DRAINAGE SYSTEM (DEFAULT)
R= 0.23	D= 0.86

CALCULATED UNIT HYDROGRAPH

TIME TO PEAK (MIN)	PEAK RATE OF RUNOFF (CFS/SQMI)	UNIT HYDROGRAPH PEAK (CFS)	VOLUME OF RUNOFF (AF)
12.60	1885.17	339.33	9.60

WIDTH AT 50 = 16. MIN. WIDTH AT 75 = 8. MIN. K50 =0.35 K75 =0.45

RAINFALL LOSSES INPUT W/ BASIN DATA

MAX. PERVIOUS RET. =0.40 IN. MAX. IMPERVIOUS RET. =0.10 IN.
INFILTRATION = 4.50 IN./HR. DECAY = 0.00180/SECOND FNINFL = 0.60 IN./HR.

TIME	UNIT HYDROGRAPH	TIME	UNIT HYDROGRAPH	TIME	UNIT HYDROGRAPH
0.	0.	25.	147.	50.	26.
5.	96.	30.	104.	55.	19.
10.	300.	35.	74.	60.	13.
15.	313.	40.	52.	65.	9.
20.	213.	45.	37.	70.	0.

1 BASIN ID: -- BASIN COMMENT: 400

**** STORM NO. = 1 **** DATE OR RETURN PERIOD = 100-year,

TOTAL PRECIP. = 4.41 EXCESS PRECIP. = 2.982 INCHES
VOLUME OF EXCESS PRECIP = 28.63 ACRE-FEET
PEAK Q = 458. CFS TIME OF PEAK = 135. MIN.

INFILT.= 4.50 IN/HR DECAY =0.00180 FNINF = 0.60 IN/HR
MAX.PERV.RET.=0.40 IN. MAX.IMP.RET.=0.10 IN.
1 U.D.F.C.D. CUHP RUNOFF ANALYSIS EXECUTED ON DATE 5/23/2005 AT TIME 16:45

CUHPF/PC RELEASE 2A (32-BIT VER) SEPTEMBER 10, 1998

PRINT OPTION NUMBER SELECTED FOR THIS BASIN IS 8

IL

BASIN ID: -- BASIN COMMENT: 500

AREA (SQMI)	LENGTH OF BASIN (MI)	DIST TO CENTROID (MI)	IMPERV. AREA (PCT)	SLOPE (FT/FT)	UNIT DURATION (MIN)
0.39	0.63	0.28	30.59	0.0010	5.00

COEFFICIENT (REFLECTING TIME TO PEAK)	COEFFICIENT (RELATED TO PEAK RATE OF RUNOFF)
0.099	0.351

THIS BASIN USES TRADITIONAL DRAINAGE PRACTICES

FRACTION OF PERVIOUS AREA RECEIVING IMPERVIOUS DRAINAGE (DEFAULT)	FRACTION OF IMPERVIOUS AREA DIRECTLY CONNECTED TO DRAINAGE SYSTEM (DEFAULT)
R= 0.16	D= 0.61

CALCULATED UNIT HYDROGRAPH

TIME TO PEAK (MIN)	PEAK RATE OF RUNOFF (CFS/SQMI)	UNIT HYDROGRAPH PEAK (CFS)	VOLUME OF RUNOFF (AF)
16.02	997.80	389.14	20.80

WIDTH AT 50 = 30. MIN. WIDTH AT 75 = 16. MIN. K50 =0.32 K75 =0.43

RAINFALL LOSSES INPUT W/ BASIN DATA

MAX. PERVIOUS RET. =0.40 IN. MAX. IMPERVIOUS RET. =0.10 IN.
INFILTRATION = 4.50 IN./HR. DECAY = 0.00180/SECOND FNINFL = 0.60 IN./HR.

TIME	UNIT HYDROGRAPH	TIME	UNIT HYDROGRAPH	TIME	UNIT HYDROGRAPH
0.	0.	50.	123.	100.	23.
5.	138.	55.	104.	105.	19.
10.	314.	60.	88.	110.	16.
15.	387.	65.	74.	115.	14.
20.	365.	70.	63.	120.	12.
25.	291.	75.	53.	125.	10.
30.	249.	80.	45.	130.	8.
35.	207.	85.	38.	135.	0.
40.	173.	90.	32.	0.	0.
45.	146.	95.	27.	0.	0.

1 BASIN ID: -- BASIN COMMENT: 500

**** STORM NO. = 1 **** DATE OR RETURN PERIOD = 100-year,

TOTAL PRECIP. = 4.41 EXCESS PRECIP. = 2.488 INCHES
VOLUME OF EXCESS PRECIP = 51.75 ACRE-FEET
PEAK Q = 675. CFS TIME OF PEAK = 140. MIN.
INFILT.= 4.50 IN/HR DECAY =0.00180 FNINF = 0.60 IN/HR
MAX.PERV.RET.=0.40 IN. MAX.IMP.RET.=0.10 IN.

1 U.D.F.C.D. CUHP RUNOFF ANALYSIS EXECUTED ON DATE 5/23/2005 AT TIME 16:45

CUHPF/PC RELEASE 2A (32-BIT VER) SEPTEMBER 10, 1998

PRINT OPTION NUMBER SELECTED FOR THIS BASIN IS 8

IL

BASIN ID: -- BASIN COMMENT: 600

AREA (SQMI)	LENGTH OF BASIN (MI)	DIST TO CENTROID (MI)	IMPERV. AREA (PCT)	SLOPE (FT/FT)	UNIT DURATION (MIN)
0.06	0.36	0.20	72.35	0.0157	5.00

COEFFICIENT (REFLECTING TIME TO PEAK)	COEFFICIENT (RELATED TO PEAK RATE OF RUNOFF)
0.079	0.503

THIS BASIN USES TRADITIONAL DRAINAGE PRACTICES

FRACTION OF PERVIOUS AREA RECEIVING IMPERVIOUS DRAINAGE (DEFAULT)	FRACTION OF IMPERVIOUS AREA DIRECTLY CONNECTED TO DRAINAGE SYSTEM (DEFAULT)
R= 0.30	D= 0.96

CALCULATED UNIT HYDROGRAPH

TIME TO PEAK (MIN)	TIME OF CONCENTRATION (MIN)	PEAK RATE OF RUNOFF (CFS/SQMI)	UNIT HYDROGRAPH PEAK (CFS)	VOLUME OF RUNOFF (AF)
9.36	20.67	2814.43	168.87	3.20

*** NOTE : THE TIME TO PEAK IS CALCULATED BASED ON THE TIME OF CONCENTRATION PROVIDED BY THE USER, REPLACING THE ONE COMPUTED BY CUHPF (TP= 6.15)

WIDTH AT 50 = 11. MIN. WIDTH AT 75 = 6. MIN. K50 =0.35 K75 =0.45

RAINFALL LOSSES INPUT W/ BASIN DATA

MAX. PERVIOUS RET. =0.40 IN. MAX. IMPERVIOUS RET. =0.10 IN.
INFILTRATION = 4.50 IN./HR. DECAY = 0.00180/SECOND FNINFL = 0.60 IN./HR.

TIME	UNIT HYDROGRAPH	TIME	UNIT HYDROGRAPH	TIME	UNIT HYDROGRAPH
0.	0.	20.	58.	40.	8.
5.	67.	25.	35.	45.	0.
10.	167.	30.	21.	0.	0.
15.	98.	35.	13.	0.	0.

1 BASIN ID: -- BASIN COMMENT: 600

```
**** STORM NO. =   1  ****      DATE OR RETURN PERIOD = 100-year,

         TOTAL PRECIP. =  4.41      EXCESS PRECIP. = 3.467  INCHES
         VOLUME OF EXCESS PRECIP =  11.09  ACRE-FEET
         PEAK Q =  181. CFS        TIME OF PEAK = 135. MIN.
         INFILT.= 4.50 IN/HR     DECAY =0.00180    FNINF = 0.60 IN/HR
         MAX.PERV.RET.=0.40 IN.      MAX.IMP.RET.=0.10 IN.
1    U.D.F.C.D. CUHP RUNOFF ANALYSIS    EXECUTED ON DATE  5/23/2005 AT TIME 16:45

     CUHPF/PC RELEASE 2A (32-BIT VER) SEPTEMBER 10, 1998

     PRINT OPTION NUMBER SELECTED FOR THIS BASIN IS  8

     IL

     BASIN ID:           --  BASIN COMMENT:  550

    AREA  LENGTH OF BASIN  DIST TO CENTROID  IMPERV. AREA  SLOPE  UNIT DURATION
   (SQMI)      (MI)              (MI)            (PCT)     (FT/FT)    (MIN)

   0.13        0.56              0.28            46.60     0.0253     5.00

                    COEFFICIENT                      COEFFICIENT
              (REFLECTING TIME TO PEAK)   (RELATED TO PEAK RATE OF RUNOFF)

                       0.090                            0.436

     THIS BASIN USES TRADITIONAL DRAINAGE PRACTICES

              FRACTION OF PERVIOUS          FRACTION OF IMPERVIOUS
                 AREA RECEIVING             AREA DIRECTLY CONNECTED
              IMPERVIOUS DRAINAGE           TO DRAINAGE SYSTEM
                 ( DEFAULT )                   ( DEFAULT )
                   R= 0.21                  D=   0.83

                         CALCULATED UNIT HYDROGRAPH

       TIME TO PEAK  TIME OF CONCENTRATION  PEAK RATE OF RUNOFF  UNIT HYDROGRAPH PEAK  VOLUME OF RUNOFF
          (MIN)             (MIN)              (CFS/SQMI)              (CFS)                (AF)
```



```
          11.07             26.51              1952.54                 253.83               6.93


       *** NOTE : THE TIME TO PEAK IS CALCULATED BASED ON THE TIME OF CONCENTRATION PROVIDED BY THE USER,
                  REPLACING THE ONE COMPUTED BY CUHPF (TP=  7.88)

       WIDTH AT 50 =  15. MIN.   WIDTH AT 75 =   8. MIN.  K50 =0.35  K75 =0.45

               RAINFALL LOSSES INPUT W/ BASIN DATA

        MAX. PERVIOUS RET. =0.40 IN.    MAX. IMPERVIOUS RET. =0.10 IN.
      INFILTRATION = 4.50 IN./HR.   DECAY = 0.00180/SECOND    FNINFL = 0.60 IN./HR.
```

TIME	UNIT HYDROGRAPH	TIME	UNIT HYDROGRAPH	TIME	UNIT HYDROGRAPH
0.	0.	25.	97.	50.	17.
5.	104.	30.	68.	55.	12.
10.	249.	35.	48.	60.	9.
15.	202.	40.	34.	65.	0.
20.	139.	45.	24.	0.	0.

```
1          BASIN ID:           --  BASIN COMMENT:  550

 **** STORM NO. =   1  ****      DATE OR RETURN PERIOD = 100-year,

          TOTAL PRECIP. =  4.41      EXCESS PRECIP. = 2.858  INCHES
          VOLUME OF EXCESS PRECIP =  19.81  ACRE-FEET
          PEAK Q =  333. CFS        TIME OF PEAK = 135. MIN.
          INFILT.= 4.50 IN/HR     DECAY =0.00180    FNINF = 0.60 IN/HR
          MAX.PERV.RET.=0.40 IN.      MAX.IMP.RET.=0.10 IN.
1    U.D.F.C.D. CUHP RUNOFF ANALYSIS    EXECUTED ON DATE  5/23/2005 AT TIME 16:45

     CUHPF/PC RELEASE 2A (32-BIT VER) SEPTEMBER 10, 1998

     PRINT OPTION NUMBER SELECTED FOR THIS BASIN IS  8

     IL
```

BASIN ID: -- BASIN COMMENT: 700

AREA (SQMI)	LENGTH OF BASIN (MI)	DIST TO CENTROID (MI)	IMPERV. AREA (PCT)	SLOPE (FT/FT)	UNIT DURATION (MIN)
0.11	0.68	0.29	18.44	0.0122	5.00

COEFFICIENT (REFLECTING TIME TO PEAK)	COEFFICIENT (RELATED TO PEAK RATE OF RUNOFF)
0.113	0.224

THIS BASIN USES TRADITIONAL DRAINAGE PRACTICES

FRACTION OF PERVIOUS AREA RECEIVING IMPERVIOUS DRAINAGE (DEFAULT)	FRACTION OF IMPERVIOUS AREA DIRECTLY CONNECTED TO DRAINAGE SYSTEM (DEFAULT)
R= 0.11	D= 0.37

CALCULATED UNIT HYDROGRAPH

TIME TO PEAK (MIN)	TIME OF CONCENTRATION (MIN)	PEAK RATE OF RUNOFF (CFS/SQMI)	UNIT HYDROGRAPH PEAK (CFS)	VOLUME OF RUNOFF (AF)
7.58	30.06	1693.51	186.29	5.87

*** NOTE : THE TIME TO PEAK IS CALCULATED BASED ON THE TIME OF CONCENTRATION PROVIDED BY THE USER, REPLACING THE ONE COMPUTED BY CUHPF (TP= 11.51)

WIDTH AT 50 = 18. MIN. WIDTH AT 75 = 9. MIN. K50 =0.26 K75 =0.35

RAINFALL LOSSES INPUT W/ BASIN DATA

MAX. PERVIOUS RET. =0.40 IN. MAX. IMPERVIOUS RET. =0.10 IN.
INFILTRATION = 4.50 IN./HR. DECAY = 0.00180/SECOND FNINFL = 0.60 IN./HR.

TIME	UNIT HYDROGRAPH	TIME	UNIT HYDROGRAPH	TIME	UNIT HYDROGRAPH
0.	0.	25.	75.	50.	20.
5.	158.	30.	58.	55.	16.
10.	171.	35.	44.	60.	12.
15.	130.	40.	34.	65.	9.
20.	98.	45.	26.	70.	0.

1 BASIN ID: -- BASIN COMMENT: 700

**** STORM NO. = 1 **** DATE OR RETURN PERIOD = 100-year,

TOTAL PRECIP. = 4.41 EXCESS PRECIP. = 2.235 INCHES
VOLUME OF EXCESS PRECIP = 13.11 ACRE-FEET
PEAK Q = 255. CFS TIME OF PEAK = 135. MIN.
INFILT.= 4.50 IN/HR DECAY =0.00180 FNINF = 0.60 IN/HR
MAX.PERV.RET.=0.40 IN. MAX.IMP.RET.=0.10 IN.

1 U.D.F.C.D. CUHP RUNOFF ANALYSIS EXECUTED ON DATE 5/23/2005 AT TIME 16:45

CUHPF/PC RELEASE 2A (32-BIT VER) SEPTEMBER 10, 1998

PRINT OPTION NUMBER SELECTED FOR THIS BASIN IS 8

IL

BASIN ID: -- BASIN COMMENT: 750

AREA (SQMI)	LENGTH OF BASIN (MI)	DIST TO CENTROID (MI)	IMPERV. AREA (PCT)	SLOPE (FT/FT)	UNIT DURATION (MIN)
0.10	0.74	0.31	82.43	0.0150	5.00

COEFFICIENT (REFLECTING TIME TO PEAK)	COEFFICIENT (RELATED TO PEAK RATE OF RUNOFF)
0.076	0.571

THIS BASIN USES TRADITIONAL DRAINAGE PRACTICES

FRACTION OF PERVIOUS FRACTION OF IMPERVIOUS

AREA RECEIVING IMPERVIOUS DRAINAGE (DEFAULT)	AREA DIRECTLY CONNECTED TO DRAINAGE SYSTEM (DEFAULT)
R= 0.34	D= 1.00

CALCULATED UNIT HYDROGRAPH

TIME TO PEAK (MIN)	TIME OF CONCENTRATION (MIN)	PEAK RATE OF RUNOFF (CFS/SQMI)	UNIT HYDROGRAPH PEAK (CFS)	VOLUME OF RUNOFF (AF)
13.85	31.65	1931.31	193.13	5.33

*** NOTE : THE TIME TO PEAK IS CALCULATED BASED ON THE TIME OF CONCENTRATION PROVIDED BY THE USER, REPLACING THE ONE COMPUTED BY CUHPF (TP= 8.67)

WIDTH AT 50 = 16. MIN. WIDTH AT 75 = 8. MIN. K50 =0.35 K75 =0.45

RAINFALL LOSSES INPUT W/ BASIN DATA

MAX. PERVIOUS RET. =0.40 IN. MAX. IMPERVIOUS RET. =0.10 IN.
INFILTRATION = 4.50 IN./HR. DECAY = 0.00180/SECOND FNINFL = 0.60 IN./HR.

TIME	UNIT HYDROGRAPH	TIME	UNIT HYDROGRAPH	TIME	UNIT HYDROGRAPH
0.	0.	25.	90.	50.	16.
5.	37.	30.	63.	55.	11.
10.	138.	35.	45.	60.	8.
15.	189.	40.	32.	65.	0.
20.	130.	45.	22.	0.	0.

1 BASIN ID: -- BASIN COMMENT: 750

**** STORM NO. = 1 **** DATE OR RETURN PERIOD = 100-year,

TOTAL PRECIP. = 4.41 EXCESS PRECIP. = 3.719 INCHES
VOLUME OF EXCESS PRECIP = 19.84 ACRE-FEET

PEAK Q = 272. CFS TIME OF PEAK = 140. MIN.
INFILT.= 4.50 IN/HR DECAY =0.00180 FNINF = 0.60 IN/HR
MAX.PERV.RET.=0.40 IN. MAX.IMP.RET.=0.10 IN.

1 U.D.F.C.D. CUHP RUNOFF ANALYSIS EXECUTED ON DATE 5/23/2005 AT TIME 16:45

CUHPF/PC RELEASE 2A (32-BIT VER) SEPTEMBER 10, 1998

PRINT OPTION NUMBER SELECTED FOR THIS BASIN IS 8

IL

BASIN ID: -- BASIN COMMENT: 800

AREA (SQMI)	LENGTH OF BASIN (MI)	DIST TO CENTROID (MI)	IMPERV. AREA (PCT)	SLOPE (FT/FT)	UNIT DURATION (MIN)
0.12	0.27	0.12	72.23	0.0492	5.00

COEFFICIENT (REFLECTING TIME TO PEAK)	COEFFICIENT (RELATED TO PEAK RATE OF RUNOFF)
0.079	0.558

THIS BASIN USES TRADITIONAL DRAINAGE PRACTICES

FRACTION OF PERVIOUS AREA RECEIVING IMPERVIOUS DRAINAGE (DEFAULT)	FRACTION OF IMPERVIOUS AREA DIRECTLY CONNECTED TO DRAINAGE SYSTEM (DEFAULT)
R= 0.30	D= 0.96

CALCULATED UNIT HYDROGRAPH

TIME TO PEAK (MIN)	TIME OF CONCENTRATION (MIN)	PEAK RATE OF RUNOFF (CFS/SQMI)	UNIT HYDROGRAPH PEAK (CFS)	VOLUME OF RUNOFF (AF)
7.50	15.26	4284.07	514.09	6.40

*** NOTE : THE TIME TO PEAK IS CALCULATED BASED ON THE TIME OF CONCENTRATION PROVIDED BY THE USER, REPLACING THE ONE COMPUTED BY CUHPF (TP= 4.41)

WIDTH AT 50 = 7. MIN. WIDTH AT 75 = 4. MIN. K50 =0.35 K75 =0.45

RAINFALL LOSSES INPUT W/ BASIN DATA

MAX. PERVIOUS RET. =0.40 IN. MAX. IMPERVIOUS RET. =0.10 IN.
INFILTRATION = 4.50 IN./HR. DECAY = 0.00180/SECOND FNINFL = 0.60 IN./HR.

TIME	UNIT HYDROGRAPH	TIME	UNIT HYDROGRAPH	TIME	UNIT HYDROGRAPH
0.	0.	15.	157.	30.	13.
5.	250.	20.	68.	35.	0.
10.	360.	25.	30.	0.	0.

1 BASIN ID: -- BASIN COMMENT: 800

**** STORM NO. = 1 **** DATE OR RETURN PERIOD = 100-year,

TOTAL PRECIP. = 4.41 EXCESS PRECIP. = 3.463 INCHES
VOLUME OF EXCESS PRECIP = 22.17 ACRE-FEET
PEAK Q = 359. CFS TIME OF PEAK = 135. MIN.
INFILT.= 4.50 IN/HR DECAY =0.00180 FNINF = 0.60 IN/HR
MAX.PERV.RET.=0.40 IN. MAX.IMP.RET.=0.10 IN.

1 U.D.F.C.D. CUHP RUNOFF ANALYSIS EXECUTED ON DATE 5/23/2005 AT TIME 16:45

CUHPF/PC RELEASE 2A (32-BIT VER) SEPTEMBER 10, 1998

PRINT OPTION NUMBER SELECTED FOR THIS BASIN IS 8

IL

BASIN ID: -- BASIN COMMENT: 850

AREA (SQMI)	LENGTH OF BASIN (MI)	DIST TO CENTROID (MI)	IMPERV. AREA (PCT)	SLOPE (FT/FT)	UNIT DURATION (MIN)
0.13	0.63	0.36	98.00	0.0165	5.00

COEFFICIENT (REFLECTING TIME TO PEAK)	COEFFICIENT (RELATED TO PEAK RATE OF RUNOFF)
0.073	0.622

THIS BASIN USES TRADITIONAL DRAINAGE PRACTICES

FRACTION OF PERVIOUS AREA RECEIVING IMPERVIOUS DRAINAGE (DEFAULT)	FRACTION OF IMPERVIOUS AREA DIRECTLY CONNECTED TO DRAINAGE SYSTEM (DEFAULT)
R= 0.39	D= 1.00

CALCULATED UNIT HYDROGRAPH

TIME TO PEAK (MIN)	TIME OF CONCENTRATION (MIN)	PEAK RATE OF RUNOFF (CFS/SQMI)	UNIT HYDROGRAPH PEAK (CFS)	VOLUME OF RUNOFF (AF)
9.07	21.29	3638.87	473.05	6.93

*** NOTE : THE TIME TO PEAK IS CALCULATED BASED ON THE TIME OF CONCENTRATION PROVIDED BY THE USER,
REPLACING THE ONE COMPUTED BY CUHPF (TP= 8.29)

WIDTH AT 50 = 8. MIN. WIDTH AT 75 = 4. MIN. K50 =0.35 K75 =0.45

RAINFALL LOSSES INPUT W/ BASIN DATA

MAX. PERVIOUS RET. =0.40 IN. MAX. IMPERVIOUS RET. =0.10 IN.
INFILTRATION = 4.50 IN./HR. DECAY = 0.00180/SECOND FNINFL = 0.60 IN./HR.

TIME	UNIT HYDROGRAPH	TIME	UNIT HYDROGRAPH	TIME	UNIT HYDROGRAPH
0.	0.	15.	218.	30.	25.
5.	135.	20.	107.	35.	12.
10.	451.	25.	52.	40.	0.

1 BASIN ID: -- BASIN COMMENT: 850

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**** STORM NO. =   1  ****       DATE OR RETURN PERIOD = 100-year,

        TOTAL PRECIP. =  4.41       EXCESS PRECIP. = 4.054  INCHES
        VOLUME OF EXCESS PRECIP =  28.11  ACRE-FEET
        PEAK Q =  413. CFS        TIME OF PEAK = 135. MIN.
        INFILT.= 4.50 IN/HR     DECAY =0.00180     FNINF = 0.60 IN/HR
        MAX.PERV.RET.=0.40 IN.      MAX.IMP.RET.=0.10 IN.
1    U.D.F.C.D. CUHP RUNOFF ANALYSIS     EXECUTED ON DATE  5/23/2005 AT TIME 16:45

     CUHPF/PC RELEASE 2A (32-BIT VER) SEPTEMBER 10, 1998

     PRINT OPTION NUMBER SELECTED FOR THIS BASIN IS  8

     IL

     BASIN ID:           --  BASIN COMMENT:  900

  AREA  LENGTH OF BASIN  DIST TO CENTROID  IMPERV. AREA  SLOPE  UNIT DURATION
 (SQMI)      (MI)              (MI)            (PCT)      (FT/FT)    (MIN)

  0.07        0.36             0.17            66.24     0.0121     5.00

               COEFFICIENT                   COEFFICIENT
        (REFLECTING TIME TO PEAK)   (RELATED TO PEAK RATE OF RUNOFF)

                  0.081                          0.494

     THIS BASIN USES TRADITIONAL DRAINAGE PRACTICES

             FRACTION OF PERVIOUS         FRACTION OF IMPERVIOUS
                AREA RECEIVING            AREA DIRECTLY CONNECTED
             IMPERVIOUS DRAINAGE          TO DRAINAGE SYSTEM
                ( DEFAULT )                   ( DEFAULT )
                  R= 0.28                     D=    0.93

                            CALCULATED UNIT HYDROGRAPH

      TIME TO PEAK  TIME OF CONCENTRATION  PEAK RATE OF RUNOFF  UNIT HYDROGRAPH PEAK  VOLUME OF RUNOFF
         (MIN)             (MIN)               (CFS/SQMI)             (CFS)               (AF)

          9.35             20.48                2773.90               194.17              3.73
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      *** NOTE : THE TIME TO PEAK IS CALCULATED BASED ON THE TIME OF CONCENTRATION PROVIDED BY THE USER,
                 REPLACING THE ONE COMPUTED BY CUHPF (TP=  6.22)

      WIDTH AT 50 =  11. MIN.   WIDTH AT 75 =   6. MIN.  K50 =0.35  K75 =0.45

              RAINFALL LOSSES INPUT W/ BASIN DATA

      MAX. PERVIOUS RET. =0.40 IN.     MAX. IMPERVIOUS RET. =0.10 IN.
    INFILTRATION = 4.50 IN./HR.    DECAY = 0.00180/SECOND    FNINFL = 0.60 IN./HR.
```

TIME	UNIT HYDROGRAPH	TIME	UNIT HYDROGRAPH	TIME	UNIT HYDROGRAPH
0.	0.	20.	68.	40.	10.
5.	79.	25.	42.	45.	0.
10.	192.	30.	25.	0.	0.
15.	114.	35.	16.	0.	0.

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1        BASIN ID:           --  BASIN COMMENT:  900

**** STORM NO. =   1  ****       DATE OR RETURN PERIOD = 100-year,

        TOTAL PRECIP. =  4.41       EXCESS PRECIP. = 3.314  INCHES
        VOLUME OF EXCESS PRECIP =  12.37  ACRE-FEET
        PEAK Q =  210. CFS        TIME OF PEAK = 135. MIN.
        INFILT.= 4.50 IN/HR     DECAY =0.00180     FNINF = 0.60 IN/HR
        MAX.PERV.RET.=0.40 IN.      MAX.IMP.RET.=0.10 IN.
1    U.D.F.C.D. CUHP RUNOFF ANALYSIS     EXECUTED ON DATE  5/23/2005 AT TIME 16:45

     CUHPF/PC RELEASE 2A (32-BIT VER) SEPTEMBER 10, 1998

     PRINT OPTION NUMBER SELECTED FOR THIS BASIN IS  8

     IL
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BASIN ID: -- BASIN COMMENT: 950

AREA (SQMI)	LENGTH OF BASIN (MI)	DIST TO CENTROID (MI)	IMPERV. AREA (PCT)	SLOPE (FT/FT)	UNIT DURATION (MIN)
0.12	0.63	0.29	98.00	0.0154	5.00

COEFFICIENT (REFLECTING TIME TO PEAK)	COEFFICIENT (RELATED TO PEAK RATE OF RUNOFF)
0.073	0.615

THIS BASIN USES TRADITIONAL DRAINAGE PRACTICES

FRACTION OF PERVIOUS AREA RECEIVING IMPERVIOUS DRAINAGE (DEFAULT)	FRACTION OF IMPERVIOUS AREA DIRECTLY CONNECTED TO DRAINAGE SYSTEM (DEFAULT)
R= 0.39	D= 1.00

CALCULATED UNIT HYDROGRAPH

TIME TO PEAK (MIN)	TIME OF CONCENTRATION (MIN)	PEAK RATE OF RUNOFF (CFS/SQMI)	UNIT HYDROGRAPH PEAK (CFS)	VOLUME OF RUNOFF (AF)
8.05	18.91	4252.17	510.26	6.40

*** NOTE : THE TIME TO PEAK IS CALCULATED BASED ON THE TIME OF CONCENTRATION PROVIDED BY THE USER, REPLACING THE ONE COMPUTED BY CUHPF (TP= 7.76)

WIDTH AT 50 = 7. MIN. WIDTH AT 75 = 4. MIN. K50 =0.35 K75 =0.45

RAINFALL LOSSES INPUT W/ BASIN DATA

MAX. PERVIOUS RET. =0.40 IN. MAX. IMPERVIOUS RET. =0.10 IN.
INFILTRATION = 4.50 IN./HR. DECAY = 0.00180/SECOND FNINFL = 0.60 IN./HR.

TIME	UNIT HYDROGRAPH	TIME	UNIT HYDROGRAPH	TIME	UNIT HYDROGRAPH
0.	0.	15.	172.	30.	14.
5.	186.	20.	75.	35.	0.
10.	390.	25.	33.	0.	0.

1 BASIN ID: -- BASIN COMMENT: 950

**** STORM NO. = 1 **** DATE OR RETURN PERIOD = 100-year,

TOTAL PRECIP. = 4.41 EXCESS PRECIP. = 4.054 INCHES
VOLUME OF EXCESS PRECIP = 25.95 ACRE-FEET
PEAK Q = 363. CFS TIME OF PEAK = 135. MIN.
INFILT.= 4.50 IN/HR DECAY =0.00180 FNINF = 0.60 IN/HR
MAX.PERV.RET.=0.40 IN. MAX.IMP.RET.=0.10 IN.

1 U.D.F.C.D. CUHP RUNOFF ANALYSIS EXECUTED ON DATE 5/23/2005 AT TIME 16:45

CUHPF/PC RELEASE 2A (32-BIT VER) SEPTEMBER 10, 1998

PRINT OPTION NUMBER SELECTED FOR THIS BASIN IS 8

IL

BASIN ID: -- BASIN COMMENT: 551 aka 550B

AREA (SQMI)	LENGTH OF BASIN (MI)	DIST TO CENTROID (MI)	IMPERV. AREA (PCT)	SLOPE (FT/FT)	UNIT DURATION (MIN)
0.06	0.30	0.19	79.10	0.0212	5.00

COEFFICIENT (REFLECTING TIME TO PEAK)	COEFFICIENT (RELATED TO PEAK RATE OF RUNOFF)
0.077	0.521

THIS BASIN USES TRADITIONAL DRAINAGE PRACTICES

FRACTION OF PERVIOUS AREA RECEIVING IMPERVIOUS DRAINAGE (DEFAULT)	FRACTION OF IMPERVIOUS AREA DIRECTLY CONNECTED TO DRAINAGE SYSTEM (DEFAULT)
R= 0.33	D= 1.00

CALCULATED UNIT HYDROGRAPH

TIME TO PEAK (MIN)	TIME OF CONCENTRATION (MIN)	PEAK RATE OF RUNOFF (CFS/SQMI)	UNIT HYDROGRAPH PEAK (CFS)	VOLUME OF RUNOFF (AF)
8.41	18.68	3387.70	203.26	3.20

*** NOTE : THE TIME TO PEAK IS CALCULATED BASED ON THE TIME OF CONCENTRATION PROVIDED BY THE USER,
REPLACING THE ONE COMPUTED BY CUHPF (TP= 5.44)

WIDTH AT 50 = 9. MIN. WIDTH AT 75 = 5. MIN. K50 =0.35 K75 =0.45

RAINFALL LOSSES INPUT W/ BASIN DATA

MAX. PERVIOUS RET. =0.40 IN. MAX. IMPERVIOUS RET. =0.10 IN.
INFILTRATION = 4.50 IN./HR. DECAY = 0.00180/SECOND FNINFL = 0.60 IN./HR.

TIME	UNIT HYDROGRAPH	TIME	UNIT HYDROGRAPH	TIME	UNIT HYDROGRAPH
0.	0.	15.	92.	30.	15.
5.	89.	20.	50.	35.	8.
10.	181.	25.	27.	40.	0.

1 BASIN ID: -- BASIN COMMENT: 551 aka 5508

**** STORM NO. = 1 **** DATE OR RETURN PERIOD = 100-year,

TOTAL PRECIP. = 4.41 EXCESS PRECIP. = 3.643 INCHES
VOLUME OF EXCESS PRECIP = 11.66 ACRE-FEET
PEAK Q = 186. CFS TIME OF PEAK = 135. MIN.
INFILT.= 4.50 IN/HR DECAY =0.00180 FNINF = 0.60 IN/HR
MAX.PERV.RET.=0.40 IN. MAX.IMP.RET.=0.10 IN.

1 U.D.F.C.D. CUHP RUNOFF ANALYSIS EXECUTED ON DATE 5/23/2005 AT TIME 16:45

CUHPF/PC RELEASE 2A (32-BIT VER) SEPTEMBER 10, 1998

PRINT OPTION NUMBER SELECTED FOR THIS BASIN IS 8

IL

BASIN ID: -- BASIN COMMENT: 875

AREA (SQMI)	LENGTH OF BASIN (MI)	DIST TO CENTROID (MI)	IMPERV. AREA (PCT)	SLOPE (FT/FT)	UNIT DURATION (MIN)
0.14	0.59	0.16	94.14	0.0188	5.00

COEFFICIENT (REFLECTING TIME TO PEAK)	COEFFICIENT (RELATED TO PEAK RATE OF RUNOFF)
0.074	0.623

THIS BASIN USES TRADITIONAL DRAINAGE PRACTICES

FRACTION OF PERVIOUS AREA RECEIVING IMPERVIOUS DRAINAGE (DEFAULT)	FRACTION OF IMPERVIOUS AREA DIRECTLY CONNECTED TO DRAINAGE SYSTEM (DEFAULT)
R= 0.38	D= 1.00

CALCULATED UNIT HYDROGRAPH

TIME TO PEAK (MIN)	TIME OF CONCENTRATION (MIN)	PEAK RATE OF RUNOFF (CFS/SQMI)	UNIT HYDROGRAPH PEAK (CFS)	VOLUME OF RUNOFF (AF)
11.77	27.40	2582.60	361.56	7.47

*** NOTE : THE TIME TO PEAK IS CALCULATED BASED ON THE TIME OF CONCENTRATION PROVIDED BY THE USER,
REPLACING THE ONE COMPUTED BY CUHPF (TP= 6.24)

WIDTH AT 50 = 12. MIN. WIDTH AT 75 = 6. MIN. K50 =0.35 K75 =0.45

RAINFALL LOSSES INPUT W/ BASIN DATA

MAX. PERVIOUS RET. =0.40 IN. MAX. IMPERVIOUS RET. =0.10 IN.

INFILTRATION = 4.50 IN./HR. DECAY = 0.00180/SECOND FNINFL = 0.60 IN./HR.

TIME	UNIT HYDROGRAPH	TIME	UNIT HYDROGRAPH	TIME	UNIT HYDROGRAPH
0.	0.	20.	169.	40.	23.
5.	70.	25.	102.	45.	14.
10.	325.	30.	62.	50.	8.
15.	275.	35.	38.	55.	0.

1 BASIN ID: -- BASIN COMMENT: 875

**** STORM NO. = 1 **** DATE OR RETURN PERIOD = 100-year,

TOTAL PRECIP. = 4.41 EXCESS PRECIP. = 3.971 INCHES
VOLUME OF EXCESS PRECIP = 29.65 ACRE-FEET
PEAK Q = 419. CFS TIME OF PEAK = 135. MIN.
INFILT.= 4.50 IN/HR DECAY =0.00180 FNINF = 0.60 IN/HR
MAX.PERV.RET.=0.40 IN. MAX.IMP.RET.=0.10 IN.

1 U.D.F.C.D. CUHP RUNOFF ANALYSIS EXECUTED ON DATE 5/23/2005 AT TIME 16:45

CUHPF/PC RELEASE 2A (32-BIT VER) SEPTEMBER 10, 1998

PRINT OPTION NUMBER SELECTED FOR THIS BASIN IS 8

IL

BASIN ID: -- BASIN COMMENT: 825

AREA (SQMI)	LENGTH OF BASIN (MI)	DIST TO CENTROID (MI)	IMPERV. AREA (PCT)	SLOPE (FT/FT)	UNIT DURATION (MIN)
0.02	0.21	0.09	98.00	0.0328	5.00

COEFFICIENT (REFLECTING TIME TO PEAK)	COEFFICIENT (RELATED TO PEAK RATE OF RUNOFF)
0.073	0.470

THIS BASIN USES TRADITIONAL DRAINAGE PRACTICES

FRACTION OF PERVIOUS AREA RECEIVING IMPERVIOUS DRAINAGE (DEFAULT)	FRACTION OF IMPERVIOUS AREA DIRECTLY CONNECTED TO DRAINAGE SYSTEM (DEFAULT)
R= 0.39	D= 1.00

CALCULATED UNIT HYDROGRAPH

TIME TO PEAK (MIN)	TIME OF CONCENTRATION (MIN)	PEAK RATE OF RUNOFF (CFS/SQMI)	UNIT HYDROGRAPH PEAK (CFS)	VOLUME OF RUNOFF (AF)
7.50	7.99	3608.84	72.18	1.07

*** NOTE : THE TIME TO PEAK IS CALCULATED BASED ON THE TIME OF CONCENTRATION PROVIDED BY THE USER, REPLACING THE ONE COMPUTED BY CUHPF (TP= 4.02)

WIDTH AT 50 = 8. MIN. WIDTH AT 75 = 4. MIN. K50 =0.35 K75 =0.45

RAINFALL LOSSES INPUT W/ BASIN DATA

MAX. PERVIOUS RET. =0.40 IN. MAX. IMPERVIOUS RET. =0.10 IN.
INFILTRATION = 4.50 IN./HR. DECAY = 0.00180/SECOND FNINFL = 0.60 IN./HR.

TIME	UNIT HYDROGRAPH	TIME	UNIT HYDROGRAPH	TIME	UNIT HYDROGRAPH
0.	0.	15.	28.	30.	0.
5.	43.	20.	16.	0.	0.
10.	53.	25.	9.	0.	0.

1 BASIN ID: -- BASIN COMMENT: 825

**** STORM NO. = 1 **** DATE OR RETURN PERIOD = 100-year,

TOTAL PRECIP. = 4.41 EXCESS PRECIP. = 4.054 INCHES

VOLUME OF EXCESS PRECIP = 4.32 ACRE-FEET
PEAK Q = 63. CFS TIME OF PEAK = 135. MIN.
INFILT.= 4.50 IN/HR DECAY =0.00180 FNINF = 0.60 IN/HR
MAX.PERV.RET.=0.40 IN. MAX.IMP.RET.=0.10 IN.

1 U.D.F.C.D. CUHP RUNOFF ANALYSIS EXECUTED ON DATE 5/23/2005 AT TIME 16:45

CUHPF/PC RELEASE 2A (32-BIT VER) SEPTEMBER 10, 1998

PRINT OPTION NUMBER SELECTED FOR THIS BASIN IS 8

IL

BASIN ID: -- BASIN COMMENT: 925

AREA (SQMI)	LENGTH OF BASIN (MI)	DIST TO CENTROID (MI)	IMPERV. AREA (PCT)	SLOPE (FT/FT)	UNIT DURATION (MIN)
0.05	0.31	0.14	98.00	0.0143	5.00

COEFFICIENT (REFLECTING TIME TO PEAK)	COEFFICIENT (RELATED TO PEAK RATE OF RUNOFF)
0.073	0.539

THIS BASIN USES TRADITIONAL DRAINAGE PRACTICES

FRACTION OF PERVIOUS AREA RECEIVING IMPERVIOUS DRAINAGE (DEFAULT)	FRACTION OF IMPERVIOUS AREA DIRECTLY CONNECTED TO DRAINAGE SYSTEM (DEFAULT)
R= 0.39	D= 1.00

CALCULATED UNIT HYDROGRAPH

TIME TO PEAK (MIN)	TIME OF CONCENTRATION (MIN)	PEAK RATE OF RUNOFF (CFS/SQMI)	UNIT HYDROGRAPH PEAK (CFS)	VOLUME OF RUNOFF (AF)
7.50	14.78	4140.56	207.03	2.67

*** NOTE : THE TIME TO PEAK IS CALCULATED BASED ON THE TIME OF CONCENTRATION PROVIDED BY THE USER, REPLACING THE ONE COMPUTED BY CUHPF (TP= 5.26)

WIDTH AT 50 = 7. MIN. WIDTH AT 75 = 4. MIN. K50 =0.35 K75 =0.45

RAINFALL LOSSES INPUT W/ BASIN DATA

MAX. PERVIOUS RET. =0.40 IN. MAX. IMPERVIOUS RET. =0.10 IN.
INFILTRATION = 4.50 IN./HR. DECAY = 0.00180/SECOND FNINFL = 0.60 IN./HR.

TIME	UNIT HYDROGRAPH	TIME	UNIT HYDROGRAPH	TIME	UNIT HYDROGRAPH
0.	0.	15.	67.	30.	0.
5.	105.	20.	30.	0.	0.
10.	147.	25.	14.	0.	0.

1 BASIN ID: -- BASIN COMMENT: 925

**** STORM NO. = 1 **** DATE OR RETURN PERIOD = 100-year,

TOTAL PRECIP. = 4.41 EXCESS PRECIP. = 4.054 INCHES
VOLUME OF EXCESS PRECIP = 10.81 ACRE-FEET
PEAK Q = 152. CFS TIME OF PEAK = 135. MIN.
INFILT.= 4.50 IN/HR DECAY =0.00180 FNINF = 0.60 IN/HR
MAX.PERV.RET.=0.40 IN. MAX.IMP.RET.=0.10 IN.

1 U.D.F.C.D. CUHP RUNOFF ANALYSIS EXECUTED ON DATE 5/23/2005 AT TIME 16:45

CUHPF/PC RELEASE 2A (32-BIT VER) SEPTEMBER 10, 1998

PRINT OPTION NUMBER SELECTED FOR THIS BASIN IS 8

IL

BASIN ID: -- BASIN COMMENT: 625

AREA (SQMI)	LENGTH OF BASIN (MI)	DIST TO CENTROID (MI)	IMPERV. AREA (PCT)	SLOPE (FT/FT)	UNIT DURATION (MIN)
0.03	0.17	0.01	76.02	0.0197	5.00

COEFFICIENT (REFLECTING TIME TO PEAK)	COEFFICIENT (RELATED TO PEAK RATE OF RUNOFF)
0.078	0.463

THIS BASIN USES TRADITIONAL DRAINAGE PRACTICES

FRACTION OF PERVIOUS AREA RECEIVING IMPERVIOUS DRAINAGE (DEFAULT)	FRACTION OF IMPERVIOUS AREA DIRECTLY CONNECTED TO DRAINAGE SYSTEM (DEFAULT)
R= 0.32	D= 0.98

CALCULATED UNIT HYDROGRAPH

TIME TO PEAK (MIN)	TIME OF CONCENTRATION (MIN)	PEAK RATE OF RUNOFF (CFS/SQMI)	UNIT HYDROGRAPH PEAK (CFS)	VOLUME OF RUNOFF (AF)
7.50	14.85	3553.12	106.59	1.60

*** NOTE : THE TIME TO PEAK IS CALCULATED BASED ON THE TIME OF CONCENTRATION PROVIDED BY THE USER, REPLACING THE ONE COMPUTED BY CUHPF (TP= 3.05)

WIDTH AT 50 = 8. MIN. WIDTH AT 75 = 4. MIN. K50 =0.35 K75 =0.45

RAINFALL LOSSES INPUT W/ BASIN DATA

MAX. PERVIOUS RET. =0.40 IN. MAX. IMPERVIOUS RET. =0.10 IN.
INFILTRATION = 4.50 IN./HR. DECAY = 0.00180/SECOND FNINFL = 0.60 IN./HR.

TIME	UNIT HYDROGRAPH	TIME	UNIT HYDROGRAPH	TIME	UNIT HYDROGRAPH
0.	0.	15.	42.	30.	7.
5.	65.	20.	24.	35.	0.
10.	79.	25.	13.	0.	0.

1 BASIN ID: -- BASIN COMMENT: 625

**** STORM NO. = 1 **** DATE OR RETURN PERIOD = 100-year,

TOTAL PRECIP. = 4.41 EXCESS PRECIP. = 3.562 INCHES
VOLUME OF EXCESS PRECIP = 5.70 ACRE-FEET
PEAK Q = 94. CFS TIME OF PEAK = 135. MIN.
INFILT.= 4.50 IN/HR DECAY =0.00180 FNINF = 0.60 IN/HR
MAX.PERV.RET.=0.40 IN. MAX.IMP.RET.=0.10 IN.

1 U.D.F.C.D. CUHP RUNOFF ANALYSIS EXECUTED ON DATE 5/23/2005 AT TIME 16:45

CUHPF/PC RELEASE 2A (32-BIT VER) SEPTEMBER 10, 1998

PRINT OPTION NUMBER SELECTED FOR THIS BASIN IS 8

IL

BASIN ID: -- BASIN COMMENT: 650

AREA (SQMI)	LENGTH OF BASIN (MI)	DIST TO CENTROID (MI)	IMPERV. AREA (PCT)	SLOPE (FT/FT)	UNIT DURATION (MIN)
0.18	0.58	0.29	69.53	0.0157	5.00

COEFFICIENT (REFLECTING TIME TO PEAK)	COEFFICIENT (RELATED TO PEAK RATE OF RUNOFF)
0.080	0.583

THIS BASIN USES TRADITIONAL DRAINAGE PRACTICES

FRACTION OF PERVIOUS AREA RECEIVING IMPERVIOUS DRAINAGE (DEFAULT)	FRACTION OF IMPERVIOUS AREA DIRECTLY CONNECTED TO DRAINAGE SYSTEM (DEFAULT)
R= 0.29	D= 0.95

CALCULATED UNIT HYDROGRAPH

TIME TO PEAK (MIN) PEAK RATE OF RUNOFF (CFS/SQMI) UNIT HYDROGRAPH PEAK (CFS) VOLUME OF RUNOFF (AF)

8.04 4042.45 727.64 9.60

WIDTH AT 50 = 7. MIN. WIDTH AT 75 = 4. MIN. K50 =0.35 K75 =0.45

RAINFALL LOSSES INPUT W/ BASIN DATA

MAX. PERVIOUS RET. =0.40 IN. MAX. IMPERVIOUS RET. =0.10 IN.
INFILTRATION = 4.50 IN./HR. DECAY = 0.00180/SECOND FNINFL = 0.60 IN./HR.

TIME	UNIT HYDROGRAPH	TIME	UNIT HYDROGRAPH	TIME	UNIT HYDROGRAPH
0.	0.	15.	257.	30.	22.
5.	291.	20.	114.	35.	10.
10.	569.	25.	50.	40.	0.

1 BASIN ID: -- BASIN COMMENT: 650

**** STORM NO. = 1 **** DATE OR RETURN PERIOD = 100-year,

TOTAL PRECIP. = 4.41 EXCESS PRECIP. = 3.395 INCHES
VOLUME OF EXCESS PRECIP = 32.59 ACRE-FEET
PEAK Q = 531. CFS TIME OF PEAK = 135. MIN.
INFILT.= 4.50 IN/HR DECAY =0.00180 FNINF = 0.60 IN/HR
MAX.PERV.RET.=0.40 IN. MAX.IMP.RET.=0.10 IN.

1 U.D.F.C.D. CUHP RUNOFF ANALYSIS EXECUTED ON DATE 5/23/2005 AT TIME 16:45

CUHPF/PC RELEASE 2A (32-BIT VER) SEPTEMBER 10, 1998

PRINT OPTION NUMBER SELECTED FOR THIS BASIN IS 8

IL

BASIN ID: -- BASIN COMMENT: 660

AREA (SQMI)	LENGTH OF BASIN (MI)	DIST TO CENTROID (MI)	IMPERV. AREA (PCT)	SLOPE (FT/FT)	UNIT DURATION (MIN)
0.31	0.64	0.39	92.74	0.0248	5.00

COEFFICIENT (REFLECTING TIME TO PEAK)	COEFFICIENT (RELATED TO PEAK RATE OF RUNOFF)
0.074	0.700

THIS BASIN USES TRADITIONAL DRAINAGE PRACTICES

FRACTION OF PERVIOUS AREA RECEIVING IMPERVIOUS DRAINAGE (DEFAULT)	FRACTION OF IMPERVIOUS AREA DIRECTLY CONNECTED TO DRAINAGE SYSTEM (DEFAULT)
R= 0.37	D= 1.00

CALCULATED UNIT HYDROGRAPH

TIME TO PEAK (MIN)	PEAK RATE OF RUNOFF (CFS/SQMI)	UNIT HYDROGRAPH PEAK (CFS)	VOLUME OF RUNOFF (AF)
8.08	4812.33	1491.82	16.53

WIDTH AT 50 = 6. MIN. WIDTH AT 75 = 3. MIN. K50 =0.35 K75 =0.45

RAINFALL LOSSES INPUT W/ BASIN DATA

MAX. PERVIOUS RET. =0.40 IN. MAX. IMPERVIOUS RET. =0.10 IN.
INFILTRATION = 4.50 IN./HR. DECAY = 0.00180/SECOND FNINFL = 0.60 IN./HR.

TIME	UNIT HYDROGRAPH	TIME	UNIT HYDROGRAPH	TIME	UNIT HYDROGRAPH
0.	0.	15.	430.	30.	24.
5.	419.	20.	164.	35.	9.
10.	1097.	25.	63.	40.	0.

1 BASIN ID: -- BASIN COMMENT: 660

**** STORM NO. = 1 **** DATE OR RETURN PERIOD = 100-year,

TOTAL PRECIP. = 4.41 EXCESS PRECIP. = 3.941 INCHES

VOLUME OF EXCESS PRECIP = 65.16 ACRE-FEET
PEAK Q = 913. CFS TIME OF PEAK = 135. MIN.
INFILT.= 4.50 IN/HR DECAY =0.00180 FNINF = 0.60 IN/HR
MAX.PERV.RET.=0.40 IN. MAX.IMP.RET.=0.10 IN.

1 U.D.F.C.D. CUHP RUNOFF ANALYSIS EXECUTED ON DATE 5/23/2005 AT TIME 16:45

CUHPF/PC RELEASE 2A (32-BIT VER) SEPTEMBER 10, 1998

PRINT OPTION NUMBER SELECTED FOR THIS BASIN IS 8

IL

BASIN ID: -- BASIN COMMENT: 450

AREA (SQMI)	LENGTH OF BASIN (MI)	DIST TO CENTROID (MI)	IMPERV. AREA (PCT)	SLOPE (FT/FT)	UNIT DURATION (MIN)
0.13	0.38	0.18	74.47	0.0232	5.00

COEFFICIENT (REFLECTING TIME TO PEAK)	COEFFICIENT (RELATED TO PEAK RATE OF RUNOFF)
0.079	0.572

THIS BASIN USES TRADITIONAL DRAINAGE PRACTICES

FRACTION OF PERVIOUS AREA RECEIVING IMPERVIOUS DRAINAGE (DEFAULT)	FRACTION OF IMPERVIOUS AREA DIRECTLY CONNECTED TO DRAINAGE SYSTEM (DEFAULT)
R= 0.31	D= 0.97

CALCULATED UNIT HYDROGRAPH

TIME TO PEAK (MIN)	TIME OF CONCENTRATION (MIN)	PEAK RATE OF RUNOFF (CFS/SQMI)	UNIT HYDROGRAPH PEAK (CFS)	VOLUME OF RUNOFF (AF)
9.57	21.24	3104.21	403.55	6.93

*** NOTE : THE TIME TO PEAK IS CALCULATED BASED ON THE TIME OF CONCENTRATION PROVIDED BY THE USER, REPLACING THE ONE COMPUTED BY CUHPF (TP= 5.71)

WIDTH AT 50 = 10. MIN. WIDTH AT 75 = 5. MIN. K50 =0.35 K75 =0.45

RAINFALL LOSSES INPUT W/ BASIN DATA

MAX. PERVIOUS RET. =0.40 IN. MAX. IMPERVIOUS RET. =0.10 IN.
INFILTRATION = 4.50 IN./HR. DECAY = 0.00180/SECOND FNINFL = 0.60 IN./HR.

TIME	UNIT HYDROGRAPH	TIME	UNIT HYDROGRAPH	TIME	UNIT HYDROGRAPH
0.	0.	20.	123.	40.	11.
5.	125.	25.	68.	45.	0.
10.	401.	30.	37.	0.	0.
15.	226.	35.	21.	0.	0.

1 BASIN ID: -- BASIN COMMENT: 450

**** STORM NO. = 1 **** DATE OR RETURN PERIOD = 100-year,

TOTAL PRECIP. = 4.41 EXCESS PRECIP. = 3.521 INCHES
VOLUME OF EXCESS PRECIP = 24.41 ACRE-FEET
PEAK Q = 400. CFS TIME OF PEAK = 135. MIN.
INFILT.= 4.50 IN/HR DECAY =0.00180 FNINF = 0.60 IN/HR
MAX.PERV.RET.=0.40 IN. MAX.IMP.RET.=0.10 IN.

1 U.D.F.C.D. CUHP RUNOFF ANALYSIS EXECUTED ON DATE 5/23/2005 AT TIME 16:45

CUHPF/PC RELEASE 2A (32-BIT VER) SEPTEMBER 10, 1998

PRINT OPTION NUMBER SELECTED FOR THIS BASIN IS 8

IL

BASIN ID: -- BASIN COMMENT: 675

AREA (SQMI) | LENGTH OF BASIN (MI) | DIST TO CENTROID (MI) | IMPERV. AREA (PCT) | SLOPE (FT/FT) | UNIT DURATION (MIN)

0.11	0.94	0.41	46.14	0.0085	5.00

COEFFICIENT (REFLECTING TIME TO PEAK)	COEFFICIENT (RELATED TO PEAK RATE OF RUNOFF)
0.090	0.422

THIS BASIN USES TRADITIONAL DRAINAGE PRACTICES

FRACTION OF PERVIOUS AREA RECEIVING IMPERVIOUS DRAINAGE (DEFAULT)	FRACTION OF IMPERVIOUS AREA DIRECTLY CONNECTED TO DRAINAGE SYSTEM (DEFAULT)
R= 0.21	D= 0.83

CALCULATED UNIT HYDROGRAPH

TIME TO PEAK (MIN)	TIME OF CONCENTRATION (MIN)	PEAK RATE OF RUNOFF (CFS/SQMI)	UNIT HYDROGRAPH PEAK (CFS)	VOLUME OF RUNOFF (AF)
15.05	37.70	1291.18	142.03	5.87

*** NOTE : THE TIME TO PEAK IS CALCULATED BASED ON THE TIME OF CONCENTRATION PROVIDED BY THE USER,
REPLACING THE ONE COMPUTED BY CUHPF (TP= 13.25)

WIDTH AT 50 = 23. MIN. WIDTH AT 75 = 12. MIN. K50 =0.35 K75 =0.45

RAINFALL LOSSES INPUT W/ BASIN DATA

MAX. PERVIOUS RET. =0.40 IN. MAX. IMPERVIOUS RET. =0.10 IN.
INFILTRATION = 4.50 IN./HR. DECAY = 0.00180/SECOND FNINFL = 0.60 IN./HR.

TIME	UNIT HYDROGRAPH	TIME	UNIT HYDROGRAPH	TIME	UNIT HYDROGRAPH
0.	0.	30.	72.	60.	20.
5.	45.	35.	58.	65.	17.
10.	112.	40.	47.	70.	13.
15.	142.	45.	38.	75.	11.
20.	121.	50.	31.	80.	9.
25.	93.	55.	25.	85.	0.

1 BASIN ID: -- BASIN COMMENT: 675

**** STORM NO. = 1 **** DATE OR RETURN PERIOD = 100-year,

TOTAL PRECIP. = 4.41 EXCESS PRECIP. = 2.847 INCHES
VOLUME OF EXCESS PRECIP = 16.70 ACRE-FEET
PEAK Q = 232. CFS TIME OF PEAK = 140. MIN.
INFILT.= 4.50 IN/HR DECAY =0.00180 FNINF = 0.60 IN/HR
MAX.PERV.RET.=0.40 IN. MAX.IMP.RET.=0.10 IN.

1 U.D.F.C.D. CUHP RUNOFF ANALYSIS EXECUTED ON DATE 5/23/2005 AT TIME 16:45

CUHPF/PC RELEASE 2A (32-BIT VER) SEPTEMBER 10, 1998

PRINT OPTION NUMBER SELECTED FOR THIS BASIN IS 8

IL

BASIN ID: -- BASIN COMMENT: 725

AREA (SQMI)	LENGTH OF BASIN (MI)	DIST TO CENTROID (MI)	IMPERV. AREA (PCT)	SLOPE (FT/FT)	UNIT DURATION (MIN)
0.19	0.65	0.21	9.27	0.0101	5.00

COEFFICIENT (REFLECTING TIME TO PEAK)	COEFFICIENT (RELATED TO PEAK RATE OF RUNOFF)
0.129	0.226

THIS BASIN USES TRADITIONAL DRAINAGE PRACTICES

FRACTION OF PERVIOUS AREA RECEIVING IMPERVIOUS DRAINAGE (DEFAULT)	FRACTION OF IMPERVIOUS AREA DIRECTLY CONNECTED TO DRAINAGE SYSTEM (DEFAULT)
R= 0.08	D= 0.19

CALCULATED UNIT HYDROGRAPH

TIME TO PEAK (MIN)	PEAK RATE OF RUNOFF (CFS/SQMI)	UNIT HYDROGRAPH PEAK (CFS)	VOLUME OF RUNOFF (AF)
11.48	968.97	184.10	10.13

WIDTH AT 50 = 31. MIN. WIDTH AT 75 = 16. MIN. K50 =0.22 K75 =0.30

RAINFALL LOSSES INPUT W/ BASIN DATA

MAX. PERVIOUS RET. =0.40 IN. MAX. IMPERVIOUS RET. =0.10 IN.
INFILTRATION = 4.50 IN./HR. DECAY = 0.00180/SECOND FNINFL = 0.60 IN./HR.

TIME	UNIT HYDROGRAPH	TIME	UNIT HYDROGRAPH	TIME	UNIT HYDROGRAPH
0.	0.	45.	70.	90.	19.
5.	103.	50.	60.	95.	16.
10.	181.	55.	52.	100.	14.
15.	170.	60.	45.	105.	12.
20.	138.	65.	39.	110.	11.
25.	130.	70.	34.	115.	9.
30.	112.	75.	29.	120.	8.
35.	94.	80.	25.	125.	0.
40.	81.	85.	22.	0.	0.

1 BASIN ID: -- BASIN COMMENT: 725

**** STORM NO. = 1 **** DATE OR RETURN PERIOD = 100-year,

TOTAL PRECIP. = 4.41 EXCESS PRECIP. = 2.069 INCHES
VOLUME OF EXCESS PRECIP = 20.97 ACRE-FEET
PEAK Q = 291. CFS TIME OF PEAK = 140. MIN.
INFILT.= 4.50 IN/HR DECAY =0.00180 FNINF = 0.60 IN/HR
MAX.PERV.RET.=0.40 IN. MAX.IMP.RET.=0.10 IN.
1 U.D.F.C.D. CUHP RUNOFF ANALYSIS EXECUTED ON DATE 5/23/2005 AT TIME 16:45

CUHPF/PC RELEASE 2A (32-BIT VER) SEPTEMBER 10, 1998

PRINT OPTION NUMBER SELECTED FOR THIS BASIN IS 8

IL

BASIN ID: -- BASIN COMMENT: 525

AREA (SQMI)	LENGTH OF BASIN (MI)	DIST TO CENTROID (MI)	IMPERV. AREA (PCT)	SLOPE (FT/FT)	UNIT DURATION (MIN)
0.05	0.18	0.04	27.24	0.0325	5.00

COEFFICIENT (REFLECTING TIME TO PEAK)	COEFFICIENT (RELATED TO PEAK RATE OF RUNOFF)
0.102	0.238

THIS BASIN USES TRADITIONAL DRAINAGE PRACTICES

FRACTION OF PERVIOUS AREA RECEIVING IMPERVIOUS DRAINAGE (DEFAULT)	FRACTION OF IMPERVIOUS AREA DIRECTLY CONNECTED TO DRAINAGE SYSTEM (DEFAULT)
R= 0.15	D= 0.54

CALCULATED UNIT HYDROGRAPH

TIME TO PEAK (MIN)	TIME OF CONCENTRATION (MIN)	PEAK RATE OF RUNOFF (CFS/SQMI)	UNIT HYDROGRAPH PEAK (CFS)	VOLUME OF RUNOFF (AF)
7.50	15.16	1825.72	91.29	2.67

*** NOTE : THE TIME TO PEAK IS CALCULATED BASED ON THE TIME OF CONCENTRATION PROVIDED BY THE USER, REPLACING THE ONE COMPUTED BY CUHPF (TP= 3.80)

WIDTH AT 50 = 16. MIN. WIDTH AT 75 = 9. MIN. K50 =0.27 K75 =0.37

RAINFALL LOSSES INPUT W/ BASIN DATA

MAX. PERVIOUS RET. =0.40 IN. MAX. IMPERVIOUS RET. =0.10 IN.
INFILTRATION = 4.50 IN./HR. DECAY = 0.00180/SECOND FNINFL = 0.60 IN./HR.

TIME	UNIT HYDROGRAPH	TIME	UNIT HYDROGRAPH	TIME	UNIT HYDROGRAPH
0.	0.	20.	44.	40.	16.
5.	78.	25.	34.	45.	12.
10.	83.	30.	26.	50.	9.
15.	61.	35.	20.	55.	0.

1 BASIN ID: -- BASIN COMMENT: 525

**** STORM NO. = 1 **** DATE OR RETURN PERIOD = 100-year,

TOTAL PRECIP. = 4.41 EXCESS PRECIP. = 2.414 INCHES
VOLUME OF EXCESS PRECIP = 6.44 ACRE-FEET
PEAK Q = 123. CFS TIME OF PEAK = 135. MIN.
INFILT.= 4.50 IN/HR DECAY =0.00180 FNINF = 0.60 IN/HR
MAX.PERV.RET.=0.40 IN. MAX.IMP.RET.=0.10 IN.

1 U.D.F.C.D. CUHP RUNOFF ANALYSIS EXECUTED ON DATE 5/23/2005 AT TIME 16:45

CUHPF/PC RELEASE 2A (32-BIT VER) SEPTEMBER 10, 1998

PRINT OPTION NUMBER SELECTED FOR THIS BASIN IS 8

IL

BASIN ID: -- BASIN COMMENT: 685

AREA (SQMI)	LENGTH OF BASIN (MI)	DIST TO CENTROID (MI)	IMPERV. AREA (PCT)	SLOPE (FT/FT)	UNIT DURATION (MIN)
0.09	0.95	0.47	20.97	0.0065	5.00

COEFFICIENT (REFLECTING TIME TO PEAK)	COEFFICIENT (RELATED TO PEAK RATE OF RUNOFF)
0.109	0.227

THIS BASIN USES TRADITIONAL DRAINAGE PRACTICES

FRACTION OF PERVIOUS AREA RECEIVING IMPERVIOUS DRAINAGE (DEFAULT)	FRACTION OF IMPERVIOUS AREA DIRECTLY CONNECTED TO DRAINAGE SYSTEM (DEFAULT)
R= 0.12	D= 0.42

CALCULATED UNIT HYDROGRAPH

TIME TO PEAK (MIN)	TIME OF CONCENTRATION (MIN)	PEAK RATE OF RUNOFF (CFS/SQMI)	UNIT HYDROGRAPH PEAK (CFS)	VOLUME OF RUNOFF (AF)
9.24	37.76	1292.82	116.35	4.80

*** NOTE : THE TIME TO PEAK IS CALCULATED BASED ON THE TIME OF CONCENTRATION PROVIDED BY THE USER, REPLACING THE ONE COMPUTED BY CUHPF (TP= 17.39)

WIDTH AT 50 = 23. MIN. WIDTH AT 75 = 12. MIN. K50 =0.24 K75 =0.32

RAINFALL LOSSES INPUT W/ BASIN DATA

MAX. PERVIOUS RET. =0.40 IN. MAX. IMPERVIOUS RET. =0.10 IN.
INFILTRATION = 4.50 IN./HR. DECAY = 0.00180/SECOND FNINFL = 0.60 IN./HR.

TIME	UNIT HYDROGRAPH	TIME	UNIT HYDROGRAPH	TIME	UNIT HYDROGRAPH
0.	0.	30.	52.	60.	17.
5.	83.	35.	43.	65.	14.
10.	116.	40.	36.	70.	12.
15.	92.	45.	30.	75.	10.
20.	79.	50.	25.	80.	8.
25.	64.	55.	20.	85.	0.

1 BASIN ID: -- BASIN COMMENT: 685

**** STORM NO. = 1 **** DATE OR RETURN PERIOD = 100-year,

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TOTAL PRECIP. =  4.41      EXCESS PRECIP. = 2.284  INCHES
VOLUME OF EXCESS PRECIP =  10.97  ACRE-FEET
PEAK Q =  177. CFS        TIME OF PEAK = 135. MIN.
INFILT.= 4.50 IN/HR    DECAY =0.00180     FNINF = 0.60 IN/HR
MAX.PERV.RET.=0.40 IN.      MAX.IMP.RET.=0.10 IN.
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1COSA-100Y24H
1100-year, .013.013.013.017.017.017.017.017.017.017.017.017.017.017.017.029.029
1100-year, .029.037.037.037 .44 .44 .44 .44 .44 .44.051.051.051.051.051.051.036
1100-year, .036.036.036.036.036.029.029.029.029.029.029.029.029.029.029.029.029
1100-year, .022.022.022.022.022.022.022.022.022.022.022.022.022.022.022.022.022
1100-year, .022.022.022.022

81 1 1 5.        10B100
 .05.1626 .05816.66.072314.77    .4    .1   4.5.0018    .6
81 1 1 5.        15B150
 .03.2016.116590.54.030210.96    .4    .1   4.5.0018    .6
81 1 1 5.        21B215
 .05.3793.1437 33.8.052621.13    .4    .1   4.5.0018    .6
81 1 1 5.        22B225
 .03.1865.100587.56.061810.23    .4    .1   4.5.0018    .6
81 1 1 5.        25B250
 .09.2758 .12595.74.042310.43    .4    .1   4.5.0018    .6
81 1 1 5.        27B270
 .14.3925.2158   2. .02521.52    .4    .1   4.5.0018    .6
81 1 1 5.        29B275
 .03.1898.087495.75 .01611.81    .4    .1   4.5.0018    .6
81 1 1 5.        30B300
 .14.5578.2873 2.08.022626.36    .4    .1   4.5.0018    .6
80 1 1 5.        20B200
 .371.232.5722 8.53  .04         .4    .1   4.5.0018    .6
81 1 1 5.        26B260
 .06.2814.113695.53.011817.18    .4    .1   4.5.0018    .6
E
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1 U.D.F.C.D. CUHP RUNOFF ANALYSIS EXECUTED ON DATE 5/23/2005 AT TIME 16:28

CUHPF/PC RELEASE 2A (32-BIT VER) SEPTEMBER 10, 1998

PRINT OPTION NUMBER SELECTED FOR THIS BASIN IS 8

00Y24H

BASIN ID: -- BASIN COMMENT: B100

AREA (SQMI)	LENGTH OF BASIN (MI)	DIST TO CENTROID (MI)	IMPERV. AREA (PCT)	SLOPE (FT/FT)	UNIT DURATION (MIN)
0.05	0.16	0.06	16.66	0.0723	5.00

COEFFICIENT (REFLECTING TIME TO PEAK)	COEFFICIENT (RELATED TO PEAK RATE OF RUNOFF)
0.115	0.194

THIS BASIN USES TRADITIONAL DRAINAGE PRACTICES

FRACTION OF PERVIOUS AREA RECEIVING IMPERVIOUS DRAINAGE (DEFAULT)	FRACTION OF IMPERVIOUS AREA DIRECTLY CONNECTED TO DRAINAGE SYSTEM (DEFAULT)
R= 0.11	D= 0.33

CALCULATED UNIT HYDROGRAPH

TIME TO PEAK (MIN)	TIME OF CONCENTRATION (MIN)	PEAK RATE OF RUNOFF (CFS/SQMI)	UNIT HYDROGRAPH PEAK (CFS)	VOLUME OF RUNOFF (AF)
7.50	14.77	1488.57	74.43	2.67

*** NOTE : THE TIME TO PEAK IS CALCULATED BASED ON THE TIME OF CONCENTRATION PROVIDED BY THE USER, REPLACING THE ONE COMPUTED BY CUHPF (TP= 3.88)

WIDTH AT 50 = 20. MIN. WIDTH AT 75 = 10. MIN. K50 =0.22 K75 =0.30

RAINFALL LOSSES INPUT W/ BASIN DATA

MAX. PERVIOUS RET. =0.40 IN. MAX. IMPERVIOUS RET. =0.10 IN.
INFILTRATION = 4.50 IN./HR. DECAY = 0.00180/SECOND FNINFL = 0.60 IN./HR.

TIME	UNIT HYDROGRAPH	TIME	UNIT HYDROGRAPH	TIME	UNIT HYDROGRAPH
0.	0.	25.	35.	50.	13.
5.	64.	30.	29.	55.	11.
10.	68.	35.	24.	60.	9.
15.	55.	40.	19.	65.	0.
20.	44.	45.	16.	0.	0.

1 BASIN ID: -- BASIN COMMENT: B100

**** STORM NO. = 1 **** DATE OR RETURN PERIOD = 100-year,

TOTAL PRECIP. = 4.41 EXCESS PRECIP. = 2.201 INCHES
VOLUME OF EXCESS PRECIP = 5.87 ACRE-FEET
PEAK Q = 107. CFS TIME OF PEAK = 135. MIN.
INFILT.= 4.50 IN/HR DECAY =0.00180 FNINF = 0.60 IN/HR
MAX.PERV.RET.=0.40 IN. MAX.IMP.RET.=0.10 IN.

1 U.D.F.C.D. CUHP RUNOFF ANALYSIS EXECUTED ON DATE 5/23/2005 AT TIME 16:28

CUHPF/PC RELEASE 2A (32-BIT VER) SEPTEMBER 10, 1998

PRINT OPTION NUMBER SELECTED FOR THIS BASIN IS 8

00Y24H

BASIN ID: -- BASIN COMMENT: B150

AREA (SQMI)	LENGTH OF BASIN (MI)	DIST TO CENTROID (MI)	IMPERV. AREA (PCT)	SLOPE (FT/FT)	UNIT DURATION (MIN)
0.03	0.20	0.12	90.54	0.0302	5.00

COEFFICIENT COEFFICIENT

(REFLECTING TIME TO PEAK)	(RELATED TO PEAK RATE OF RUNOFF)
0.075	0.490

THIS BASIN USES TRADITIONAL DRAINAGE PRACTICES

FRACTION OF PERVIOUS AREA RECEIVING IMPERVIOUS DRAINAGE (DEFAULT)	FRACTION OF IMPERVIOUS AREA DIRECTLY CONNECTED TO DRAINAGE SYSTEM (DEFAULT)
R= 0.37	D= 1.00

CALCULATED UNIT HYDROGRAPH

TIME TO PEAK (MIN)	TIME OF CONCENTRATION (MIN)	PEAK RATE OF RUNOFF (CFS/SQMI)	UNIT HYDROGRAPH PEAK (CFS)	VOLUME OF RUNOFF (AF)
7.50	10.96	3762.65	112.88	1.60

*** NOTE : THE TIME TO PEAK IS CALCULATED BASED ON THE TIME OF CONCENTRATION PROVIDED BY THE USER, REPLACING THE ONE COMPUTED BY CUHPF (TP= 4.21)

WIDTH AT 50 = 8. MIN. WIDTH AT 75 = 4. MIN. K50 =0.35 K75 =0.45

RAINFALL LOSSES INPUT W/ BASIN DATA

MAX. PERVIOUS RET. =0.40 IN. MAX. IMPERVIOUS RET. =0.10 IN.
INFILTRATION = 4.50 IN./HR. DECAY = 0.00180/SECOND FNINFL = 0.60 IN./HR.

TIME	UNIT HYDROGRAPH	TIME	UNIT HYDROGRAPH	TIME	UNIT HYDROGRAPH
0.	0.	15.	42.	30.	0.
5.	64.	20.	22.	0.	0.
10.	83.	25.	12.	0.	0.

1 BASIN ID: -- BASIN COMMENT: B150

**** STORM NO. = 1 **** DATE OR RETURN PERIOD = 100-year,

TOTAL PRECIP. = 4.41 EXCESS PRECIP. = 3.894 INCHES
VOLUME OF EXCESS PRECIP = 6.23 ACRE-FEET
PEAK Q = 93. CFS TIME OF PEAK = 135. MIN.
INFILT.= 4.50 IN/HR DECAY =0.00180 FNINF = 0.60 IN/HR
MAX.PERV.RET.=0.40 IN. MAX.IMP.RET.=0.10 IN.

1 U.D.F.C.D. CUHP RUNOFF ANALYSIS EXECUTED ON DATE 5/23/2005 AT TIME 16:28

CUHPF/PC RELEASE 2A (32-BIT VER) SEPTEMBER 10, 1998

PRINT OPTION NUMBER SELECTED FOR THIS BASIN IS 8

00Y24H

BASIN ID: -- BASIN COMMENT: B215

AREA (SQMI)	LENGTH OF BASIN (MI)	DIST TO CENTROID (MI)	IMPERV. AREA (PCT)	SLOPE (FT/FT)	UNIT DURATION (MIN)
0.05	0.38	0.14	33.80	0.0526	5.00

COEFFICIENT (REFLECTING TIME TO PEAK)	COEFFICIENT (RELATED TO PEAK RATE OF RUNOFF)
0.097	0.281

THIS BASIN USES TRADITIONAL DRAINAGE PRACTICES

FRACTION OF PERVIOUS AREA RECEIVING IMPERVIOUS DRAINAGE (DEFAULT)	FRACTION OF IMPERVIOUS AREA DIRECTLY CONNECTED TO DRAINAGE SYSTEM (DEFAULT)
R= 0.17	D= 0.68

CALCULATED UNIT HYDROGRAPH

TIME TO PEAK (MIN)	TIME OF CONCENTRATION (MIN)	PEAK RATE OF RUNOFF (CFS/SQMI)	UNIT HYDROGRAPH PEAK (CFS)	VOLUME OF RUNOFF (AF)
7.76	21.13	2048.38	102.42	2.67

*** NOTE : THE TIME TO PEAK IS CALCULATED BASED ON THE TIME OF CONCENTRATION PROVIDED BY THE USER,
REPLACING THE ONE COMPUTED BY CUHPF (TP= 5.41)

WIDTH AT 50 = 15. MIN. WIDTH AT 75 = 8. MIN. K50 =0.32 K75 =0.43

RAINFALL LOSSES INPUT W/ BASIN DATA

MAX. PERVIOUS RET. =0.40 IN. MAX. IMPERVIOUS RET. =0.10 IN.
INFILTRATION = 4.50 IN./HR. DECAY = 0.00180/SECOND FNINFL = 0.60 IN./HR.

TIME	UNIT HYDROGRAPH	TIME	UNIT HYDROGRAPH	TIME	UNIT HYDROGRAPH
0.	0.	20.	45.	40.	13.
5.	85.	25.	33.	45.	10.
10.	94.	30.	24.	50.	0.
15.	64.	35.	18.	0.	0.

1 BASIN ID: -- BASIN COMMENT: B215

**** STORM NO. = 1 **** DATE OR RETURN PERIOD = 100-year,

TOTAL PRECIP. = 4.41 EXCESS PRECIP. = 2.561 INCHES
VOLUME OF EXCESS PRECIP = 6.83 ACRE-FEET
PEAK Q = 132. CFS TIME OF PEAK = 135. MIN.
INFILT.= 4.50 IN/HR DECAY =0.00180 FNINF = 0.60 IN/HR
MAX.PERV.RET.=0.40 IN. MAX.IMP.RET.=0.10 IN.

1 U.D.F.C.D. CUHP RUNOFF ANALYSIS EXECUTED ON DATE 5/23/2005 AT TIME 16:28

CUHPF/PC RELEASE 2A (32-BIT VER) SEPTEMBER 10, 1998

PRINT OPTION NUMBER SELECTED FOR THIS BASIN IS 8

00Y24H

BASIN ID: -- BASIN COMMENT: B225

AREA (SQMI)	LENGTH OF BASIN (MI)	DIST TO CENTROID (MI)	IMPERV. AREA (PCT)	SLOPE (FT/FT)	UNIT DURATION (MIN)
0.03	0.19	0.10	87.56	0.0618	5.00

COEFFICIENT (REFLECTING TIME TO PEAK)	COEFFICIENT (RELATED TO PEAK RATE OF RUNOFF)
0.075	0.485

THIS BASIN USES TRADITIONAL DRAINAGE PRACTICES

FRACTION OF PERVIOUS AREA RECEIVING IMPERVIOUS DRAINAGE (DEFAULT)	FRACTION OF IMPERVIOUS AREA DIRECTLY CONNECTED TO DRAINAGE SYSTEM (DEFAULT)
R= 0.36	D= 1.00

CALCULATED UNIT HYDROGRAPH

TIME TO PEAK (MIN)	TIME OF CONCENTRATION (MIN)	PEAK RATE OF RUNOFF (CFS/SQMI)	UNIT HYDROGRAPH PEAK (CFS)	VOLUME OF RUNOFF (AF)
7.50	10.23	3727.71	111.83	1.60

*** NOTE : THE TIME TO PEAK IS CALCULATED BASED ON THE TIME OF CONCENTRATION PROVIDED BY THE USER,
REPLACING THE ONE COMPUTED BY CUHPF (TP= 3.80)

WIDTH AT 50 = 8. MIN. WIDTH AT 75 = 4. MIN. K50 =0.35 K75 =0.45

RAINFALL LOSSES INPUT W/ BASIN DATA

MAX. PERVIOUS RET. =0.40 IN. MAX. IMPERVIOUS RET. =0.10 IN.
INFILTRATION = 4.50 IN./HR. DECAY = 0.00180/SECOND FNINFL = 0.60 IN./HR.

TIME	UNIT HYDROGRAPH	TIME	UNIT HYDROGRAPH	TIME	UNIT HYDROGRAPH

0.	0.	15.	42.	30.	0.
5.	65.	20.	23.	0.	0.
10.	82.	25.	12.	0.	0.

1 BASIN ID: -- BASIN COMMENT: B225

**** STORM NO. = 1 **** DATE OR RETURN PERIOD = 100-year,

TOTAL PRECIP. = 4.41 EXCESS PRECIP. = 3.830 INCHES
VOLUME OF EXCESS PRECIP = 6.13 ACRE-FEET
PEAK Q = 93. CFS TIME OF PEAK = 135. MIN.
INFILT.= 4.50 IN/HR DECAY =0.00180 FNINF = 0.60 IN/HR
MAX.PERV.RET.=0.40 IN. MAX.IMP.RET.=0.10 IN.

1 U.D.F.C.D. CUHP RUNOFF ANALYSIS EXECUTED ON DATE 5/23/2005 AT TIME 16:28

CUHPF/PC RELEASE 2A (32-BIT VER) SEPTEMBER 10, 1998

PRINT OPTION NUMBER SELECTED FOR THIS BASIN IS 8

00Y24H

BASIN ID: -- BASIN COMMENT: B250

AREA (SQMI)	LENGTH OF BASIN (MI)	DIST TO CENTROID (MI)	IMPERV. AREA (PCT)	SLOPE (FT/FT)	UNIT DURATION (MIN)
0.09	0.28	0.12	95.74	0.0423	5.00

COEFFICIENT (REFLECTING TIME TO PEAK)	COEFFICIENT (RELATED TO PEAK RATE OF RUNOFF)
0.074	0.586

THIS BASIN USES TRADITIONAL DRAINAGE PRACTICES

FRACTION OF PERVIOUS AREA RECEIVING IMPERVIOUS DRAINAGE (DEFAULT)	FRACTION OF IMPERVIOUS AREA DIRECTLY CONNECTED TO DRAINAGE SYSTEM (DEFAULT)
R= 0.39	D= 1.00

CALCULATED UNIT HYDROGRAPH

TIME TO PEAK (MIN)	TIME OF CONCENTRATION (MIN)	PEAK RATE OF RUNOFF (CFS/SQMI)	UNIT HYDROGRAPH PEAK (CFS)	VOLUME OF RUNOFF (AF)
7.50	10.43	4498.78	404.89	4.80

*** NOTE : THE TIME TO PEAK IS CALCULATED BASED ON THE TIME OF CONCENTRATION PROVIDED BY THE USER, REPLACING THE ONE COMPUTED BY CUHPF (TP= 4.37)

WIDTH AT 50 = 7. MIN. WIDTH AT 75 = 3. MIN. K50 =0.35 K75 =0.45

RAINFALL LOSSES INPUT W/ BASIN DATA

MAX. PERVIOUS RET. =0.40 IN. MAX. IMPERVIOUS RET. =0.10 IN.
INFILTRATION = 4.50 IN./HR. DECAY = 0.00180/SECOND FNINFL = 0.60 IN./HR.

TIME	UNIT HYDROGRAPH	TIME	UNIT HYDROGRAPH	TIME	UNIT HYDROGRAPH
0.	0.	15.	116.	30.	8.
5.	185.	20.	48.	35.	0.
10.	279.	25.	20.	0.	0.

1 BASIN ID: -- BASIN COMMENT: B250

**** STORM NO. = 1 **** DATE OR RETURN PERIOD = 100-year,

TOTAL PRECIP. = 4.41 EXCESS PRECIP. = 4.006 INCHES
VOLUME OF EXCESS PRECIP = 19.23 ACRE-FEET
PEAK Q = 273. CFS TIME OF PEAK = 135. MIN.
INFILT.= 4.50 IN/HR DECAY =0.00180 FNINF = 0.60 IN/HR
MAX.PERV.RET.=0.40 IN. MAX.IMP.RET.=0.10 IN.

1 U.D.F.C.D. CUHP RUNOFF ANALYSIS EXECUTED ON DATE 5/23/2005 AT TIME 16:28

CUHPF/PC RELEASE 2A (32-BIT VER) SEPTEMBER 10, 1998

PRINT OPTION NUMBER SELECTED FOR THIS BASIN IS 8

00Y24H

BASIN ID: -- BASIN COMMENT: B270

AREA (SQMI)	LENGTH OF BASIN (MI)	DIST TO CENTROID (MI)	IMPERV. AREA (PCT)	SLOPE (FT/FT)	UNIT DURATION (MIN)
0.14	0.39	0.22	2.00	0.0250	5.00

COEFFICIENT (REFLECTING TIME TO PEAK)	COEFFICIENT (RELATED TO PEAK RATE OF RUNOFF)
0.156	0.249

THIS BASIN USES TRADITIONAL DRAINAGE PRACTICES

FRACTION OF PERVIOUS AREA RECEIVING IMPERVIOUS DRAINAGE (DEFAULT)	FRACTION OF IMPERVIOUS AREA DIRECTLY CONNECTED TO DRAINAGE SYSTEM (DEFAULT)
R= 0.06	D= 0.04

CALCULATED UNIT HYDROGRAPH

TIME TO PEAK (MIN)	TIME OF CONCENTRATION (MIN)	PEAK RATE OF RUNOFF (CFS/SQMI)	UNIT HYDROGRAPH PEAK (CFS)	VOLUME OF RUNOFF (AF)
7.50	21.52	1909.08	267.27	7.47

*** NOTE : THE TIME TO PEAK IS CALCULATED BASED ON THE TIME OF CONCENTRATION PROVIDED BY THE USER, REPLACING THE ONE COMPUTED BY CUHPF (TP= 9.42)

WIDTH AT 50 = 16. MIN. WIDTH AT 75 = 8. MIN. K50 =0.29 K75 =0.39

RAINFALL LOSSES INPUT W/ BASIN DATA

MAX. PERVIOUS RET. =0.40 IN. MAX. IMPERVIOUS RET. =0.10 IN.
INFILTRATION = 4.50 IN./HR. DECAY = 0.00180/SECOND FNINFL = 0.60 IN./HR.

TIME	UNIT HYDROGRAPH	TIME	UNIT HYDROGRAPH	TIME	UNIT HYDROGRAPH
0.	0.	25.	91.	50.	20.
5.	228.	30.	67.	55.	14.
10.	243.	35.	49.	60.	11.
15.	174.	40.	36.	65.	8.
20.	123.	45.	27.	70.	0.

1 BASIN ID: -- BASIN COMMENT: B270

**** STORM NO. = 1 **** DATE OR RETURN PERIOD = 100-year,

TOTAL PRECIP. = 4.41 EXCESS PRECIP. = 1.964 INCHES
VOLUME OF EXCESS PRECIP = 14.67 ACRE-FEET
PEAK Q = 335. CFS TIME OF PEAK = 135. MIN.
INFILT.= 4.50 IN/HR DECAY =0.00180 FNINF = 0.60 IN/HR
MAX.PERV.RET.=0.40 IN. MAX.IMP.RET.=0.10 IN.

1 U.D.F.C.D. CUHP RUNOFF ANALYSIS EXECUTED ON DATE 5/23/2005 AT TIME 16:28

CUHPF/PC RELEASE 2A (32-BIT VER) SEPTEMBER 10, 1998

PRINT OPTION NUMBER SELECTED FOR THIS BASIN IS 8

00Y24H

BASIN ID: -- BASIN COMMENT: B275

AREA (SQMI)	LENGTH OF BASIN (MI)	DIST TO CENTROID (MI)	IMPERV. AREA (PCT)	SLOPE (FT/FT)	UNIT DURATION (MIN)
0.03	0.19	0.09	95.75	0.0160	5.00

COEFFICIENT (REFLECTING TIME TO PEAK)	COEFFICIENT (RELATED TO PEAK RATE OF RUNOFF)
0.074	0.497

THIS BASIN USES TRADITIONAL DRAINAGE PRACTICES

FRACTION OF PERVIOUS AREA RECEIVING IMPERVIOUS DRAINAGE (DEFAULT)	FRACTION OF IMPERVIOUS AREA DIRECTLY CONNECTED TO DRAINAGE SYSTEM (DEFAULT)
R= 0.39	D= 1.00

CALCULATED UNIT HYDROGRAPH

TIME TO PEAK (MIN)	TIME OF CONCENTRATION (MIN)	PEAK RATE OF RUNOFF (CFS/SQMI)	UNIT HYDROGRAPH PEAK (CFS)	VOLUME OF RUNOFF (AF)
7.50	11.81	3815.37	114.46	1.60

*** NOTE : THE TIME TO PEAK IS CALCULATED BASED ON THE TIME OF CONCENTRATION PROVIDED BY THE USER, REPLACING THE ONE COMPUTED BY CUHPF (TP= 4.16)

WIDTH AT 50 = 8. MIN. WIDTH AT 75 = 4. MIN. K50 =0.35 K75 =0.45

RAINFALL LOSSES INPUT W/ BASIN DATA

MAX. PERVIOUS RET. =0.40 IN. MAX. IMPERVIOUS RET. =0.10 IN.
INFILTRATION = 4.50 IN./HR. DECAY = 0.00180/SECOND FNINFL = 0.60 IN./HR.

TIME	UNIT HYDROGRAPH	TIME	UNIT HYDROGRAPH	TIME	UNIT HYDROGRAPH
0.	0.	15.	42.	30.	0.
5.	64.	20.	22.	0.	0.
10.	83.	25.	12.	0.	0.

1 BASIN ID: -- BASIN COMMENT: B275

**** STORM NO. = 1 **** DATE OR RETURN PERIOD = 100-year,

TOTAL PRECIP. = 4.41 EXCESS PRECIP. = 4.006 INCHES

VOLUME OF EXCESS PRECIP = 6.41 ACRE-FEET
PEAK Q = 93. CFS TIME OF PEAK = 135. MIN.
INFILT.= 4.50 IN/HR DECAY =0.00180 FNINF = 0.60 IN/HR
MAX.PERV.RET.=0.40 IN. MAX.IMP.RET.=0.10 IN.

1 U.D.F.C.D. CUHP RUNOFF ANALYSIS EXECUTED ON DATE 5/23/2005 AT TIME 16:28

CUHPF/PC RELEASE 2A (32-BIT VER) SEPTEMBER 10, 1998

PRINT OPTION NUMBER SELECTED FOR THIS BASIN IS 8

00Y24H

BASIN ID: -- BASIN COMMENT: B300

AREA (SQMI)	LENGTH OF BASIN (MI)	DIST TO CENTROID (MI)	IMPERV. AREA (PCT)	SLOPE (FT/FT)	UNIT DURATION (MIN)
0.14	0.56	0.29	2.08	0.0226	5.00

COEFFICIENT (REFLECTING TIME TO PEAK)	COEFFICIENT (RELATED TO PEAK RATE OF RUNOFF)
0.155	0.248

THIS BASIN USES TRADITIONAL DRAINAGE PRACTICES

FRACTION OF PERVIOUS AREA RECEIVING IMPERVIOUS DRAINAGE (DEFAULT)	FRACTION OF IMPERVIOUS AREA DIRECTLY CONNECTED TO DRAINAGE SYSTEM (DEFAULT)
R= 0.06	D= 0.04

CALCULATED UNIT HYDROGRAPH

TIME TO PEAK (MIN)	TIME OF CONCENTRATION (MIN)	PEAK RATE OF RUNOFF (CFS/SQMI)	UNIT HYDROGRAPH PEAK (CFS)	VOLUME OF RUNOFF (AF)
7.50	26.36	1905.29	266.74	7.47

*** NOTE : THE TIME TO PEAK IS CALCULATED BASED ON THE TIME OF CONCENTRATION PROVIDED BY THE USER, REPLACING THE ONE COMPUTED BY CUHPF (TP= 12.11)

WIDTH AT 50 = 16. MIN. WIDTH AT 75 = 8. MIN. K50 =0.29 K75 =0.39

RAINFALL LOSSES INPUT W/ BASIN DATA

MAX. PERVIOUS RET. =0.40 IN. MAX. IMPERVIOUS RET. =0.10 IN.
INFILTRATION = 4.50 IN./HR. DECAY = 0.00180/SECOND FNINFL = 0.60 IN./HR.

TIME	UNIT HYDROGRAPH	TIME	UNIT HYDROGRAPH	TIME	UNIT HYDROGRAPH
0.	0.	25.	91.	50.	20.
5.	228.	30.	67.	55.	14.
10.	243.	35.	49.	60.	11.
15.	173.	40.	36.	65.	8.
20.	124.	45.	27.	70.	0.

1 BASIN ID: -- BASIN COMMENT: B300

**** STORM NO. = 1 **** DATE OR RETURN PERIOD = 100-year,

TOTAL PRECIP. = 4.41 EXCESS PRECIP. = 1.965 INCHES
VOLUME OF EXCESS PRECIP = 14.67 ACRE-FEET
PEAK Q = 335. CFS TIME OF PEAK = 135. MIN.
INFILT.= 4.50 IN/HR DECAY =0.00180 FNINF = 0.60 IN/HR
MAX.PERV.RET.=0.40 IN. MAX.IMP.RET.=0.10 IN.

1 U.D.F.C.D. CUHP RUNOFF ANALYSIS EXECUTED ON DATE 5/23/2005 AT TIME 16:28

CUHPF/PC RELEASE 2A (32-BIT VER) SEPTEMBER 10, 1998

PRINT OPTION NUMBER SELECTED FOR THIS BASIN IS 8

00Y24H

BASIN ID: -- BASIN COMMENT: B200

AREA (SQMI)	LENGTH OF BASIN (MI)	DIST TO CENTROID (MI)	IMPERV. AREA (PCT)	SLOPE (FT/FT)	UNIT DURATION (MIN)
0.37	1.23	0.57	8.53	0.0400	5.00

COEFFICIENT (REFLECTING TIME TO PEAK)	COEFFICIENT (RELATED TO PEAK RATE OF RUNOFF)
0.131	0.253

THIS BASIN USES TRADITIONAL DRAINAGE PRACTICES

FRACTION OF PERVIOUS AREA RECEIVING IMPERVIOUS DRAINAGE (DEFAULT)	FRACTION OF IMPERVIOUS AREA DIRECTLY CONNECTED TO DRAINAGE SYSTEM (DEFAULT)
R= 0.08	D= 0.17

CALCULATED UNIT HYDROGRAPH

TIME TO PEAK (MIN)	PEAK RATE OF RUNOFF (CFS/SQMI)	UNIT HYDROGRAPH PEAK (CFS)	VOLUME OF RUNOFF (AF)
16.93	673.35	249.14	19.73

WIDTH AT 50 = 45. MIN. WIDTH AT 75 = 23. MIN. K50 =0.23 K75 =0.31

RAINFALL LOSSES INPUT W/ BASIN DATA

MAX. PERVIOUS RET. =0.40 IN. MAX. IMPERVIOUS RET. =0.10 IN.
INFILTRATION = 4.50 IN./HR. DECAY = 0.00180/SECOND FNINFL = 0.60 IN./HR.

TIME	UNIT HYDROGRAPH	TIME	UNIT HYDROGRAPH	TIME	UNIT HYDROGRAPH
0.	0.	65.	93.	130.	24.
5.	81.	70.	84.	135.	22.
10.	192.	75.	76.	140.	19.
15.	245.	80.	68.	145.	17.
20.	242.	85.	61.	150.	16.
25.	212.	90.	55.	155.	14.
30.	187.	95.	50.	160.	13.
35.	180.	100.	45.	165.	11.
40.	163.	105.	40.	170.	10.

45.	146.	110.	36.	175.	9.
50.	129.	115.	33.	180.	8.
55.	115.	120.	29.	185.	8.
60.	104.	125.	27.	190.	0.

1 BASIN ID: -- BASIN COMMENT: B200

**** STORM NO. = 1 **** DATE OR RETURN PERIOD = 100-year,

TOTAL PRECIP. = 4.41 EXCESS PRECIP. = 2.057 INCHES
VOLUME OF EXCESS PRECIP = 40.59 ACRE-FEET
PEAK Q = 429. CFS TIME OF PEAK = 140. MIN.
INFILT.= 4.50 IN/HR DECAY =0.00180 FNINF = 0.60 IN/HR
MAX.PERV.RET.=0.40 IN. MAX.IMP.RET.=0.10 IN.

1 U.D.F.C.D. CUHP RUNOFF ANALYSIS EXECUTED ON DATE 5/23/2005 AT TIME 16:28

CUHPF/PC RELEASE 2A (32-BIT VER) SEPTEMBER 10, 1998

PRINT OPTION NUMBER SELECTED FOR THIS BASIN IS 8

00Y24H

BASIN ID: -- BASIN COMMENT: B260

AREA (SQMI)	LENGTH OF BASIN (MI)	DIST TO CENTROID (MI)	IMPERV. AREA (PCT)	SLOPE (FT/FT)	UNIT DURATION (MIN)
0.06	0.28	0.11	95.53	0.0118	5.00

COEFFICIENT (REFLECTING TIME TO PEAK)	COEFFICIENT (RELATED TO PEAK RATE OF RUNOFF)
0.074	0.551

THIS BASIN USES TRADITIONAL DRAINAGE PRACTICES

FRACTION OF PERVIOUS AREA RECEIVING IMPERVIOUS DRAINAGE (DEFAULT)	FRACTION OF IMPERVIOUS AREA DIRECTLY CONNECTED TO DRAINAGE SYSTEM (DEFAULT)
R= 0.38	D= 1.00

CALCULATED UNIT HYDROGRAPH

TIME TO PEAK (MIN)	TIME OF CONCENTRATION (MIN)	PEAK RATE OF RUNOFF (CFS/SQMI)	UNIT HYDROGRAPH PEAK (CFS)	VOLUME OF RUNOFF (AF)
7.50	17.18	4231.17	253.87	3.20

*** NOTE : THE TIME TO PEAK IS CALCULATED BASED ON THE TIME OF CONCENTRATION PROVIDED BY THE USER, REPLACING THE ONE COMPUTED BY CUHPF (TP= 4.95)

WIDTH AT 50 = 7. MIN. WIDTH AT 75 = 4. MIN. K50 =0.35 K75 =0.45

RAINFALL LOSSES INPUT W/ BASIN DATA

MAX. PERVIOUS RET. =0.40 IN. MAX. IMPERVIOUS RET. =0.10 IN.
INFILTRATION = 4.50 IN./HR. DECAY = 0.00180/SECOND FNINFL = 0.60 IN./HR.

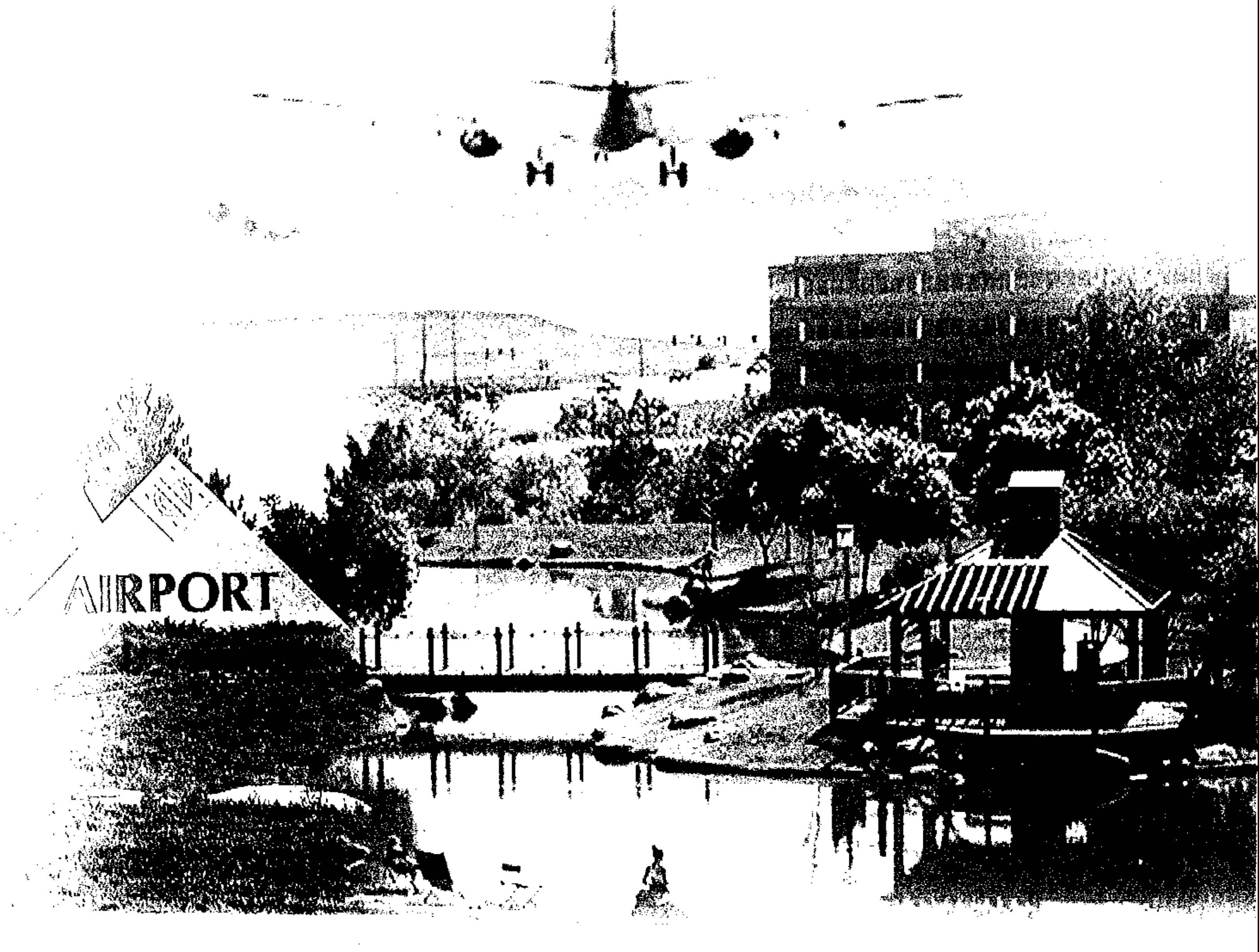
TIME	UNIT HYDROGRAPH	TIME	UNIT HYDROGRAPH	TIME	UNIT HYDROGRAPH
0.	0.	15.	79.	30.	0.
5.	126.	20.	35.	0.	0.
10.	179.	25.	16.	0.	0.

1 BASIN ID: -- BASIN COMMENT: B260

**** STORM NO. = 1 **** DATE OR RETURN PERIOD = 100-year,

TOTAL PRECIP. = 4.41 EXCESS PRECIP. = 4.001 INCHES
VOLUME OF EXCESS PRECIP = 12.80 ACRE-FEET
PEAK Q = 181. CFS TIME OF PEAK = 135. MIN.
INFILT.= 4.50 IN/HR DECAY =0.00180 FNINF = 0.60 IN/HR
MAX.PERV.RET.=0.40 IN. MAX.IMP.RET.=0.10 IN.

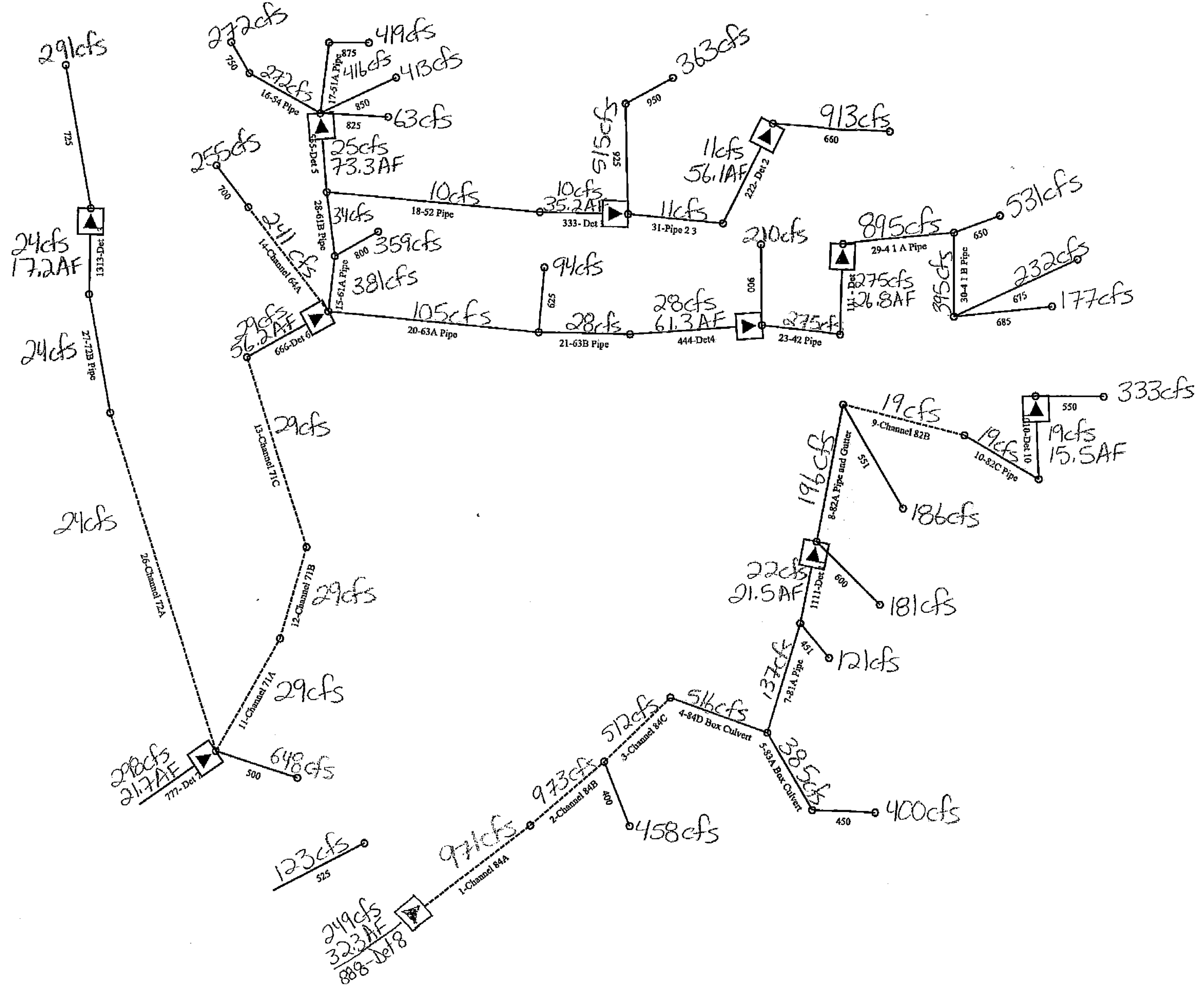
Future Condition Hydrology - UDSWM
Input and Output



APPENDIX F

Future Conditions Hydrology – UDSWM Input and Output (including Network Schematics)

Windmill Gulch
SWMM Model



WBG on Gecko \184050-CCCA\May 2005 Revised Hydrology and Hydraulics\Windmill Gulch_SWMM

SWMM Input for Windmill Gulch

Job Title (max 80 characters)	New SWMM 2000 Type 0 Model Module (Version
Job Sub-Title (max 80 characters)	A new SWMM 2000 System
Number of time-steps to be calculated:	99
Hour of start of storm:	0
Minute of start of storm:	0
Integration period (min.):	5.000
Check this box to create a printed summary of peak flows and stages at end of output:	[x]

CUHP Sub-catchment Number:	UDSWM Conveyance Element Number Draining This Subcatchment:
67	675
46	451
40	400
50	500
60	600
55	550
70	700
75	750
80	800
85	850
90	900
95	950
56	551
87	875
82	825
92	925
62	625
65	650
66	660
45	450
52	525
72	725
68	685

	Number of pairs of tabular values if a Detention element is used:	Conveyance Element Number:	Next down stream Conveyance Element number:	Type of Conveyance Element:	Pipe Diameter or Bottom width of channel (ft)	Length of Conveyance Element (ft) :	Invert slope of Conveyance Element (ft/ft)	Channel's Left-hand side slope (ft/ft) :	Channel's Right-hand side slope (ft/ft) :	Manning's n of Conveyance Element:	Depth of channel in feet when full or the pipe diameter :
		400	2	2 = Pipe	30	0.1	0.01	0	0	0.013	30
Detention Basin	9	1010	10	2 = Pipe	0.25	0.1	0.01	0	0	0.013	0.25
		17	555	2 = Pipe	5	700	0.027	0	0	0.013	5
		600	1111	2 = Pipe	30	0.1	0.01	0	0	0.013	30
		551	8	2 = Pipe	30	0.1	0.01	0	0	0.013	30
		685	30	2 = Pipe	30	0.1	0.01	0	0	0.013	30
		11	777	1 = Channel	8	1900	0.003	4	4	0.03	5.2
		525	0	2 = Pipe	30	0.1	0.01	0	0	0.013	30
Detention Basin	7	1313	27	2 = Pipe	0.25	0.1	0.01	0	0	0.013	0.25
		2	1	1 = Channel	10	440	0.003	4	4	0.03	5.5
		1	888	1 = Channel	10	604	0.0025	4	4	0.03	6
		8	1111	2 = Pipe	5.5	1290	0.005	0	0	0.013	5.5
		700	14	2 = Pipe	30	0.1	0.01	0	0	0.013	30
		725	1313	2 = Pipe	30	0.1	0.01	0	0	0.013	30
		12	11	1 = Channel	5	460	0.007	4	4	0.03	3.18
		7	4	2 = Pipe	4.5	785	0.007	0	0	0.013	4.5
		950	925	2 = Pipe	30	0.1	0.01	0	0	0.013	30
		26	777	1 = Channel	3	1600	0.025	4	4	0.03	2
		9	8	1 = Channel	2	770	0.013	4	4	0.03	2
		27	26	2 = Pipe	2	700	0.02	0	0	0.013	2
		31	333	2 = Pipe	1.75	355	0.005	0	0	0.013	1.75
Detention Basin	10	222	31	2 = Pipe	0.25	0.1	0.01	0	0	0.013	0.25
		18	28	2 = Pipe	1.75	2784	0.007	0	0	0.013	1.75
		451	7	2 = Pipe	30	0.1	0.01	0	0	0.013	30
		21	20	2 = Pipe	3	900	0.005	0	0	0.013	3
Detention Basin	10	111	23	2 = Pipe	0.25	0.1	0.01	0	0	0.013	0.25
		675	30	2 = Pipe	30	0.1	0.01	0	0	0.013	30
		750	16	2 = Pipe	30	0.1	0.01	0	0	0.013	30
		14	666	1 = Channel	6	1000	0.006	4	4	0.03	3.43
		13	12	1 = Channel	4	1020	0.02	4	4	0.03	2
		550	1010	2 = Pipe	30	0.1	0.01	0	0	0.013	30
		825	555	2 = Pipe	30	0.1	0.01	0	0	0.013	30

	Number of pairs of tabular values if a Detention element is used:	Conveyance Element Number:	Next down stream Conveyance Element number:	Type of Conveyance Element:	Pipe Diameter or Bottom width of channel (ft)	Length of Conveyance Element (ft) :	Invert slope of Conveyance Element (ft/ft)	Channel's Left-hand side slope (ft/ft) :	Channel's Right-hand side slope (ft/ft) :	Manning's n of Conveyance Element:	Depth of channel in feet when full or the pipe diameter :
		16	555	2 = Pipe	5.5	709	0.03	0	0	0.013	5.5
		15	666	2 = Pipe	5.5	500	0.015	0	0	0.013	5.5
		450	5	2 = Pipe	30	0.1	0.01	0	0	0.013	30
		10	9	2 = Pipe	2	270	0.011	0	0	0.013	2
		850	555	2 = Pipe	30	0.1	0.01	0	0	0.013	30
		650	29	2 = Pipe	30	0.1	0.01	0	0	0.013	30
		3	2	1 = Channel	10	780	0.003	4	4	0.03	5.12
Detention Basin	10	777	0	2 = Pipe	0.25	0.1	0.01	0	0	0.013	0.25
		5	4	2 = Pipe	9.03	1700	0.001	0	0	0.013	9.03
		29	111	2 = Pipe	9.5	409	0.0053	0	0	0.013	9.5
Detention Basin	10	555	28	2 = Pipe	0.25	0.1	0.01	0	0	0.013	0.25
Detention Basin	11	888	0	2 = Pipe	0.25	0.1	0.01	0	0	0.013	0.25
		4	3	2 = Pipe	7.3	895	0.005	0	0	0.013	7.3
		875	17	2 = Pipe	30	0.1	0.01	0	0	0.013	30
Detention Basin	10	444	21	2 = Pipe	0.25	0.1	0.01	0	0	0.013	0.25
Detention Basin	8	333	18	2 = Pipe	0.25	0.1	0.01	0	0	0.013	0.25
		925	333	2 = Pipe	30	0.1	0.01	0	0	0.013	30
		30	29	2 = Pipe	6.5	2430	0.0053	0	0	0.013	6.5
		800	15	2 = Pipe	30	0.1	0.01	0	0	0.013	30
Detention Basin	9	1111	7	2 = Pipe	0.25	0.1	0.01	0	0	0.013	0.25
Detention Basin	10	666	13	2 = Pipe	0.25	0.1	0.01	0	0	0.013	0.25
		20	666	2 = Pipe	3	1190	0.032	0	0	0.013	3
		660	222	2 = Pipe	30	0.1	0.01	0	0	0.013	30
		500	777	2 = Pipe	6.85	0.1	0.01	0	0	0.013	6.85
		23	444	2 = Pipe	6	466	0.005	0	0	0.013	6
		625	20	2 = Pipe	30	0.1	0.01	0	0	0.013	30
		900	444	2 = Pipe	30	0.1	0.01	0	0	0.013	30
		28	15	2 = Pipe	4	500	0.022	0	0	0.013	4

URBAN DRAINAGE STORM WATER MANAGEMENT MODEL - 32 BIT VERSION 1998
REVISED BY UNIVERSITY OF COLORADO AT DENVER

*** ENTRY MADE TO RUNOFF MODEL ***

New SWMM 2000 Type 0 Model Module (Version 1.0.1363.13642)

A new SWMM 2000 System

0NUMBER OF TIME STEPS 99
0INTEGRATION TIME INTERVAL (MINUTES), 5.00

25.0 PERCENT OF IMPERVIOUS AREA HAS ZERO DETENTION DEPTH
1

New SWMM 2000 Type 0 Model Module (Version 1.0.1363.13642)

A new SWMM 2000 System

HYDROGRAPHS FROM CUHPF MODEL ARE LISTED FOR THE FOLLOWING 23 SUBCATCHMENTS.

```
 TIME(HR/MIN)    46        40        50        60        55        70
75        80         85         90
                 95        56        87        82        92        62
65        66         45         67
                 72        52        68

     0     0.    0.        0.        0.        0.        0.        0.
0.          0.        0.        0.
                 0.        0.        0.        0.        0.        0.
0.          0.        0.        0.
                 0.        0.        0.

     0     5.    0.        0.        0.        0.        0.        0.
0.          0.        0.        0.
                 0.        0.        0.        0.        0.        0.
0.          0.        0.        0.
                 0.        0.        0.

     0    10.    0.        0.        0.        0.        0.        0.
0.          0.        0.        0.
                 0.        0.        0.        0.        0.        0.
0.          0.        0.        0.
                 0.        0.        0.

     0    15.    0.        0.        0.        0.        0.        0.
0.          0.        0.        0.
                 0.        0.        0.        0.        0.        0.
0.          0.        0.        0.
                 0.        0.        0.

     0    20.    0.        0.        0.        0.        0.        0.
0.          0.        0.        0.
                 0.        0.        0.        0.        0.        0.
0.          0.        0.        0.
                 0.        0.        0.
```



```
     0    25.    0.        0.        0.        0.        0.        0.
0.          0.        0.        0.
                 0.        0.        0.        0.        0.        0.
0.          0.        0.        0.
                 0.        0.        0.

     0    30.    0.        0.        0.        0.        0.        0.
0.          0.        0.        0.
                 0.        0.        0.        0.        0.        0.
0.          0.        0.        0.
                 0.        0.        0.

     0    35.    0.        0.        0.        0.        0.        0.
0.          1.        1.        0.
                 1.        0.        0.        0.        1.        0.
1.          3.        1.        0.
                 0.        0.        0.

     0    40.    2.        2.        1.        2.        1.        0.
1.          4.        5.        2.
                 5.        2.        3.        1.        3.        1.
6.         13.        3.        1.
                 0.        0.        0.

     0    45.    3.        4.        2.        3.        3.        0.
3.          8.       11.        3.
                10.        4.        8.        2.        4.        2.
10.        25.        7.        1.
                 0.        0.        0.

     0    50.    4.        6.        3.        4.        4.        1.
6.          9.       13.        4.
                12.        5.       11.        2.        5.        2.
12.        30.        9.        2.
                 0.        1.        0.

     0    55.    4.        7.        4.        5.        5.        1.
7.         10.       15.        5.
                13.        5.       13.        2.        6.        3.
13.        32.       11.        3.
                 0.        1.        1.

     1     0.    4.        8.        5.        5.        5.        1.
8.         10.       15.        5.
                14.        6.       15.        2.        6.        3.
14.        33.       11.        3.
                 0.        1.        1.

     1     5.    4.        9.        6.        5.        6.        1.
9.         10.       16.        5.
                14.        6.       16.        2.        6.        3.
14.        33.       12.        4.
                 0.        1.        1.

     1    10.    4.        9.        6.        5.        6.        1.
9.         10.       16.        5.
                14.        6.       16.        2.        6.        3.
14.        33.       12.        4.
                 0.        1.        1.

     1    15.    4.       10.        7.        5.        6.        1.
10.        10.       16.        5.
                14.        6.       16.        2.        6.        3.
14.        33.       12.        4.
                 0.        1.        1.
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1 25. 6. 12. 8. 7. 8. 1.
12. 15. 22. 7.
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1 30. 6. 14. 9. 8. 9. 1.
14. 16. 25. 8.
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22. 54. 18. 6.
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1 35. 7. 15. 11. 9. 10. 1.
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1 40. 8. 17. 12. 10. 11. 2.
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28. 11. 29. 5. 12. 5.
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1 45. 8. 19. 13. 11. 12. 2.
19. 21. 33. 11.
29. 12. 32. 5. 12. 6.
29. 70. 24. 9.
1. 2. 2.

1 50. 36. 39. 32. 30. 31. 15.
32. 91. 85. 32.
100. 39. 59. 21. 52. 25.
108. 220. 61. 17.
5. 11. 10.

1 55. 77. 119. 110. 83. 99. 77.
79. 217. 255. 91.
248. 102. 179. 42. 108. 54.
294. 622. 187. 47.
48. 42. 45.

2 0. 102. 238. 242. 128. 186. 141.
148. 300. 341. 145.
315. 144. 286. 53. 134. 74.
430. 805. 292. 96.
118. 72. 88.

2 5. 114. 339. 391. 155. 254. 190.
203. 336. 383. 178.
345. 167. 353. 59. 146. 85.
492. 876. 350. 148.
183. 94. 123.

2 10. 120. 409. 525. 171. 301. 227.
240. 352. 403. 198.
358. 179. 394. 63. 151. 91.
519. 903. 382. 190.
237. 110. 153.

2 15. 121. 458. 635. 181. 333. 255.
267. 359. 413. 210.
363. 186. 419. 63. 152. 94.
531. 913. 400. 223.
288. 123. 177.

2 20. 89. 456. 675. 162. 317. 216.
272. 267. 368. 187.
294. 157. 408. 47. 113. 71.
427. 761. 363. 232.
291. 103. 165.

2 25. 48. 367. 631. 103. 239. 166.
233. 132. 201. 120.
150. 90. 297. 27. 58. 41.
215. 355. 218. 210.
258. 78. 137.

2 30. 27. 266. 548. 66. 174. 129.
172. 73. 120. 78.
86. 55. 200. 16. 34. 25.
118. 195. 134. 173.
223. 60. 115.

2 35. 17. 198. 462. 45. 129. 101.
130. 47. 81. 52.
59. 37. 141. 10. 22. 16.
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197. 48. 95.

2 40. 12. 151. 397. 32. 98. 80.
101. 36. 62. 37.
47. 26. 103. 7. 17. 11.
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170. 37. 80.

2 45. 12. 117. 341. 24. 76. 63.
81. 31. 52. 27.
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147. 27. 68.

2 50. 11. 93. 293. 19. 59. 50.
64. 28. 46. 20.
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41. 94. 40. 83.
127. 19. 57.

2 55. 10. 72. 253. 14. 44. 39.
51. 24. 39. 15.
33. 15. 52. 6. 14. 7.
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3 0. 9. 55. 218. 13. 33. 28.
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32. 73. 28. 59.
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83. 4. 34.

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31. 2. 3.

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24. 56. 20. 10.
23. 2. 3.

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24. 56. 20. 10.
18. 2. 3.

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24. 56. 20. 10.
13. 2. 3.
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5. 2. 3.

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6. 3. 14. 0. 2. 0.
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6 15. 0. 7. 9. 2. 4. 0.
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6 20. 0. 5. 7. 0. 3. 0.
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0. 0. 0.

6 25. 0. 3. 6. 0. 2. 0.
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0. 0. 0. 3.
0. 0. 0.

6 30. 0. 2. 5. 0. 0. 0.
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6 35. 0. 1. 4. 0. 0. 0.
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6 40. 0. 0. 3. 0. 0. 0.
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6 45. 0. 0. 3. 0. 0. 0.
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0.          0.        0.   0.    0.   0.     0.        0.        0.
                      0.        0.        0.

    6    55.        0.        0.        2.        0.        0.        0.
0.          0.        0.   0.    0.   0.
0.          0.        0.   0.    0.   0.     0.        0.        0.
                      0.        0.        0.

    7     0.        0.        0.        2.        0.        0.        0.
0.          0.        0.   0.    0.   0.
0.          0.        0.   0.    0.   0.     0.        0.        0.
                      0.        0.        0.

1
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New SWMM 2000 Type 0 Model Module (Version 1.0.1363.13642)

A new SWMM 2000 System

```
                                                            WIDTH
INVERT      SIDE SLOPES              OVERBANK/SURCHARGE
 GUTTER       GUTTER         NDP       NP                   OR DIAM    LENGTH
SLOPE      HORIZ TO VERT   MANNING     DEPTH         JK
 NUMBER     CONNECTION                                       (FT)       (FT)
(FT/FT)       L      R         N        (FT)

  400           2            0          2      PIPE          30.0        0.
.0100        .0     .0       .013      30.00          0
 1010          10            9          2      PIPE            .3        0.
.0100        .0     .0       .013        .25          0
                   RESERVOIR STORAGE IN ACRE-FEET VS SPILLWAY OUTFLOW
                              .0       .0      2.0      7.4      4.1     10.4
  6.3      12.8        8.6   14.8     11.0     16.5
                             13.4     18.1     16.0     19.5     18.7     20.9
   17         555            0          2      PIPE           5.0      700.
.0270        .0     .0       .013       5.00          0
  600        1111            0          2      PIPE          30.0        0.
.0100        .0     .0       .013      30.00          0
  551           8            0          2      PIPE          30.0        0.
.0100        .0     .0       .013      30.00          0
  685          30            0          2      PIPE          30.0        0.
.0100        .0     .0       .013      30.00          0
   11         777            0          1      CHANNEL        8.0     1900.
.0030       4.0    4.0       .030       5.20          0
  525           0            0          2      PIPE          30.0        0.
.0100        .0     .0       .013      30.00          0
 1313          27            7          2      PIPE            .3        0.
.0100        .0     .0       .013        .25          0
                   RESERVOIR STORAGE IN ACRE-FEET VS SPILLWAY OUTFLOW
                              .0       .0       .7     10.3      2.7     14.5
  5.8      17.8        9.8   20.5     14.6     22.9
                             20.1     25.1
    2           1            0          1      CHANNEL       10.0      440.
.0030       4.0    4.0       .030       5.50          0
    1         888            0          1      CHANNEL       10.0      604.
.0025       4.0    4.0       .030       6.00          0
    8        1111            0          2      PIPE           5.5     1290.
```



```
.0050        .0     .0       .013       5.50          0
  700          14            0          2      PIPE          30.0        0.
.0100        .0     .0       .013      30.00          0
  725        1313            0          2      PIPE          30.0        0.
.0100        .0     .0       .013      30.00          0
   12          11            0          1      CHANNEL        5.0      460.
.0070       4.0    4.0       .030       3.18          0
    7           4            0          2      PIPE           4.5      785.
.0070        .0     .0       .013       4.50          0
  950         925            0          2      PIPE          30.0        0.
.0100        .0     .0       .013      30.00          0
   26         777            0          1      CHANNEL        3.0     1600.
.0250       4.0    4.0       .030       2.00          0
    9           8            0          1      CHANNEL        2.0      770.
.0130       4.0    4.0       .030       2.00          0
   27          26            0          2      PIPE           2.0      700.
.0200        .0     .0       .013       2.00          0
   31         333            0          2      PIPE           1.8      355.
.0050        .0     .0       .013       1.75          0
  222          31           10          2      PIPE            .3        0.
.0100        .0     .0       .013        .25          0
                   RESERVOIR STORAGE IN ACRE-FEET VS SPILLWAY OUTFLOW
                              .0       .0      6.1      3.8     12.3      5.3
 18.7       6.5       25.2    7.5     31.9      8.4
                             38.8      9.2     45.9     10.0     53.1     10.7
 60.5      11.3
   18          28            0          2      PIPE           1.8     2784.
.0070        .0     .0       .013       1.75          0
  451           7            0          2      PIPE          30.0        0.
.0100        .0     .0       .013      30.00          0
   21          20            0          2      PIPE           3.0      900.
.0050        .0     .0       .013       3.00          0
  111          23           10          2      PIPE            .3        0.
.0100        .0     .0       .013        .25          0
                   RESERVOIR STORAGE IN ACRE-FEET VS SPILLWAY OUTFLOW
                              .0       .0      2.7     93.4      5.5    132.1
  8.4     161.7       11.4  186.8     14.5    208.8
                             17.7    228.7     21.0    247.1     24.4    264.1
 28.0     280.2
  675          30            0          2      PIPE          30.0        0.
.0100        .0     .0       .013      30.00          0
  750          16            0          2      PIPE          30.0        0.
.0100        .0     .0       .013      30.00          0
   14         666            0          1      CHANNEL        6.0     1000.
.0060       4.0    4.0       .030       3.43          0
   13          12            0          1      CHANNEL        4.0     1020.
.0200       4.0    4.0       .030       2.00          0
  550        1010            0          2      PIPE          30.0        0.
.0100        .0     .0       .013      30.00          0
  825         555            0          2      PIPE          30.0        0.
.0100        .0     .0       .013      30.00          0
   16         555            0          2      PIPE           5.5      709.
.0300        .0     .0       .013       5.50          0
   15         666            0          2      PIPE           5.5      500.
.0150        .0     .0       .013       5.50          0
  450           5            0          2      PIPE          30.0        0.
.0100        .0     .0       .013      30.00          0
   10           9            0          2      PIPE           2.0      270.
.0110        .0     .0       .013       2.00          0
  850         555            0          2      PIPE          30.0        0.
.0100        .0     .0       .013      30.00          0
  650          29            0          2      PIPE          30.0        0.
.0100        .0     .0       .013      30.00          0
    3           2            0          1      CHANNEL       10.0      780.
.0030       4.0    4.0       .030       5.12          0
  777           0           10          2      PIPE            .3        0.
```

```
.0100        .0     .0       .013           .25        0
                       RESERVOIR STORAGE IN ACRE-FEET VS SPILLWAY OUTFLOW
                                .0        .0        2.6    109.8          5.3    155.3
  8.1    190.2        11.0    219.6      14.0     245.5
                              17.2    269.0       20.5    290.5         23.8    310.6
 27.3    329.4
    5            4            0            2        PIPE                9.0     1700.
.0010        .0     .0       .013          9.03           0
   29          111            0            2        PIPE                9.5      409.
.0053        .0     .0       .013          9.50           0
  555           28           10            2        PIPE                 .3        0.
.0100        .0     .0       .013           .25        0
                       RESERVOIR STORAGE IN ACRE-FEET VS SPILLWAY OUTFLOW
                                .0        .0        8.1      8.5         16.3     12.0
 24.7     14.7        33.3     16.9      42.1      18.9
                              51.0     20.8       60.1     22.4         69.3     24.0
 78.8     25.4
  888            0           11            2        PIPE                 .3        0.
.0100        .0     .0       .013           .25        0
                       RESERVOIR STORAGE IN ACRE-FEET VS SPILLWAY OUTFLOW
                                .0        .0        3.9     90.4          7.9    127.9
 12.0    156.6        16.2    180.8      20.6     202.2
                              25.0    221.5       29.6    239.2         34.2    255.7
 39.1    270.8        43.9    285.9
    4            3            0            2        PIPE                7.3      895.
.0050        .0     .0       .013          7.30           0
  875           17            0            2        PIPE               30.0        0.
.0100        .0     .0       .013         30.00           0
  444           21           10            2        PIPE                 .3        0.
.0100        .0     .0       .013           .25        0
                       RESERVOIR STORAGE IN ACRE-FEET VS SPILLWAY OUTFLOW
                                .0        .0        6.7      9.6         13.5     13.6
 20.5     16.7        27.7     19.3      35.0      21.6
                              42.5     23.6       50.2     25.5         50.5     27.3
 66.2     28.9
  333           18            8            2        PIPE                 .3        0.
.0100        .0     .0       .013           .25        0
                       RESERVOIR STORAGE IN ACRE-FEET VS SPILLWAY OUTFLOW
                                .0        .0        5.0      3.8         10.2      5.3
 15.5      6.5        20.9      7.5      26.5       8.4
                              32.2      9.2       38.1     10.0
  925          333            0            2        PIPE               30.0        0.
.0100        .0     .0       .013         30.00           0
   30           29            0            2        PIPE                6.5     2430.
.0053        .0     .0       .013          6.50           0
  800           15            0            2        PIPE               30.0        0.
.0100        .0     .0       .013         30.00           0
 1111            7            9            2        PIPE                 .3        0.
.0100        .0     .0       .013           .25        0
                       RESERVOIR STORAGE IN ACRE-FEET VS SPILLWAY OUTFLOW
                                .0        .0        2.0      7.4          4.1     10.4
  6.3     12.8         8.6     14.8      11.0      16.5
                              13.4     18.1       16.0     19.5         18.7     20.9
  666           13           10            2        PIPE                 .3        0.
.0100        .0     .0       .013           .25        0
                       RESERVOIR STORAGE IN ACRE-FEET VS SPILLWAY OUTFLOW
                                .0        .0        8.3     11.5         16.9     16.3
 25.7     20.0        34.6     23.1      43.6      25.8
                              52.9     28.2       62.3     30.5         71.9     32.6
 81.6     34.6
   20          666            0            2        PIPE                3.0     1190.
.0320        .0     .0       .013          3.00           0
  660          222            0            2        PIPE               30.0        0.
.0100        .0     .0       .013         30.00           0
  500          777            0            2        PIPE                6.8        0.
.0100        .0     .0       .013          6.85           0
```



```
   23          444            0            2        PIPE                6.0      466.
.0050        .0     .0       .013          6.00           0
  625           20            0            2        PIPE               30.0        0.
.0100        .0     .0       .013         30.00           0
  900          444            0            2        PIPE               30.0        0.
.0100        .0     .0       .013         30.00           0
   28           15            0            2        PIPE                4.0      500.
.0220        .0     .0       .013          4.00           0
0TOTAL NUMBER OF GUTTERS/PIPES,   60
1

 New SWMM 2000 Type 0 Model Module (Version 1.0.1363.13642)

 A new SWMM 2000 System



 ARRANGEMENT OF SUBCATCHMENTS AND GUTTERS/PIPES

      GUTTER     TRIBUTARY GUTTER/PIPE
TRIBUTARY SUBAREA                                     D.A.(AC)

              1          2    0    0    0    0    0    0    0     0    0
   0    0     0    0     0    0    0    0    0    0  384.0

              2        400    3    0    0    0    0    0    0     0    0
   0    0     0    0     0    0    0    0    0    0  384.0

              3          4    0    0    0    0    0    0    0     0    0
   0    0     0    0     0    0    0    0    0    0  268.8

              4          7    5    0    0    0    0    0    0     0    0
   0    0     0    0     0    0    0    0    0    0  268.8

              5        450    0    0    0    0    0    0    0     0    0
   0    0     0    0     0    0    0    0    0    0   83.2

              7        451 1111    0    0    0    0    0    0     0    0
   0    0     0    0     0    0    0    0    0    0  185.6

              8        551    9    0    0    0    0    0    0     0    0
   0    0     0    0     0    0    0    0    0    0  121.6

              9         10    0    0    0    0    0    0    0     0    0
   0    0     0    0     0    0    0    0    0    0   83.2

             10       1010    0    0    0    0    0    0    0     0    0
   0    0     0    0     0    0    0    0    0    0   83.2

             11         12    0    0    0    0    0    0    0     0    0
   0    0     0    0     0    0    0    0    0    0 1011.2

             12         13    0    0    0    0    0    0    0     0    0
   0    0     0    0     0    0    0    0    0    0 1011.2

             13        666    0    0    0    0    0    0    0     0    0
   0    0     0    0     0    0    0    0    0    0 1011.2

             14        700    0    0    0    0    0    0    0     0    0
   0    0     0    0     0    0    0    0    0    0   70.4

             15        800   28    0    0    0    0    0    0     0    0
   0    0     0    0     0    0    0    0    0    0  633.6
```

```
0 0 16 0 0 750 0 0 0 0 0 0 0 0 0 0 0 0 64.0 0 0 0
0 0 17 0 0 875 0 0 0 0 0 0 0 0 0 0 0 0 89.6 0 0 0
0 0 18 0 0 333 0 0 0 0 0 0 0 0 0 0 0 0 307.2 0 0 0
0 0 20 0 0 21 0 625 0 0 0 0 0 0 0 0 0 0 307.2 0 0 0
0 0 21 0 0 444 0 0 0 0 0 0 0 0 0 0 0 0 288.0 0 0 0
0 0 23 0 0 111 0 0 0 0 0 0 0 0 0 0 0 0 243.2 0 0 0
0 0 26 0 0 27 0 0 0 0 0 0 0 0 0 0 0 0 121.6 0 0 0
0 0 27 0 0 1313 0 0 0 0 0 0 0 0 0 0 0 0 121.6 0 0 0
0 0 28 0 0 18 0 555 0 0 0 0 0 0 0 0 0 0 556.8 0 0 0
0 0 29 0 0 650 0 30 0 0 0 0 0 0 0 0 0 0 243.2 0 0 0
0 0 30 0 0 685 0 675 0 0 0 0 0 0 0 0 0 0 128.0 0 0 0
0 0 31 0 0 222 0 0 0 0 0 0 0 0 0 0 0 0 198.4 0 0 0
0 0 111 0 0 29 0 0 0 0 0 0 0 0 0 0 0 0 243.2 0 0 0
0 0 222 0 0 660 0 0 0 0 0 0 0 0 0 0 0 0 198.4 0 0 0
0 0 333 0 0 31 0 925 0 0 0 0 0 0 0 0 0 0 307.2 0 0 0
40 0 400 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 115.2 0 0 0
0 0 444 0 0 23 0 900 0 0 0 0 0 0 0 0 0 0 288.0 0 0 0
45 0 450 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 83.2 0 0 0
46 0 451 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 25.6 0 0 0
50 0 500 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 249.6 0 0 0
52 0 525 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 32.0 0 0 0
55 0 550 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 83.2 0 0 0
```



```
56 0 551 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 38.4 0 0 0
0 0 555 0 0 17 0 825 0 16 0 850 0 0 0 0 0 0 249.6 0 0 0
60 0 600 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 38.4 0 0 0
62 0 625 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 19.2 0 0 0
65 0 650 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 115.2 0 0 0
66 0 660 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 198.4 0 0 0
0 0 666 0 0 14 0 15 0 20 0 0 0 0 0 0 0 0 1011.2 0 0 0
67 0 675 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 70.4 0 0 0
68 0 685 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 57.6 0 0 0
70 0 700 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 70.4 0 0 0
72 0 725 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 121.6 0 0 0
75 0 750 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 64.0 0 0 0
0 0 777 0 0 11 0 26 0 500 0 0 0 0 0 0 0 0 1382.4 0 0 0
80 0 800 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 76.8 0 0 0
82 0 825 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 12.8 0 0 0
85 0 850 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 83.2 0 0 0
87 0 875 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 89.6 0 0 0
0 0 888 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 384.0 0 0 0
90 0 900 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 44.8 0 0 0
92 0 925 0 0 950 0 0 0 0 0 0 0 0 0 0 0 0 108.8 0 0 0
95 0 950 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 76.8 0 0 0
0 0 1010 0 0 550 0 0 0 0 0 0 0 0 0 0 0 0 83.2 0 0 0
```

```
     1111       600   8   0   0   0   0   0   0   0   0
0    0    0    0    0    0    0    0    0    0   160.0

     1313       725   0   0   0   0   0   0   0   0   0
0    0    0    0    0    0    0    0    0    0   121.6
1
```

New SWMM 2000 Type 0 Model Module (Version 1.0.1363.13642)

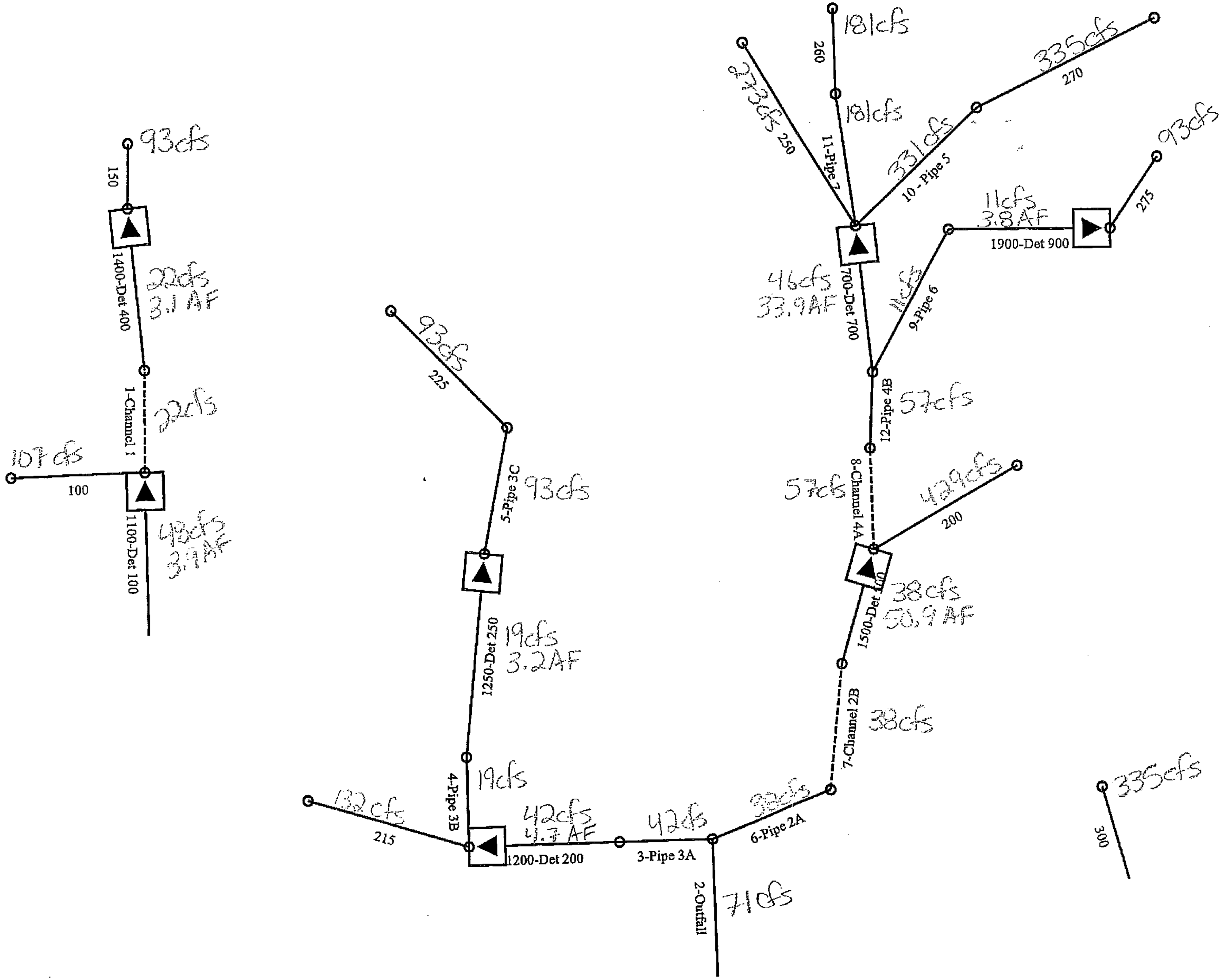
A new SWMM 2000 System

*** PEAK FLOWS, STAGES AND STORAGES OF GUTTERS AND DETENTION DAMS ***

CONVEYANCE ELEMENT	PEAK (CFS)	STAGE (FT)	STORAGE (AC-FT)	TIME (HR/MIN)
675	232.	1.8		2 20.
685	177.	1.6		2 15.
550	333.	2.2		2 15.
30	395.	5.6		2 20.
650	531.	2.7		2 15.
660	913.	3.5		2 15.
1010	19.	.3	15.5	3 10.
29	895.	6.7		2 15.
950	363.	2.3		2 15.
222	11.	.3	56.1	6 10.
10	19.	1.4		3 10.
111	275.	.3	26.8	2 40.
750	272.	2.0		2 20.
875	419.	2.4		2 15.
925	515.	2.7		2 15.
31	11.	1.4		6 10.
9	19.	.9		3 15.
551	186.	1.7		2 15.
900	210.	1.8		2 15.
23	275.	4.5		2 40.
850	413.	2.4		2 15.
16	272.	2.6		2 20.
825	63.	1.0		2 15.
17	416.	4.0		2 15.
333	10.	.3	35.2	8 15.
8	196.	3.8		2 15.
600	181.	1.6		2 15.
444	28.	.3	61.3	6 10.
555	25.	.3	73.3	6 15.
18	10.	1.1		8 15.
450	400.	2.4		2 15.
1111	22.	.3	21.5	6 15.
451	121.	1.4		2 15.
625	94.	1.2		2 15.
21	28.	1.7		6 15.
28	34.	1.1		6 20.
800	359.	2.3		2 15.
700	255.	1.9		2 15.
5	385.	7.1		2 15.
7	137.	3.1		2 15.
20	105.	2.2		2 15.
15	381.	4.2		2 15.
14	241.	2.7		2 15.
4	516.	6.1		2 15.
725	291.	2.1		2 20.
666	29.	.3	56.2	8 15.

3	512.	4.0		2 20.
400	458.	2.5		2 15.
1313	24.	.3	17.2	3 50.
13	29.	.8		8 15.
2	973.	5.4		2 20.
27	24.	1.3		3 50.
12	29.	1.0		8 15.
1	971.	5.6		2 20.
500	648.	6.8	.1	2 25.
26	24.	.8		3 55.
11	29.	1.0		8 15.
888	249.	.3	32.3	2 45.
777	298.	.3	21.7	2 55.
525	123.	1.4		2 15.

Big Johnson
SWMM Model



SWMM Input for Big Johnson

Job Title (max 80 characters): New SWMM 2000 Type 0 Model Module (Version

Job Sub-Title (max 80 characters): A new SWMM 2000 System

Number of time-steps to be calculated: 99

Hour of start of storm: 0

Minute of start of storm: 0

Integration period (min.): 5.000

Check this box to create a printed summary of peak flows and stages at end of output: ☑

CUHP Sub-catchment Number:	UDSWM Conveyance Element Number Draining This Subcatchment:
10	100
15	150
21	215
22	225
25	250
27	270
29	275
30	300
20	200
26	260

	Number of pairs of tabular values (NDP) If Detention is used:	Conveyance Element Number:	Next down stream Conveyance Element number:	Type of Conveyance Element:	Pipe Diameter or Bottom width of channel (ft)	Length of Conveyance Element (ft) :	Invert slope of Conveyance Element (ft/ft) :	Channel's Left-hand side slope (ft/ft) :	Channel's Right-hand side slope (ft/ft) :	Manning's n of Conveyance Element:	Depth of channel in feet when full or the pipe diameter :
Detention Basin	10	1700	12	2 = Pipe	0.25	0.1	0.01	0	0	0.013	0.25
		6	2	2 = Pipe	2.75	285	0.005	0	0	0.013	2.75
		270	10	2 = Pipe	30	0.1	0.01	0	0	0.013	30
		2	0	2 = Pipe	30	0.1	0.01	0	0	0.013	30
Detention Basin	8	1400	1	2 = Pipe	0.25	0.1	0.01	0	0	0.013	0.25
		11	1700	2 = Pipe	4.5	434	0.0098	0	0	0.013	4.5
		8	1500	1 = Channel	4	805	0.008	4	4	0.03	2
Detention Basin	9	1250	4	2 = Pipe	0.25	0.1	0.01	0	0	0.013	0.25
		150	1400	2 = Pipe	30	0.1	0.01	0	0	0.013	30
		9	12	2 = Pipe	1.5	450	0.059	0	0	0.013	1.5
		4	1200	2 = Pipe	1.5	297	0.0357	0	0	0.013	1.5
Detention Basin	9	1900	9	2 = Pipe	0.25	0.1	0.01	0	0	0.013	0.25
		215	1200	2 = Pipe	30	0.1	0.01	0	0	0.013	30
		250	1700	2 = Pipe	30	0.1	0.01	0	0	0.013	30
Detention Basin	10	1500	7	2 = Pipe	0.25	0.1	0.01	0	0	0.013	0.25
		225	5	2 = Pipe	30	0.1	0.01	0	0	0.013	30
		300	0	2 = Pipe	30	0.1	0.01	0	0	0.013	30
		12	8	2 = Pipe	2.5	379	0.026	0	0	0.013	2.5
		200	1500	2 = Pipe	30	0.1	0.01	0	0	0.013	30
		100	1100	2 = Pipe	30	0.1	0.01	0	0	0.013	30
		260	11	2 = Pipe	30	0.1	0.01	0	0	0.013	30
Detention Basin	7	1100	0	2 = Pipe	0.25	0.1	0.01	0	0	0.013	0.25
		10	1700	2 = Pipe	5	393	0.0225	0	0	0.013	5
		5	1250	2 = Pipe	3	723	0.025	0	0	0.013	3
		1	1100	1 = Channel	2	310	0.025	4	4	0.03	2
		275	1900	2 = Pipe	30	0.1	0.01	0	0	0.013	30
Detention Basin	10	1200	3	2 = Pipe	0.25	0.1	0.01	0	0	0.013	0.25
		3	2	2 = Pipe	1.75	109	0.07	0	0	0.013	1.75
		7	6	1 = Channel	5	504	0.019	4	4	0.03	0.91

URBAN DRAINAGE STORM WATER MANAGEMENT MODEL - 32 BIT VERSION 1998
REVISED BY UNIVERSITY OF COLORADO AT DENVER

*** ENTRY MADE TO RUNOFF MODEL ***

New SWMM 2000 Type 0 Model Module (Version 1.0.1363.13642)

A new SWMM 2000 System

0NUMBER OF TIME STEPS 99
0INTEGRATION TIME INTERVAL (MINUTES). 5.00

25.0 PERCENT OF IMPERVIOUS AREA HAS ZERO DETENTION DEPTH
1

New SWMM 2000 Type 0 Model Module (Version 1.0.1363.13642)

A new SWMM 2000 System

HYDROGRAPHS FROM CUHPF MODEL ARE LISTED FOR THE FOLLOWING 10 SUBCATCHMENTS

TIME(HR	/MIN)	10	15	21	22	25	27	29	30	20	26
0	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0	5.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0	10.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0	15.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0	20.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0	25.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0	30.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0	35.	0.	0.	0.	0.	1.	0.	0.	0.	0.	1.
0	40.	0.	1.	0.	1.	5.	0.	2.	0.	0.	3.
0	45.	0.	2.	1.	2.	8.	0.	3.	0.	0.	5.
0	50.	0.	3.	1.	3.	9.	0.	3.	0.	0.	6.

0	55.	0.	3.	1.	3.	10.	0.	3.	0.	0.	7.
1	0.	0.	3.	1.	3.	10.	0.	3.	0.	0.	7.
1	5.	0.	3.	1.	3.	10.	0.	3.	0.	0.	7.
1	10.	0.	3.	1.	3.	10.	0.	3.	0.	0.	7.
1	15.	0.	3.	1.	3.	10.	0.	3.	0.	0.	7.
1	20.	0.	4.	2.	4.	12.	0.	4.	0.	0.	8.
1	25.	0.	5.	2.	5.	15.	0.	5.	0.	0.	10.
1	30.	0.	5.	2.	5.	16.	0.	6.	0.	1.	11.
1	35.	1.	6.	2.	6.	18.	0.	6.	0.	1.	12.
1	40.	1.	7.	3.	6.	21.	0.	7.	0.	1.	14.
1	45.	1.	7.	3.	7.	21.	0.	7.	0.	1.	14.
1	50.	6.	29.	15.	28.	89.	2.	31.	2.	4.	60.
1	55.	30.	60.	49.	59.	195.	89.	63.	89.	40.	128.
2	0.	56.	78.	82.	77.	242.	183.	79.	183.	116.	160.
2	5.	77.	87.	104.	87.	261.	251.	88.	251.	212.	174.
2	10.	94.	92.	120.	92.	269.	300.	93.	299.	305.	181.
2	15.	107.	93.	132.	93.	273.	335.	93.	335.	388.	181.
2	20.	93.	69.	108.	69.	204.	273.	69.	273.	429.	134.
2	25.	76.	38.	78.	38.	101.	198.	39.	198.	425.	68.
2	30.	62.	23.	58.	22.	58.	144.	23.	144.	393.	39.
2	35.	51.	14.	44.	14.	41.	107.	15.	107.	356.	26.
2	40.	43.	10.	31.	10.	33.	79.	10.	79.	324.	20.

10.	2	45.	59.	36.	297.	10.	20.	22.	10.	30.	59.
10.	2	50.	44.	29.	268.	9.	18.	15.	9.	28.	43.
8.	2	55.	32.	22.	240.	8.	16.	9.	8.	24.	32.
8.	3	0.	21.	15.	216.	7.	15.	5.	7.	22.	21.
7.	3	5.	13.	10.	194.	7.	14.	5.	7.	22.	13.
7.	3	10.	8.	6.	176.	7.	14.	4.	7.	22.	8.
7.	3	15.	3.	2.	159.	7.	14.	4.	7.	21.	3.
7.	3	20.	0.	2.	143.	7.	13.	4.	6.	20.	0.
6.	3	25.	0.	2.	129.	6.	12.	3.	6.	18.	0.
6.	3	30.	0.	2.	117.	6.	12.	3.	6.	18.	0.
6.	3	35.	0.	0.	105.	6.	12.	3.	5.	17.	0.
6.	3	40.	0.	0.	95.	6.	11.	3.	5.	17.	0.
6.	3	45.	0.	0.	86.	6.	11.	3.	5.	17.	0.
6.	3	50.	0.	0.	78.	6.	11.	3.	5.	17.	0.
6.	3	55.	0.	0.	70.	6.	11.	3.	5.	17.	0.
6.	4	0.	0.	0.	63.	6.	11.	3.	5.	17.	0.
6.	4	5.	0.	0.	57.	6.	11.	3.	5.	17.	0.
6.	4	10.	0.	0.	52.	6.	11.	3.	5.	17.	0.
6.	4	15.	0.	0.	47.	6.	11.	3.	5.	17.	0.
5.	4	20.	0.	0.	42.	5.	11.	3.	5.	16.	0.
5.	4	25.	0.	0.	38.	5.	10.	2.	5.	14.	0.
5.	4	30.	0.	0.	35.	4.	9.	2.	4.	14.	0.

5.	4	35.	0.	0.	31.	4.	9.	2.	4.	13.	0.
4.	4	40.	0.	0.	28.	4.	9.	2.	4.	13.	0.
4.	4	45.	0.	0.	25.	4.	9.	2.	4.	13.	0.
4.	4	50.	0.	0.	23.	4.	9.	2.	4.	13.	0.
4.	4	55.	0.	0.	21.	4.	9.	2.	4.	13.	0.
4.	5	0.	0.	0.	16.	4.	9.	2.	4.	13.	0.
4.	5	5.	0.	0.	12.	4.	9.	2.	4.	13.	0.
4.	5	10.	0.	0.	8.	4.	9.	2.	4.	13.	0.
4.	5	15.	0.	0.	5.	4.	9.	2.	4.	13.	0.
4.	5	20.	0.	0.	2.	4.	9.	2.	4.	13.	0.
4.	5	25.	0.	0.	2.	4.	9.	2.	4.	13.	0.
4.	5	30.	0.	0.	1.	4.	9.	2.	4.	13.	0.
4.	5	35.	0.	0.	0.	4.	9.	2.	4.	13.	0.
4.	5	40.	0.	0.	0.	4.	9.	2.	4.	13.	0.
4.	5	45.	0.	0.	0.	4.	9.	2.	4.	13.	0.
4.	5	50.	0.	0.	0.	4.	9.	2.	4.	13.	0.
4.	5	55.	0.	0.	0.	4.	9.	2.	4.	13.	0.
4.	6	0.	0.	0.	0.	4.	9.	2.	4.	13.	0.
3.	6	5.	0.	0.	0.	3.	6.	1.	3.	9.	0.
2.	6	10.	0.	0.	0.	1.	3.	0.	1.	4.	0.
0.	6	15.	0.	0.	0.	0.	0.	0.	0.	2.	0.

1

New SWMM 2000 Type 0 Model Module (Version 1.0.1363.13642)

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```
                                                            WIDTH
INVERT     SIDE SLOPES              OVERBANK/SURCHARGE
 GUTTER       GUTTER        NDP        NP                   OR DIAM     LENGTH
SLOPE     HORIZ TO VERT   MANNING      DEPTH        JK
 NUMBER     CONNECTION                                        (FT)        (FT)
(FT/FT)         L      R       N          (FT)

 1700          12          10          2       PIPE              .3         0.
.0100         .0     .0     .013        .25          0
                       RESERVOIR STORAGE IN ACRE-FEET VS SPILLWAY OUTFLOW
                               .0       .0        3.9     16.6       7.9     23.5
12.0     28.8       16.3   33.2       20.7     37.1
                           25.3     40.7       30.0    43.9       34.9     47.0
39.8     49.8
    6           2          0           2       PIPE             2.8       285.
.0050         .0     .0     .013       2.75          0
  270          10          0           2       PIPE            30.0         0.
.0100         .0     .0     .013       30.00         0
    2           0          0           2       PIPE            30.0         0.
.0100         .0     .0     .013       30.00         0
    1        1100          0           1       CHANNEL          2.0       310.
.0250        4.0    4.0     .030       2.00          0
 1400           1          8           2       PIPE              .3         0.
.0100         .0     .0     .013        .25          0
                       RESERVOIR STORAGE IN ACRE-FEET VS SPILLWAY OUTFLOW
                               .0       .0         .4      9.0        .8     12.8
  1.3    15.7        1.8   18.1        2.4     20.2
                           3.0      22.2        3.7     23.9
   11        1700          0           2       PIPE             4.5       434.
.0098         .0     .0     .013       4.50          0
    8        1500          0           1       CHANNEL          4.0       805.
.0080        4.0    4.0     .030       2.00          0
 1250           4          9           2       PIPE              .3         0.
.0100         .0     .0     .013        .25          0
                       RESERVOIR STORAGE IN ACRE-FEET VS SPILLWAY OUTFLOW
                               .0       .0         .3      6.9        .6      9.7
  1.0    11.9        1.4   13.7        1.9     15.3
                           2.4      16.8        3.0     18.2        3.6     19.4
  150        1400          0           2       PIPE            30.0         0.
.0100         .0     .0     .013       30.00         0
    9          12          0           2       PIPE             1.5       450.
.0590         .0     .0     .013       1.50          0
  260          11          0           2       PIPE            30.0         0.
.0100         .0     .0     .013       30.00         0
 1900           9          9           2       PIPE              .3         0.
.0100         .0     .0     .013        .25          0
                       RESERVOIR STORAGE IN ACRE-FEET VS SPILLWAY OUTFLOW
                               .0       .0         .3      3.8        .7      5.4
  1.1     6.7        1.6    7.7        2.1      8.6
                            2.6      9.4        3.2     10.2        3.8     10.9
  215        1200          0           2       PIPE            30.0         0.
.0100         .0     .0     .013       30.00         0
  250        1700          0           2       PIPE            30.0         0.
.0100         .0     .0     .013       30.00         0
 1500           7         10           2       PIPE              .3         0.
.0100         .0     .0     .013        .25          0
                       RESERVOIR STORAGE IN ACRE-FEET VS SPILLWAY OUTFLOW
                               .0       .0        5.9     13.3      11.9     18.8
```



```
18.1     23.1       24.4   26.6       30.9     29.8
                           37.6     32.6       44.4    35.2       51.3     37.6
58.5     39.9
  225           5          0           2       PIPE            30.0         0.
.0100         .0     .0     .013       30.00         0
  300           0          0           2       PIPE            30.0         0.
.0100         .0     .0     .013       30.00         0
   12           8          0           2       PIPE             2.5       379.
.0260         .0     .0     .013       2.50          0
  100        1100          0           2       PIPE            30.0         0.
.0100         .0     .0     .013       30.00         0
  200        1500          0           2       PIPE            30.0         0.
.0100         .0     .0     .013       30.00         0
 1100           0          7           2       PIPE              .3         0.
.0100         .0     .0     .013        .25          0
                       RESERVOIR STORAGE IN ACRE-FEET VS SPILLWAY OUTFLOW
                               .0       .0         .6     20.6       1.3     29.2
  2.0    35.7        2.7   41.2        3.6     46.1
                           4.5      50.5
   10        1700          0           2       PIPE             5.0       393.
.0225         .0     .0     .013       5.00          0
    5        1250          0           2       PIPE             3.0       723.
.0250         .0     .0     .013       3.00          0
    4        1200          0           2       PIPE             1.5       297.
.0357         .0     .0     .013       1.50          0
  275        1900          0           2       PIPE            30.0         0.
.0100         .0     .0     .013       30.00         0
 1200           3         10           2       PIPE              .3         0.
.0100         .0     .0     .013        .25          0
                       RESERVOIR STORAGE IN ACRE-FEET VS SPILLWAY OUTFLOW
                               .0       .0         .6     15.1       1.3     21.3
  2.1    26.1        2.6   30.1        3.1     33.7
                           3.7      36.9        4.2     39.9       4.8     42.6
  5.3    45.2
    3           2          0           2       PIPE             1.8       109.
.0700         .0     .0     .013       1.75          0
    7           6          0           1       CHANNEL          5.0       504.
.0190        4.0    4.0     .030        .91          0
0TOTAL NUMBER OF GUTTERS/PIPES,  29
1
```

New SWMM 2000 Type 0 Model Module (Version 1.0.1363.13642)

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ARRANGEMENT OF SUBCATCHMENTS AND GUTTERS/PIPES

```
       GUTTER      TRIBUTARY GUTTER/PIPE
TRIBUTARY SUBAREA                                       D.A.(AC)

            1     1400    0    0    0    0    0    0    0    0    0
0    0      0    0    0    0    0    0    0    0    19.2

            2        6    3    0    0    0    0    0    0    0    0
0    0      0    0    0    0    0    0    0    0   492.8

            3     1200    0    0    0    0    0    0    0    0    0
0    0      0    0    0    0    0    0    0    0    51.2

            4     1250    0    0    0    0    0    0    0    0    0
0    0      0    0    0    0    0    0    0    0    19.2
```

```
         5      225    0    0    0    0    0    0    0     0    0
0    0    0   0    0    0    0    0    0    0   19.2

         6        7    0    0    0    0    0    0    0     0    0
0    0    0   0    0    0    0    0    0    0  441.6

         7     1500    0    0    0    0    0    0    0     0    0
0    0    0   0    0    0    0    0    0    0  441.6

         8       12    0    0    0    0    0    0    0     0    0
0    0    0   0    0    0    0    0    0    0  204.8

         9     1900    0    0    0    0    0    0    0     0    0
0    0    0   0    0    0    0    0    0    0   19.2

        10      270    0    0    0    0    0    0    0     0    0
0    0    0   0    0    0    0    0    0    0   89.6

        11      260    0    0    0    0    0    0    0     0    0
0    0    0   0    0    0    0    0    0    0   38.4

        12     1700    9    0    0    0    0    0    0     0    0
0    0    0   0    0    0    0    0    0    0  204.8

      100           0    0    0    0    0    0    0    0    0    0
10   0    0    0    0    0    0    0    0    0   32.0

      150           0    0    0    0    0    0    0    0    0    0
15   0    0    0    0    0    0    0    0    0   19.2

      200           0    0    0    0    0    0    0    0    0    0
20   0    0    0    0    0    0    0    0    0  236.8

      215           0    0    0    0    0    0    0    0    0    0
21   0    0    0    0    0    0    0    0    0   32.0

      225           0    0    0    0    0    0    0    0    0    0
22   0    0    0    0    0    0    0    0    0   19.2

      250           0    0    0    0    0    0    0    0    0    0
25   0    0    0    0    0    0    0    0    0   57.6

      260           0    0    0    0    0    0    0    0    0    0
26   0    0    0    0    0    0    0    0    0   38.4

      270           0    0    0    0    0    0    0    0    0    0
27   0    0    0    0    0    0    0    0    0   89.6

      275           0    0    0    0    0    0    0    0    0    0
29   0    0    0    0    0    0    0    0    0   19.2

      300           0    0    0    0    0    0    0    0    0    0
30   0    0    0    0    0    0    0    0    0   89.6

     1100           1  100    0    0    0    0    0    0    0    0
0    0    0    0    0    0    0    0    0    0   51.2

     1200        215    4    0    0    0    0    0    0    0    0
0    0    0    0    0    0    0    0    0    0   51.2

     1250           5    0    0    0    0    0    0    0    0    0
0    0    0    0    0    0    0    0    0    0   19.2

     1400        150    0    0    0    0    0    0    0    0    0
0    0    0    0    0    0    0    0    0    0   19.2
```



```
     1500           8  200    0    0    0    0    0    0    0    0
0    0    0    0    0    0    0    0    0    0  441.6

     1700          11  250   10    0    0    0    0    0    0    0
0    0    0    0    0    0    0    0    0    0  185.6

     1900         275    0    0    0    0    0    0    0    0    0
0    0    0    0    0    0    0    0    0    0   19.2
1
```

New SWMM 2000 Type 0 Model Module (Version 1.0.1363.13642)

A new SWMM 2000 System

*** PEAK FLOWS, STAGES AND STORAGES OF GUTTERS AND DETENTION DAMS ***

CONVEYANCE ELEMENT	PEAK (CFS)	STAGE (FT)	STORAGE (AC-FT)	TIME (HR/MIN)
275	93.	1.2		2 15.
270	335.	2.2		2 15.
260	181.	1.6		2 15.
1900	11.	.3	3.8	2 40.
10	331.	3.5		2 15.
250	273.	2.0		2 15.
11	181.	3.4		2 15.
225	93.	1.2		2 15.
9	11.	.7		2 45.
1700	46.	.3	33.9	3 10.
5	93.	2.2		2 15.
12	57.	1.8		3 0.
1250	19.	.3	3.2	2 35.
200	429.	2.5		2 20.
8	57.	1.4		3 5.
150	93.	1.2		2 15.
4	19.	1.2		2 30.
215	132.	1.4		2 15.
1500	38.	.3	50.9	8 15.
1400	22.	.3	3.1	2 30.
1200	42.	.3	4.7	2 45.
7	38.	.9		8 15.
100	107.	1.3		2 15.
1	22.	.8		2 30.
3	42.	1.5		2 45.
6	38.	2.3		8 15.
1100	48.	.3	3.9	2 50.
300	335.	2.2		2 15.
2	71.	1.1		3 10.

Water Quality Capture Volume (WQCV) Calculations

APPENDIX G

Water Quality Capture Volume (WQCV) Calculations

Computation of Water Quality Capture Volumes for Each Sub Basin

$WQCV_{40} = 0.91\,i^3 - 1.19\,i^2 + 0.78\,i$

Required Storage = [WQCV/12] *Area

Sub-Basin	Area (mi^2)	Area (ac.)	Imperviousness	$WQCV_{40}$ (Watershed in.)	Required Storage (AF)
Windmill Gulch					
950	0.12	77	1.00	0.50	3.2
925	0.05	32	1.00	0.50	1.3
900	0.07	45	0.66	0.26	1.0
875	0.14	90	0.94	0.44	3.3
850	0.13	83	1.00	0.50	3.5
825	0.02	13	1.00	0.50	0.5
800	0.12	77	0.72	0.28	1.8
750	0.1	64	0.82	0.34	1.8
725	0.19	122	0.09	0.06	0.6
700	0.11	70	0.18	0.11	0.6
685	0.09	58	0.21	0.12	0.6
675	0.11	70	0.46	0.20	1.1
660	0.31	198	0.93	0.43	7.1
650	0.18	115	0.70	0.28	2.6
625	0.03	19	0.76	0.30	0.5
600	0.06	38	0.72	0.28	0.9
551	0.06	38	0.79	0.32	1.0
550	0.13	83	0.47	0.20	1.4
525	0.05	32	0.27	0.14	0.4
500	0.39	250	0.31	0.15	3.2
451	0.04	26	0.83	0.35	0.7
450	0.13	83	0.74	0.29	2.0
400	0.18	115	0.52	0.21	2.0
Big Johnson					
100	0.05	32	0.17	0.10	0.3
150	0.03	19	0.91	0.41	0.7
200	0.37	237	0.09	0.06	1.2
215	0.05	32	0.34	0.16	0.4
225	0.03	19	0.88	0.39	0.6
250	0.09	38	0.96	0.46	1.5
260	0.06	45	0.96	0.46	1.7
270	0.14	45	0.99	0.49	1.8
275	0.03	19	0.96	0.46	0.7
300	0.14	90	0.02	0.02	0.1

Windmill Gulch Detention Ponds-Water Quality Capture Volumes

Detention 1

Basin	Storage (AF)
675	1.1
685	0.6
	1.7
*1.2/2=	**1.0**

Detention 2

Basin	Storage (AF)
660	7.1
	7.1
*1.2/2=	**4.3**

Detention 3

Basin	Storage (AF)
950	3.2
925	1.3
	4.5
*1.2/2=	**2.7**

Detention 4

Basin	Storage (AF)
900	1.0
650	2.6
675	1.1
685	0.6
	5.3
*1.2/2=	**3.2**

Detention 5

Basin	Storage (AF)
875	3.3
850	3.5
825	0.5
750	1.8
	9.1
*1.2/2=	**5.5**

Detention 6

Basin	Storage (AF)
675	1.1
685	0.6
660	7.1
950	3.2
925	3.2
900	1.0
650	2.6
875	3.3
850	3.5
825	0.5
750	1.8
800	1.8
625	0.5
700	0.6
	30.8
*1.2/2=	**18.5**

Detention 7

Basin	Storage (AF)
500	3.2
675	1.1
685.0	0.6
660	7.1
950	3.2
925	1.3
900	1.0
650	2.6
875	3.3
850	3.5
825	0.5
750	1.8
800	1.8
625	0.5
725	0.6
700	0.6
	32.7
*1.2/2=	**19.6**

Detention 8

Basin	Storage (AF)
550	1.4
551	1.0
600	0.9
550	1.4
451	0.7
450	2.0
400	2.0
	9.4
*1.2/2=	**5.6**

Detention 10

Basin	Storage (AF)
550	1.4
*1.2/2=	**0.8**

Detention 11

Basin	Storage (AF)
551	1.0
600	0.9
550	1.4
	3.3
*1.2/2=	**2.0**

Detention 13

Basin	Storage (AF)
725	0.6
*1.2/2=	**0.4**

Notes: 1. Water quality capture volumes shown here include all tributary sub-basins upstream of each pond, per the Drainage Criteria Manual.

2. Volumes are multiplied by 1.2 to allow additional volume for sedimentation. Volumes are then divided by 2. Resultant volume is added to the peak water quantity detention needed for each pond for the 100-year, 24-hour storm. This is in accordance with common engineering practice, since it is very unlikely that a storm which generates water quality capture volume and the 100-year storm will occur consecutively.

Big Johnson Detention Ponds-Water Quality Capture Volumes

Detention 100

Basin	Storage (AF)
100	0.3
150	0.7
	1.0
*1.2/2=	**0.6**

Detention 250

Basin	Storage (AF)
225	0.6
	0.6
*1.2/2=	**0.4**

Detention 200

Basin	Storage (AF)
215	0.4
225	0.6
	1.0
*1.2/2=	**0.6**

Detention 400

Basin	Storage (AF)
150	0.7
*1.2/2=	**0.4**

Detention 500

Basin	Storage (AF)
200	1.2
250	1.5
260	1.7
270	1.8
275	0.7
	6.9
*1.2/2=	**4.1**

Detention 700

Basin	Storage (AF)
250	1.5
260	1.7
	3.2
*1.2/2=	**1.9**

Detention 900

Basin	Storage (AF)
275	0.7
*1.2/2=	**0.4**

Notes: 1. Water quality capture volumes shown here include all tributary sub-basins upstream of each pond, per the Drainage Criteria Manual.

2. Volumes are multiplied by 1.2 to allow additional volume for sedimentation. Volumes are then divided by 2. Resultant volume is added to the peak water quantity detention needed for each pond for the 100-year, 24-hour storm. This is in accordance with common engineering practice, since it is very unlikely that a storm which generates water quality capture volume and the 100-year storm will occur consecutively.

Stage-Storage-Discharge For Windmill Gulch Detention Facilities

Detention Pond 1

Elevation	Depth (ft)	A (ft2)	A (ac)	Storage (AF)
6044	0	115519	2.7	0.0
6045	1	119712	2.7	2.7
6046	2	123966	2.8	5.5
6047	3	128275	2.9	8.4
6048	4	132641	3.0	11.4
6049	5	137069	3.1	14.5
6050	6	141554	3.2	17.7
6051	7	146090	3.4	21.0
6052	8	150689	3.5	24.4
6053	9	160056	3.7	**28.0**
6054	10			fb

WQCV	1.02
Storage	26.8
	27.82

Detention Pond 2

Elevation	Depth (ft)	A (ft2)	A (ac)	Storage (AF)
6038	0	260108	6.0	0
6039	1	267265	6.1	6
6040	2	274472	6.3	12
6041	3	281747	6.5	19
6042	4	289080	6.6	25
6043	5	296461	6.8	32
6044	6	303909	7.0	39
6045	7	311413	7.1	46
6046	8	318971	7.3	53
6047	9	326588	7.5	**61**
6048	10	334265	7.7	fb

WQCV	4.26
Storage	56.1
	60.36

Detention Pond 3

Elevation	Depth (ft)	A (ft2)	A (ac)	Storage (AF)
6036	0	216805	5.0	0
6037	1	222417	5.1	5
6038	2	228084	5.2	10
6039	3	233816	5.4	16
6040	4	239638	5.5	21
6041	5	245500	5.6	27
6042	6	251417	5.8	32
6043	7	257394	5.9	**38**
6044	8	263011	6.0	fb

WQCV	2.7
Storage	35.2
	37.9

Detention Pond 4

Elevation	Depth (ft)	A (ft2)	A (ac)	Storage (AF)
6034	0	286404	6.6	0
6035	1	293782	6.7	7
6036	2	301252	6.9	13
6037	3	308769	7.1	20
6038	4	316340	7.3	28
6039	5	323968	7.4	35
6040	6	331654	7.6	43
6041	7	339397	7.8	50
6042	8	347179	8.0	50.5
6043	9	354996	8.1	**66.2**
6044	10	362875	8.3	fb

WQCV	3.18
Storage	61.3
	64.48

Detention Pond 5

Elevation	Depth (ft)	A (ft2)	A (ac)	Storage (AF)
6018	0	346756	8.0	0
6019	1	356011	8.2	8
6020	2	363101	8.3	16
6021	3	370249	8.5	25
6022	4	377455	8.7	33
6023	5	384718	8.8	42
6024	6	392038	9.0	51
6025	7	399415	9.2	60
6026	8	406850	9.3	69
6027	9	414343	9.5	**79**
6028	10			fb

WQCV	5.46
Storage	73.3
	78.76

Detention Pond 6

Elevation	Depth (ft)	A (ft2)	A (ac)	Storage (AF)
6006	0	357231	8.2	0
6007	1	369691	8.5	8
6008	2	376904	8.7	17
6009	3	384227	8.8	26
6010	4	391552	9.0	35
6011	5	398868	9.2	44
6012	6	406351	9.3	53
6013	7	413874	9.5	62
6014	8	421459	9.68	72
6015	9	429044	9.85	**82**
6016	10	436629	10.02	fb

WQCV	18.48
Storage	56.2
	74.68

Detention Pond 7

Elevation	Depth (ft)	A (ft2)	A (ac)	Storage (AF)
5895	0	108045	2.5	0
5896	1	115585	2.7	3
5897	2	120259	2.8	5
5898	3	124990	2.9	8
5899	4	129778	3.0	11
5900	5	134623	3.1	14
5901	6	139468	3.2	17
5902	7	144313	3.3	20
5903	8	149158	3.4	**24**
5904	9	154003	3.5	27

WQCV	-
Storage	21.7
	21.7

Water Quality Capture Volume for Upstream Sub Basins is not included in this detention facility, due to the location of the facility relative to the runway. The construction of a water quality capture volume feature at this facility would detain water long enough to allow the establishment of vegetation. This would attract waterfowl. The presence of waterfowl in this location increases the potential for incident with planes landing or taking off from runway 17R/35L, posing a safety risk. The water quality capture volume for developed areas tributary to this detention pond is detained upstream within the system.

Detention Pond 8

Elevation	Depth (ft)	A (ft2)	A (ac)	Storage (AF)
5925	0	164787	3.8	0
5926	1	172421	4.0	4
5927	2	177005	4.1	8
5928	3	181647	4.2	12
5929	4	186346	4.3	16
5930	5	191103	4.4	21
5931	6	195918	4.5	25
5932	7	200790	4.6	30
5933	8	205720	4.7	34
5934	9	210707	4.8	**39**
5935	10	215752	5.0	fb

WQCV	5.64
Storage	32.3
	37.94

Detention Pond 10

Elevation	Depth (ft)	A (ft2)	A (ac)	Storage (AF)
6020	0	84987	2.0	0
6021	1	89109	2.0	2
6022	2	93289	2.1	4
6023	3	97528	2.2	6
6024	4	101825	2.3	9
6025	5	106182	2.4	11
6026	6	110596	2.5	13
6027	7	115070	2.6	16
6028	8	119602	2.7	**19**
6029	9			fb

WQCV	0.84
Storage	15.5
	16.34

Detention Pond 11

Elevation	Depth (ft)	A (ft2)	A (ac)	Storage (AF)
5993	0	92767	2.1	0
5994	1	96346	2.2	2
5995	2	99984	2.3	4
5996	3	103682	2.4	7
5997	4	107439	2.5	9
5998	5	111255	2.6	12
5999	6	115131	2.6	14
6000	7	119066	2.7	17
6001	8	123060	2.8	20
6002	9	127368	2.9	**23**
	10			fb

WQCV	1.98
Storage	21.5
	23.48

Detention Pond 13

Elevation	Depth (ft)	A (ft2)	A (ac)	Storage (AF)
5986	0	19409	0.4	0.0
5987	1	45796	1.1	0.7
5988	2	121977	2.8	2.7
5989	3	153684	3.5	5.8
5990	4	194356	4.5	9.8
5991	5	222299	5.1	14.6
5992	6	259649	6.0	**20.1**
5993	7			fb

WQCV	0.36
Storage	17.2
	17.56

Stage - Storage for Big Johnson Detention Facilities

Pond	Elevation	Depth	Area (ft^2)	Area acres	Volume AF		
100	5937		25324	0.58			
	5938	1	27575	0.63	0.6		
	5939	2	29890	0.69	1.3	WQCV	0.6
	5940	3	32270	0.74	2.0	Storage	3.9
	5941	4	34716	0.80	2.7		4.5
	5942	5	37227	0.85	3.6		
	5943	6	39804	0.91	**4.5**		
	5944	7			fb		
200	5907		25434	0.58			
	5908	1	28398	0.65	0.6		
	5909	2	31414	0.72	1.3	WQCV	0.6
	5910	3	34487	0.79	2.1	Storage	4.7
	5911	4	37613	0.86	2.6		5.3
	5912	5	40796	0.94	3.1		
	5913	6	44033	1.01	3.7		
	5914	7	47326	1.09	4.2		
	5915	8	50674	1.16	4.8		
	5916	9	54077	1.24	**5.3**		
	5917	10			fb		
250	5915		12304	0.28			
	5916	1	14035	0.32	0.3		
	5917	2	15740	0.36	0.6	WQCV	0.4
	5918	3	17504	0.40	1.0	Storage	3.2
	5919	4	19322	0.44	1.4		3.6
	5920	5	21203	0.49	1.9		
	5921	6	23126	0.53	2.4		
	5922	7	25127	0.58	3.0		
	5923	8	27183	0.62	**3.6**		
	5924	9	29288	0.67	fb		
400	5957		16347	0.38			
	5958	1	18096	0.42	0.4		
	5959	2	19906	0.46	0.8	WQCV	0.4
	5960	3	21777	0.50	1.3	Storage	3.1
	5961	4	23706	0.54	1.8		3.5
	5962	5	25699	0.59	2.4		
	5963	6	27751	0.64	3.0		
	5964	7	29864	0.69	**3.7**		
	5965	8	27812	0.64	fb		

500	5914		251858	5.78			
	5915	1	259827	5.96	5.9	WQCV	4.1
	5916	2	266418	6.11	11.9	Storage	50.9
	5917	3	273046	6.26	18.1		55.0
	5918	4	279714	6.42	24.4		
	5919	5	286419	6.57	30.9		
	5920	6	293164	6.73	37.6		
	5921	7	299950	6.88	44.4		
	5922	8	306774	7.04	51.3		
	5923	9	313641	7.20	**58.5**		
	5924	10			fb		
700	5990		166035	3.81			
	5991	1	171880	3.94	3.9		
	5992	2	177787	4.08	7.9	WQCV	1.9
	5993	3	183747	4.22	12.0	Storage	33.9
	5994	4	189766	4.35	16.3		35.8
	5995	5	195844	4.49	20.7		
	5996	6	201979	4.63	25.3		
	5997	7	208171	4.78	30.0		
	5998	8	214423	4.92	34.9		
	5999	9	220737	5.06	**39.8**		
	6000	10			fb		
900	6014		18880	0.43			
	6015	1	20528	0.47	0.5		
	6016	2	2250	0.05	0.7	WQCV	0.4
	6017	3	24023	0.55	1.0	Storage	3.8
	6018	4	25852	0.59	1.6		4.2
	6019	5	27739	0.64	2.2		
	6020	6	29684	0.68	2.9		
	6021	7	31686	0.73	3.6		
	6022	8	33746	0.77	**4.3**		
	6023	9			fb		

Conveyance Element Calculations

Appendix H

APPENDIX H

Conveyance Element Calculations

Comparison of 2 hour to 24 hour runoff for Windmill Gulch

Basin	2hour (CFS)	24 hour (CFS)	Flow to Use (CFS)
400	370	458	458
450	375	400	400
451	121	121	121
500	472	648	648
525	85	123	123
550	260	333	333
551	179	186	186
600	162	181	181
625	87	94	94
650	534	531	534
660	1008	913	1008
675	171	232	232
685	116	177	177
700	170	255	255
725	185	291	291
750	231	272	272
800	361	359	361
825	63	63	63
850	432	413	432
875	382	419	419
900	184	210	210
925	547	515	547
950	387	363	387

Windmill Gulch North System (Tributary to Detention Basin 7)

Two-hour Flow was used if noted here, if greater than 24-hour Flow	Element	Tributary Flow(s)	Flow From Model (cfs)	Total Flow to be Conveyed (cfs)	Street Capacity (cfs)	Street Flow (cfs)	Element Flow (cfs)	Ground Slope	Design Slope	Length (ft)	Pipe Size (in)	Pipe Velocity (fps)	Box Size (ftxft)	Box Velocity (fps)	Channel B (ft)	Channel y	Channel Velocity (ft/s)	Comments / Drop Structure Info (for grass-lined channel reaches)
+	2 1 A	21B+ 37.5%(660)	Basin 660=1008	504	NA	0	504		0.60%	2800			6X6	14.04				
+	2 1 B	12.5% (660)	Basin 660=1008	126	NA	0	126	5.00%	1.50%	1360	42	14.58						
+	2 2	25%(660)	Basin 660=1008	252	NA	0	252	2.17%	1.00%	1520	60	15.11						
	2 3	Det 2 Outflow	Det 2=11	11	NA	0	11		0.50%	466	21	5.29						
+	4 1 A	41B + 650	Basin 650=534	943	NA	0	943		0.53%	2430			10x6	16.12				
	4 1 B	685+675	Basin 685=177 Basin 675=232	409	NA	0	409	2.88%	0.53%	409	78	12.86						
	4 2	Det 1 Outflow	Det 1 = 275	275	NA	0	275		0.50%	466	72	12.01						
	5 2	Det 3 Outflow	Det 3=10	10	N/A due to pond invert elev relative to street elev.	0	10		0.70%	2784	21	6.06						
	5 4A	54B		272	N/A-no street	0	272	3.02%	1.80%	709	66	19.85						54 inch pipe would work but cannot go from 72 inch into 54-inch. Max reduction in diameter allowed by criteria is 6-in.
	5 4B	Basin 750	Basin 750=272	272	N/A-no street	0	272		0.50%	691	72	12						
+	6 1 A	61B+ 61B Gutter+ (2/3) 800	Basin 800=361	396	N/A-street slopes uphill	0	396	2.20%	1.50%	500	66	19.72						
+	6 1 B	Det 5 Out, Pipe 5 2 + (1/3) 800	Basin 800=361 Det 5=25	155	N/A	0	155		2.20%	500	48	18.49						
	6 3 B	Det 4 Outflow	Det 4=28	28	N/A-pond invert elev lower than street elev.	0	28		0.50%	900	30	6.73						
	6 3 A	63B + Basin 625	Basin 625=94	122	N/A	0	116		3.20%	1190	36	18.97						
	6 4 A	3/4(Basin 700)	Basin 700=255	191	N/A	0	191	0.60%	0.60%	1000					6	2.44+1	4.97	
	7 2 A	72B		24	N/A	0	24	3.90%	2.50%	1600					3	0.78+1	4.99	22.4 feet of excess potential energy will need to be used up through drop structures due to the difference between ground slope and desired channel slope to meet velocity and depth requirements.
	7 2 B	Det 13	Det 13=24	24	N/A	0	24		2.00%	700	24	11.18						
	7 1 A	71B+ historic from 59+ 1/2(Basin 500)	Basin 500=648	507	N/A	0	507	2.80%	0.30%	1900					8	4.18+1	4.91	47.5 feet of excess potential energy will need to be used up through drop structures due to the difference between ground slope and desired channel slope to meet velocity and depth requirements.
	7 1 B	71C + historic from 27+1/4(Basin 500)	Basin 500=648	143	N/A	0	143	2.80%	0.70%	460					5	2.15+1	4.9	9.66 feet of excess potential energy will need to be used up through drop structures due to the difference between ground slope and desired channel slope to meet velocity and depth requirements.
	7 1 C	Det 6 Outflow	Det 6=29	29	N/A	0	29	3.00%	2.00%	1020					4	0.83+1 = 2	4.76	10.2 feet of excess potential energy will need to be used up through drop structures due to the difference between ground slope and desired channel slope to meet velocity and depth requirements.

A = Most downstream portion of element.

B = Next upstream portion of element

C = ...

Street Flow was computed assuming normal crown, 12" gutter height, and 2% cross slopes away from the crown.

Windmill Gulch South System (Tributary to Detention Basin 8)

Element	Tributary Flow(s)	Flow From Model (cfs)	Total Flow to be Conveyed (cfs)	Street Capacity (cfs)	Street Flow (cfs)	Element Flow (cfs)	Ground Slope	Design Slope	Length (ft)	Pipe Size (in)	Pipe Velocity (fps)	Box Size (ftxft)	Box Velocity (fps)	Channel B (ft)	Channel y (w/o fb)	Channel Velocity (ft/s)	Comments / Drop Structure Info (for grass-lined channel reaches)
8 1 A	Pipe 81B+55% of 451+ 81B Gutter	Basin 451=121 Det 11=22	143	NA-street slopes uphill	0	143		0.70%	785	54	11.65						
8 1 B	Det 11 Outflow + 45% of 451-street flow	Basin 451=121 Det 11=22	76.5	264	77	0				none							
8 2 A	82B+ Basin 551-street flow	Basin 551=186	205	95	95	110		0.50%	1290	54	9.69						
8 2 B	82C		19	NA-no street	0	19	1.30%	1.30%	770					2	0.83	4.27	
8 2 C	Det 10 Outflow	Det 10=19	19	NA-no street	0	19		1.10%	270	24	8.39						Need Energy Dissipation where this box outfalls into channel, to reduce velocities from 8.39 down to the 5-6 fps range.
8 3 A	83B + 60% of 450	Basin 450=400	400	NA-too many grade changes	0	400		0.10%	1700			8X8	6.81				
8 3 B	83C + 20% of 450 + 83C Gutter	Basin 450=400	160	NA-too many grade changes	0	160		0.70%	950	54	11.79						
8 3 C	20% of 450	Basin 450=400	80	206	80	0				none							
8 4 A	Pipe 8 4 B + (1/4) 400	Basin 400=458	773	NA	0	773	2.00%	0.25%	604					10	5.04	5.09	10.6 feet of excess potential energy will need to be used up through drop structures due to the difference between ground slope and desired channel slope to meet velocity and depth requirements.
8 4 B	Pipe 8 4 C + (1/4) 400	Basin 400=458	659	NA	0	659	2.10%	0.30%	440					10	4.5	5.23	7.92 feet of excess potential energy will need to be used up through drop structures due to the difference between ground slope and desired channel slope to meet velocity and depth requirements.
8 4 C	Pipe 8 4 D		544	NA	0	544	3.60%	0.30%	780					10	4.13	4.98	25.7 feet of excess potential energy will need to be used up through drop structures due to the difference between ground slope and desired channel slope to meet velocity and depth requirements.
8 4 D	Pipe 8 1 + Pipe 8 3		544	NA	0	544		0.50%	895			7X6	13.56				Need Energy Dissipation where this box outfalls into channel, to reduce velocities from 13.56 down to the 5-6 fps range.

A = Most downstream portion of element.
B = Next upstream portion of element
C = ...
Street Flow was computed assuming normal crown, 12" gutter height, and 2% cross slopes away from the crown.

All Report

Label	Worksheet Type	Mannings Coefficien	Slope (ft/ft)	Discharge (cfs)	Diameter (in)	Depth (ft)	Bottom Width (ft)	Velocity (ft/s)	Froude Number	Flow Type
2 1A Box	Rectangular	0.013	0.006000	504.00		5.98	6.00	14.04	1.01	Supercritic
2 1B Pipe	Circular	0.013	0.015000	126.00	42	2.95		14.58	1.40	Supercritic
2 2 Pipe	Circular	0.013	0.010000	252.00	60	3.96		15.11	1.31	Supercritic
23	Circular	0.013	0.005000	11.00	21	1.42		5.29	0.75	Subcritical
4 1 A	Rectangular	0.013	0.005300	943.00		5.85	10.00	16.12	1.17	Supercritic
4 1 B	Circular	0.013	0.005300	409.00	78	5.94		12.86	0.77	Subcritical
4 2 Pipe	Circular	0.013	0.005000	275.00	72	4.53		12.01	1.01	Supercritic
5 2 Pipe	Circular	0.013	0.007000	10.00	21	1.14		6.06	1.07	Supercritic
5 4 A Pipe	Circular	0.013	0.018000	272.00	66	3.08		19.85	2.21	Supercritic
5 4 B Pipe	Circular	0.013	0.005000	272.00	72	4.48		12.00	1.01	Supercritic
6 1 A Pipe	Circular	0.013	0.015000	396.00	66	4.33		19.72	1.64	Supercritic
6 1 B Pipe	Circular	0.013	0.022000	155.00	48	2.53		18.49	2.21	Supercritic
6 3 A Pipe	Circular	0.013	0.032000	122.00	36	2.60		18.97	1.84	Supercritic
6 3 B Pipe	Circular	0.013	0.005000	28.00	30	1.98		6.73	0.83	Subcritical
6 4A Channel	Trapezoidal	0.030	0.006000	191.00		2.44	6.00	4.97	0.71	Subcritical
7 1A Channel	Trapezoidal	0.030	0.003000	507.00		4.18	8.00	4.91	0.55	Subcritical
7 1B Channel	Trapezoidal	0.030	0.007000	143.00		2.15	5.00	4.90	0.75	Subcritical
7 1C Channel	Trapezoidal	0.030	0.020000	29.00		0.83	4.00	4.76	1.11	Supercritic
7 2 A Channel	Trapezoidal	0.030	0.025000	24.00		0.78	3.00	4.99	1.22	Supercritic
7 2 B Pipe	Circular	0.013	0.020000	24.00	24	1.29		11.18	1.86	Supercritic
8 1A Pipe	Circular	0.013	0.007000	143.00	54	3.24		11.65	1.18	Supercritic
8 2A Pipe	Circular	0.013	0.005000	110.00	54	3.02		9.69	1.04	Supercritic
8 2B Channel	Trapezoidal	0.025	0.013000	19.00		0.83	2.00	4.27	1.05	Supercritic
8 2C Pipe	Circular	0.013	0.011000	19.00	24	1.35		8.39	1.34	Supercritic
8 3A Box	Rectangular	0.013	0.001000	400.00		7.34	8.00	6.81	0.44	Subcritical
8 3B Pipe	Circular	0.013	0.007000	160.00	54	3.58		11.79	1.07	Supercritic
8 4A Channel	Trapezoidal	0.030	0.002500	773.00		5.04	10.00	5.09	0.52	Subcritical
8 4B Channel	Trapezoidal	0.030	0.003000	659.00		4.50	10.00	5.23	0.56	Subcritical
8 4C Channel	Trapezoidal	0.030	0.003000	544.00		4.13	10.00	4.98	0.55	Subcritical
8 4D Box	Rectangular	0.013	0.005000	544.00		5.73	7.00	13.56	1.00	Subcritical

Comparison of 2 hour to 24 hour runoff for Big Johnson

Basin	2hour (CFS)	24 hour (CFS)	Flow to Use (CFS)
100	70	107	107
150	93	93	93
200	281	429	429
215	97	132	132
225	92	93	93
250	289	273	289
260	191	181	191
270	218	335	335
275	94	93	94
300	218	335	335

Big Johnson System

Element	Tributary Flow(s)	Flow From Model (cfs)	Element Flow (cfs)	Ground Slope	Design Slope	Length (ft)	Pipe Size (in)	Pipe Velocity (fps)	Box Size (ftxft)	Box Velocity (fps)	Channel B (ft)	Channel y	Channel Velocity (ft/s)	Comments / Drop Structure Info (for grass-lined channel reaches)
1	Det 400 Outfall	Det 400=22	22	5.10%	2.50%	310					2	0.83+1	4.94	8.06 feet of excess potential energy will need to be used up through drop structures due to the difference between ground slope and desired channel slope to meet velocity and depth requirements.
2A	2B		38		0.50%	285	33	7.17						
2B	Det 500 Outfall	Det 500=38	38	2.49%	1.90%	504					5	0.89+1	4.96	3 feet of excess potential energy will need to be used up through drop structures due to the difference between ground slope and desired channel slope to meet velocity and depth requirements.
3A	Det 200 Outfall	Det 200=42	42		7.00%	109	21	19.88						
3B	Det 250 Outfall	Det 250=19	19		3.57%	297	18	12.79						
3C	225	Basin 225=93	93		2.50%	723	36	16.84						
4A	4B + (1/10)200	Basin 200=429	89	3.95%	0.80%	805					4	1.76+1	4.58	25.4 feet of excess potential energy will need to be used up through drop structures due to the difference between ground slope and desired channel slope to meet velocity and depth requirements.
4B	Det 700 Outfall	Det 700=46	46		2.60%	379	27	14.25						
5	270	Basin 270=335	335		2.25%	393	60	19.65						
6	Det 900 Outfall	Det 900=11	11		5.90%	450	18	13.9						
7	260	Basin 260=181	181		0.98%	434	54	13.9						

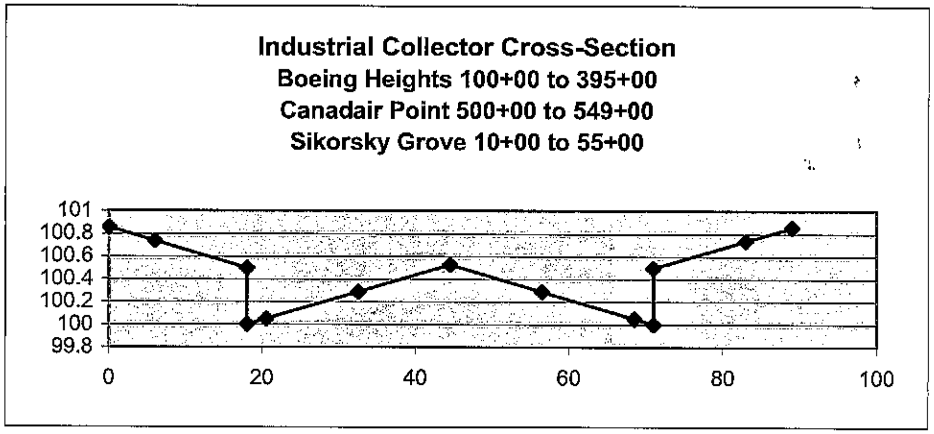
All Report

Label	Worksheet Type	Mannings Coefficien	Slope (ft/ft)	Discharge (cfs)	Diameter (in)	Depth (ft)	Bottom Width (ft)	Velocity (ft/s)	Froude Number	Flow Type
1	Trapezoidal	0.030	0.025000	22.00		0.83	2.00	4.94	1.22	Supercritic
2A	Circular	0.013	0.005000	38.00	33	2.30		7.17	0.78	Subcritical
2B	Trapezoidal	0.030	0.019000	38.00		0.89	5.00	4.96	1.10	Supercritic
3A	Circular	0.013	0.070000	42.00	21	1.44		19.88	2.80	Supercritic
3B	Circular	0.013	0.035700	19.00	18	1.18		12.79	2.06	Supercritic
3C	Circular	0.013	0.025000	93.00	36	2.19		16.84	2.06	Supercritic
4A	Trapezoidal	0.030	0.008000	100.00		1.86	4.00	4.72	0.78	Subcritical
4B	Circular	0.013	0.026000	57.00	30	1.79		15.16	2.07	Supercritic
5	Circular	0.013	0.017000	335.00	60	4.08		19.65	1.64	Supercritic
6	Circular	0.013	0.059000	11.00	18	0.69		13.90	3.37	Supercritic
7	Circular	0.013	0.009800	181.00	54	3.43		13.90	1.33	Supercritic

Street Flow Capacity

Industrial Colllector Cross Section

ft	*Horz Pos*	*Vert. Pos.*
	0	**100.86**
6	**6**	**100.74**
12	**18**	**100.5**
	18	**100**
	20.5	**100.05**
	32.5	**100.29**
26.5	**44.5**	**100.53**
	56.5	**100.29**
	68.5	**100.05**
26.5	**71**	**100**
	71	**100.5**
12	**83**	**100.74**
6	**89**	**100.86**



Q (at S = 0.014) = 205.74 cfs	Element 8 3 C
Q (at S=0.003) = 95.24 cfs	Element 8 2 A

All Report

Label	Worksheet Type	Discharge (cfs)	Depth (ft)	Slope (ft/ft)	Mannings Coefficient	Diameter (in)	Velocity (ft/s)	Flow Type	Headwater Elevation (ft)	Crest Elevation (ft)	Centroid Elevation (ft)	Tailwater Elevation (ft)	Intercepted Flow (cfs)	Spread (ft)	Gutter Width (ft)
10A	Circular	36.13	3.00	).010000	0.024	36	5.11	Subcritical							
10B	Circular	51.09	3.00	).020000	0.024	36	7.23	Subcritical							
10C	Circular	21.57	2.00	).031000	0.024	24	6.87	Subcritical							
45A	Circular	189.26	5.00	).018000	0.024	60	9.64	Subcritical							
45B	Circular	5.40	1.50	).009000	0.024	18	3.05	Subcritical							
45C	Circular	62.57	3.00	).030000	0.024	36	8.85	Subcritical							
7_888	Rectangula	430.44	3.00	).012000	0.013		17.93	Supercritic							