AVONDALE ESTATES

Kensington Road Drainage Analysis
City of Avondale Estates, Georgia

GEORGIA
REGISTERED
PE022101
PROFESSIONAL
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4-27-2010

April 27, 2010
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Clark Patterson Lee Project Number 11827.00

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PROJECT NARRATIVE

Drainage complaints related to road and property flooding has prompted an analysis to understand the cause of the problems and determine possible solutions. The area of concern extends along Kensington Road within the City of Avondale Estates of DeKalb County, Georgia (Refer to Maps section of the Appendix). An existing storm system within the project study area conveys storm water runoff through pipes, graded channels and a concrete flume. Most of the known flooding problems are within the properties adjacent to this existing storm system.

The intent of this study includes: (1) determining the basin characteristics draining into the existing storm system, (2) analyzing the basin's hydrologic patterns and flows, (3) analyzing the hydraulic capacity of the existing conveyance system under the current conditions, (4) providing possible solutions with cost estimates to alleviate the drainage problems, and (5) analyzing the properties further downstream of this project's study point.

HYDROLOGIC & HYDRAULIC ANALYSIS

Existing Data – A survey of the existing storm conveyance system was performed beginning upstream at Convington Highway and extending just south of Kensington Road. In addition, DeKalb County GIS information was obtained to assist in identifying the drainage basin to the storm system. The studied area does not lie within a designated flood hazard zone per FIRM panel 13089C0069 H dated May 7, 2001 (Refer to Maps section of the Appendix).

Basin Data – The project study point (Study Point "F") is the outlet of a 4' concrete flume located within a property on the south side of Kensington Road, parcel number 15-250-05-010. The entire drainage basin to this point consists of approximately 44 acres extending west to Lakeshore Drive, north to Covington Highway, and east to the intersection of Kensington Road and Covington Highway (Refer to Maps section of the Appendix). For analysis, sub-basins "A" through "F" were identified within the overall basin, each with its own characteristics and study point. Using impervious and topographic information from the DeKalb County GIS maps, an SCS Curve Number (CN), a rational coefficient (c), and time of concentration was calculated for each sub-basin individually. The following table lists the Curve Number and 'c' values assumed for impervious, landscaped, and wooded areas. Two or more drainage travel paths were studied to obtain the longest time of concentration within each basin. The TR-55 method in the Hydraflow software was used to calculate the time of concentration.

Table 1: Curve Number & Rational 'c' Assumptions

Area Description	SCS CN	Rational 'c'
Impervious	98	.95
Landscape	61	.35
Wooded	55	.30

A brief overview of the sub-basins is supported by the maps, calculations and tables in the Basin Data section of the Appendix. The main pipe system in this analysis, receives runoff from two

headwall inlets, Study Points "A" & "B". The upstream areas draining to these pipes consist heavily of impervious areas from the church, other buildings, and parking lots with minimal or no upstream detention. Flows from both of these basins drain through 18" pipes which join together and flow into a series of 18" pipes through the yards of two residential properties. There are several yard inlets with grates along this run of pipes in effort to capture more surface runoff contributing to sub-basin "C". The pipes then convey storm water under Kensington Road and join with another pipe that captures the road runoff. The runoff for the entire (Kensington) road is currently handled in a pair of old catch basins at the approximate low point of the road. Curb and gutter is apparent in some sections of the road and a normal crown appears to exist in the road typical section. There is approximately 14 acres of upstream surface runoff that drains onto Kensington Road and is analyzed in sub-basin "D". The pipe system downstream of the connection under the road consists of 36" pipes releasing into the 4-foot wide concrete flume ending at the project study point "F". SCS Hydrographs were created to establish flows for each of the sub-basins. The hydrograph for Basin "F" represents the total basin flows for the project study area.

Upstream Analysis – The existing pipe system was modeled in StormCAD software to analyze the capacity of the system for the 25-year storm event using the rational method. Some pipe sizes, materials and slopes were unknown and had to be assumed for analysis purposes. These were noted as such in the pipe tables. *Refer to the Storm System Data section of the Appendix*. The pipe analysis illustrated that a portion of the pipe system flows under pressure through undersized pipes. The hydraulic grade line is above the top of several structures, thus causing the flooding that has been observed. In addition to the overwhelmed pipe system, the capacity of many of the yard inlets and catch basin structures cannot accommodate the receiving runoff, thus another reason for the experienced flooding. The rational method flow and velocity exiting the system at headwall "E-1" into the concrete flume are 94.14 cfs and 17.02 fps, respectively. This velocity is considerably higher than the non-erosive exit velocity of 5 fps and is a result of a steep pipe slope as well as the undersized pipes. The velocity may or may not be causing erosion because the headwall releases the flows into a 4-foot wide concrete flume.

The flume was analyzed using Bentley FlowMaster software to determine the normal depth of water resulting from the piped system's 25-year storm flows. A depth of almost 1.5' was calculated, meaning that the water most likely flows above the sides of the flume (the geometry of the flume was assumed for this analysis). The project's study point for the overall basin is at the end of this flume. The 25-year flow data is in the following table.

Table 2: Total Basin Flow Data at Study Point 'F'

Total Drainage Area	44.0 acres
Q_{25} (SCS method)	153.58 cfs
Q_{25} (rational method)	94.14 cfs
v_{25}	16.14 fps

Analysis of Improvement Options – Based on the location of the existing pipes and structures, an analysis was conducted to determine the appropriate pipe sizes required to accommodate the storm water runoff keeping the 25-year hydraulic grade line within the system. By increasing the pipe diameters for a portion of the system (beginning with the headwalls for basins A & B and ending at the connection south of Kensington Road), the flooding due to hydraulic pressure flows can be eliminated. *Refer to the Analysis section of the Appendix.* The rational method velocities within the pipe

system are reduced with the increased pipe diameters, but the exit velocity, 16.98 fps, remains similar to the existing undersized system. Again, the high velocity may or may not be an issue because of the concrete flume.

Another area of concern and possible reason for residential drainage complaints is flooding from surface runoff onto the properties along the south side of Kensington Road. An upstream basin area of nearly 14 residential acres seems to sheet flow onto the road. The 0.4-mile road appears to have a normal crown, but curbing (no gutter) is only provided in random sections along either side of the road, probably added specifically to help with drainage runoff. Two old catch basins and a grate inlet lie near the vertical low point of the road where drainage capture is intended. The old catch basins do not have the capacity to accept the upstream basin flows, so the water likely ponds and floods the properties near this low elevation. In addition to backing up into the road and considering the sporadic presence of curb, a portion of the runoff from the upland area probably flows across the road and into the yards of the residences south of Kensington Road completely bypassing the pipe system.

If drainage is a concern to the properties on the south side of Kensington Road and for the properties near the road's low point, standard curb and gutter with a piped catch basin collection system could be installed along a portion or all of Kensington Road. Typically, single wing catch basins are spaced to meet maximum gutter spread requirements and double wing catch basins are placed at the low point. Preliminary gutter spread calculations yield a total of approximately 18 structures placed along both sides of the normal crown with more than half located east of the low point *Refer to the Analysis section of the Appendix.* By installing curb, gutter, structures and pipes, the runoff from the road and upland areas (nearly 16 acres) will be captured in a closed pipe system, alleviating downstream surface flooding issues. Note that in the pipe analysis previously discussed, the existing pipe system was assumed to carry this entire area even though some surface runoff is expected to bypass the storm structures.

Older developments tend to experience drainage issues from inadequate storm systems. In addition though, many older developments offer minimal or even no detention for attenuating peak flows, which is the case for this area within Avondale Estates. Basins 'A' and 'B' are highly impervious and are located at the highest elevations within the project watershed. A small pond does exist within basin 'B' at the corner of the church parking lot, but it is too small to model using current hydrologic methods. The existing undersized pipe system accepts storm water flows from both basins 'A' and 'B'. By reducing the peak flows at this critical point, the entire downstream conveyance system and property owners will benefit. Using Hydraflow software, an underground detention pond was modeled to reduce the combined 25-year flows of basins 'A' and 'B' from 78 cfs to 25-30 cfs, which is still greater than the capacity of the existing 18" pipe, but can easily be accommodated by the resized pipe option. Approximately 115,000 cubic feet of storage is required to detain to this target flow for the 25-year storm, with an overall storage volume of just under 150,000 cubic feet. *Refer to the Analysis section of the Appendix for pond information.* This volume can be obtained underground within the footprint of the lower level of the church parking lot. This upstream detention option would also involve rerouting the pipe system from Strattford Road to the underground facility.

Downstream Analysis – GIS topography and FEMA Floodplain Maps were consulted to conduct an analysis of the downstream conditions beyond study point 'F'. In addition, a residential homeowner

prepared a sketch of the pipe system within his yard. The location of his property is 3240 Majestic Circle which is immediately downstream of the 4' concrete flume. *Refer to the Analysis section of the Appendix for the sketch and a downstream map.* According to the sketch, a 30" pipe captures the upstream system flows from the flume and exits the property under Majestic Circle. There is also a low area within the yard containing a grate inlet structure. The pipe material or slope is not known at this time, but the GIS elevations illustrate that the pipe lies on a flat slope, maybe less than one percent. Basic pipe capacity flows for a metal or concrete pipe at various slopes are summarized in a downstream pipe analysis chart. *Refer to the Analysis section of the Appendix for the chart.* The 25-year SCS flow of the studied basin draining into this downstream pipe is 154 cfs. As shown, a 30-inch pipe is not sufficient, thus an explanation for some of the homeowner's flooding problems. The hydraulic pressure flow in the pipe is most likely causing the water to flood the grate yard inlet and also back up into the system with a tailwater effect caused in the flume.

Approximately 800' from the project study point 'F', is the headwaters of Cobbs Creek. A defined drainage path is evident for storm water exiting the 30" pipe conveyed to the creek and probably consists of eroded channels and undersized culverts. A rough hydrologic analysis of the drainage basin at the creek headwaters was conducted and a channel section of the creek illustrates the normal depth of water for the 25-year storm event. Approximately 46.6 acres of residential land area drains to the creek headwaters in addition to the studied upstream basin of 44 acres. The SCS 25-year flow is approximately 210 cfs and the normal depth of the channel is almost 6.5 feet. Floodplain limits are reached another 2,755 linear feet downstream along the creek. Approximately 3 road culverts and 9 driveway culverts convey the creek flow to the floodplain. Further information and investigation is needed to determine the point at which downstream properties are not affected by the upstream basin flows.

Please refer to the Results section of the Appendix for maps, analysis and calculations.

CONCLUSION & RECOMMENDATIONS

CONCLUSIONS

Upon review of the hydrology and hydraulics within the studied basin and the existing pipe system, it is evident that residential properties experience flooding even during smaller, more frequent rain events.

- Both pipes and structures within the existing conveyance system are performing under pressure flow conditions due to inadequate capacity.
- Surface runoff draining to Kensington Road floods the road near its catch basins and also bypasses the storm system completely by flowing via surface flow over the road and into downstream yards.
- The upper watershed's highly impervious development coupled with minimal storm water management has caused much higher peak flows than would otherwise exist.

RECOMMENDATIONS

- ***Install a road drainage system to collect water flowing from residential properties onto Kensington Road.*** The properties near both the road's low point and the

downstream (south) side of the road would be relieved with the installation of curb and gutter, catch basins and pipes.

- *Replace existing pipes upstream of Kensington Road with larger pipes that will accommodate the 25-year storm event.* Replacing a portion of the system with larger pipes and new standard inlet structures would eliminate the flooding problems to the yards immediately near the system. The properties located downstream of the studied basin may feel no relief or even may experience adverse impacts from such drainage improvements. It is also highly likely that downstream property owners will claim that their drainage problems have worsened as a result of the City's improvements. If either of the solutions is implemented, a complete downstream analysis extending down the channel and through existing culverts until reaching the floodplain is recommended to identify any existing conditions and determine any adverse impacts from the proposed improvements.

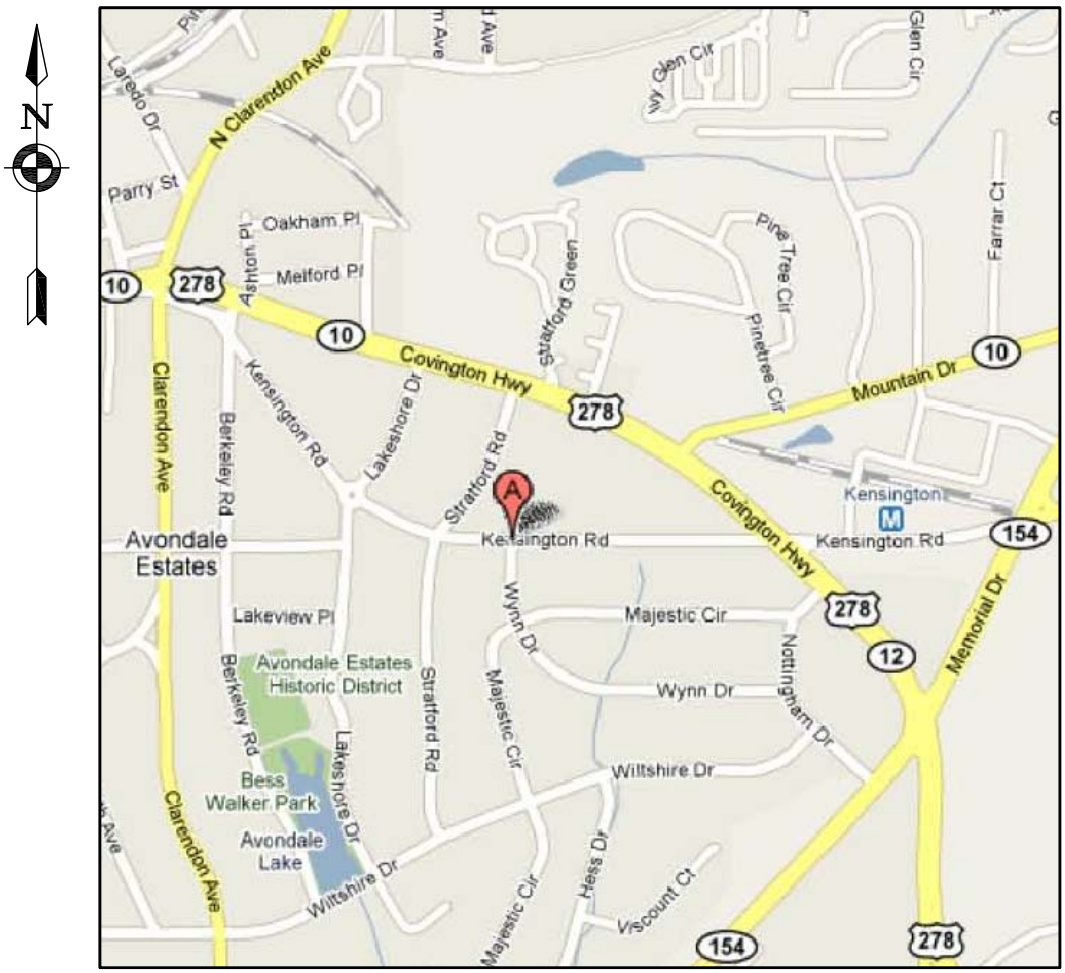
- *Install a detention pond under the Church parking lot and re-direct stormwater that is currently not detained into it.* In order to prevent new larger pipes from transferring the flooding problems downstream, it is necessary to detain the stormwater generated in highly impervious areas at the top of the watershed in a detention pond. The location with obvious appeal would be to install a detention system underneath the First Baptist Church's parking lot. This will be out of the way, and after construction, the land can still be used for parking. Attenuating the flows and releasing them at a lower controlled rate for the frequent storm events would allow the existing undersized storm system to better handle the receiving flows. In addition, the overall hydrology in the basin would be affected, so that the existing system further downstream would experience a peak flow rate reduction varying from 25%-50%.

Please refer to the Results and Cost Estimates sections of the Appendix.

REFERENCES & SOFTWARE

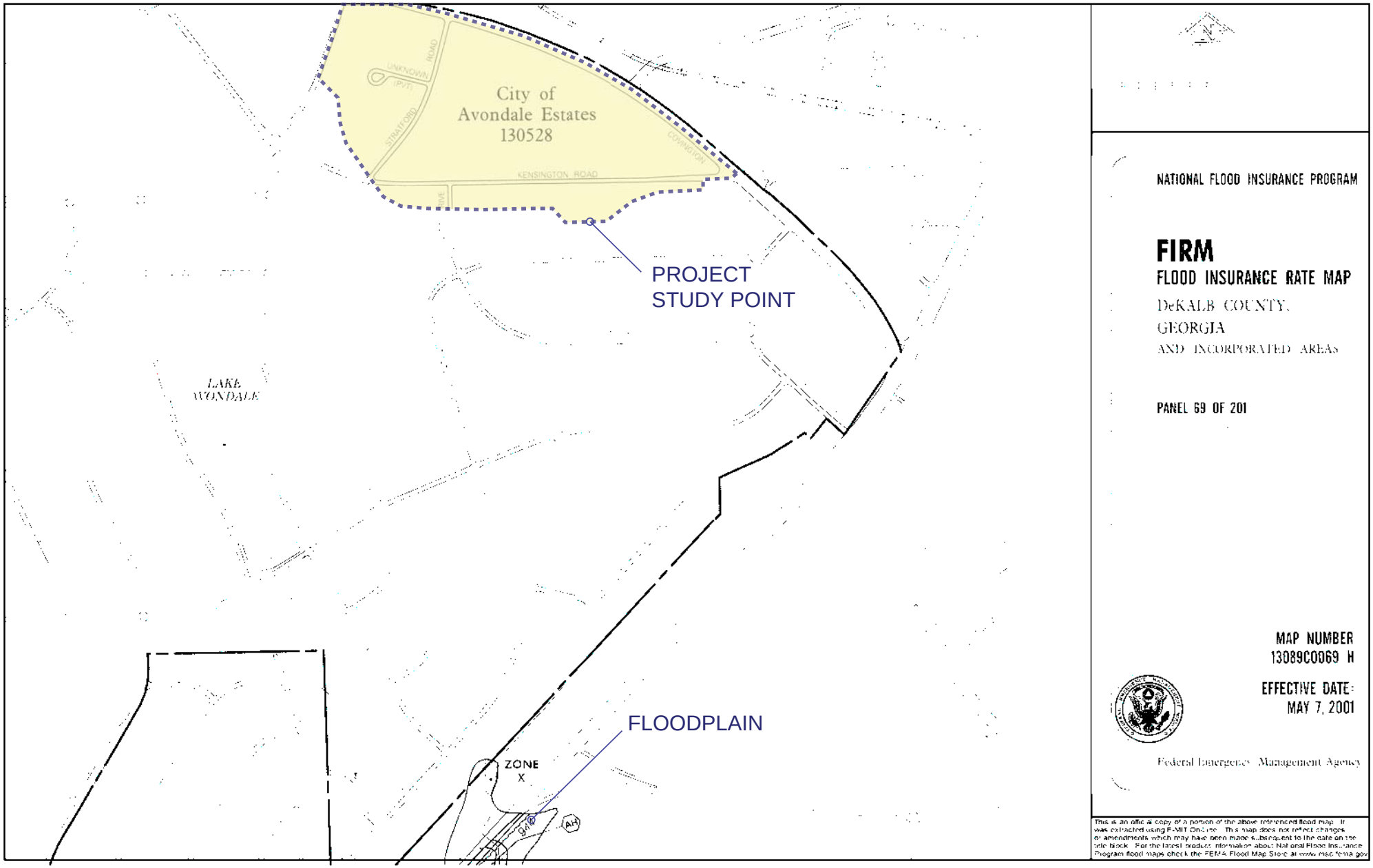
AutoCAD Civil 3D 2009
Bentley FlowMaster
DeKalb County GIS
Excel Spreadsheets
FEMA Map Number 13089C0069 H
Google Earth
Hydraflow Hydrographs Extension for AutoCAD Civil 3D 2009
StormCAD for AutoCAD

MAPS



VICINITY MAP

NTS



NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

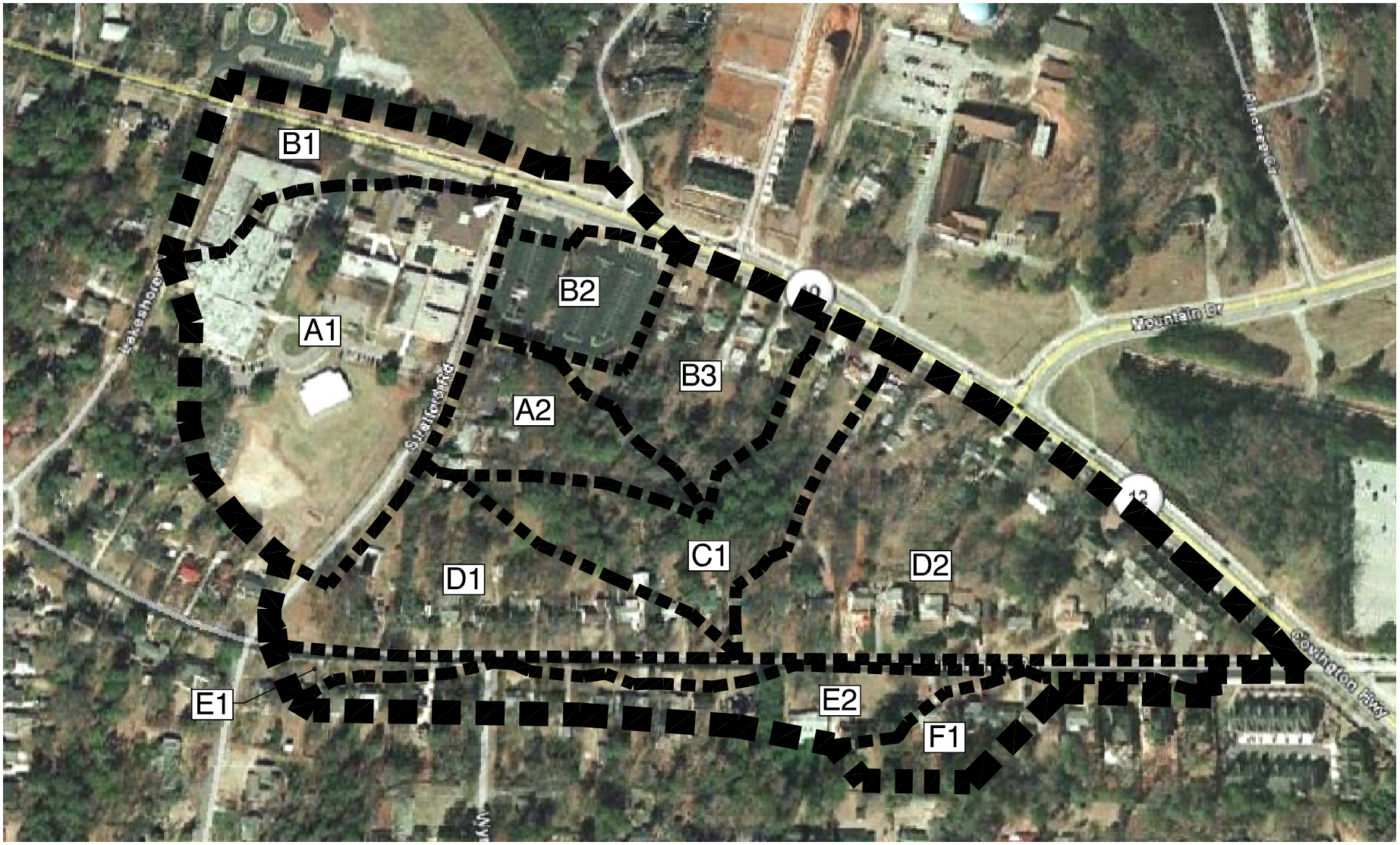
DeKALB COUNTY,
GEORGIA
AND INCORPORATED AREAS

PANEL 69 OF 201

MAP NUMBER
13089C0069 H

EFFECTIVE DATE:
MAY 7, 2001

Federal Emergency Management Agency



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KENSINGTON ROAD
DRAINAGE PROJECT

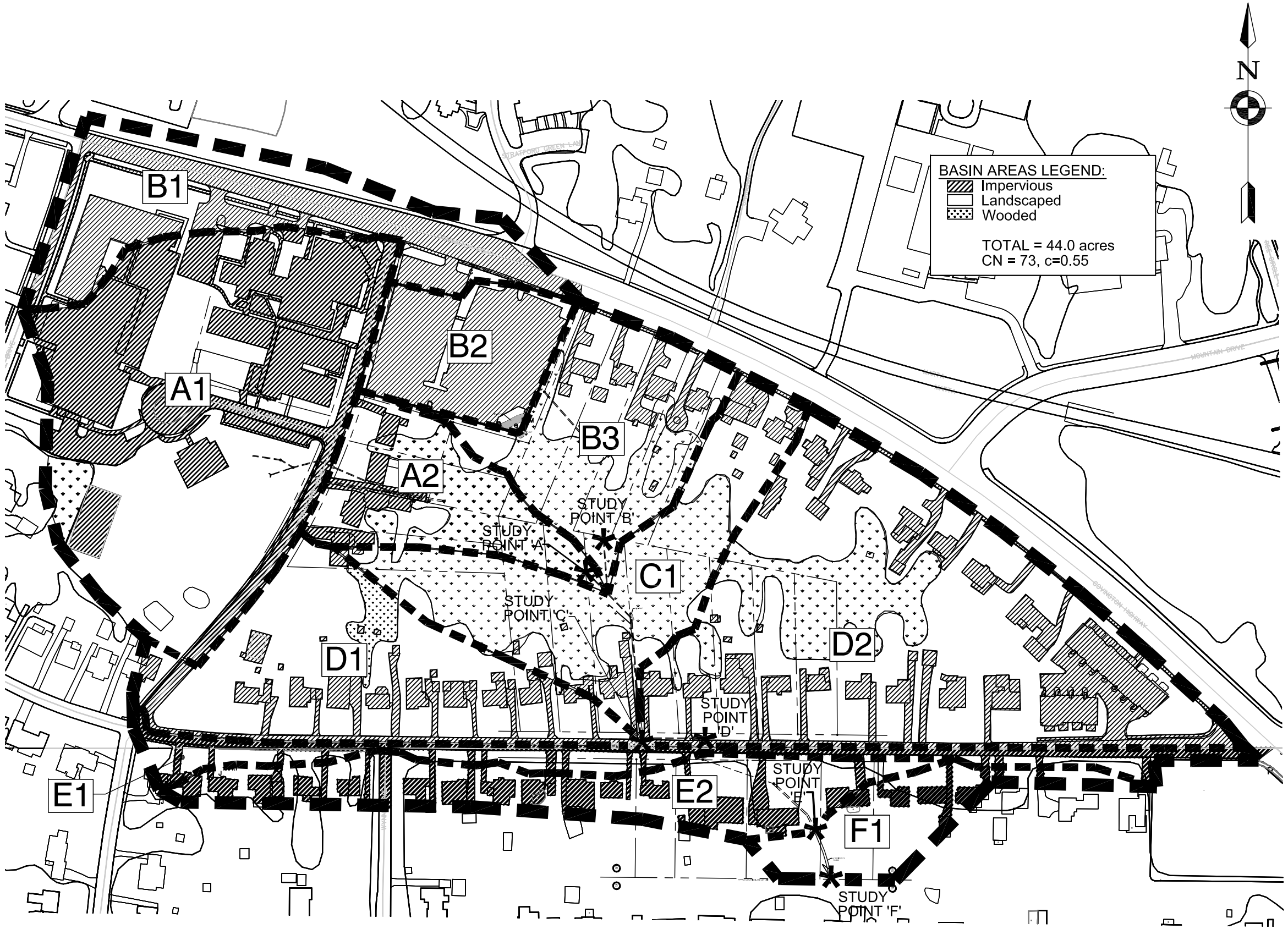
CITY OF AVONDALE ESTATES

4/22/2010 11827.00

BASIN AERIAL MAP
SCALE: 1"=300'

MAP

BASIN DATA



Basin A

Sub-Basin A-1

Description	Area (ac.)	CN	rational 'c'
Impervious	4.5	98	0.95
Landscaped	4.2	61	0.35
Wooded	0.2	55	0.30
Total Area	**8.9**	**80**	**0.65**

Sub-Basin A-2

Description	Area (ac.)	CN	rational 'c'
Impervious	0.4	98	0.95
Landscaped	0.7	61	0.35
Wooded	1.2	55	0.30
Total Area	**2.3**	**64**	**0.43**

Basin B

Sub-Basin B-1

Description	Area (ac.)	CN	rational 'c'
Impervious	2.1	98	0.95
Landscaped	1.4	61	0.35
Wooded	0.0	55	0.30
Total Area	**3.5**	**83**	**0.71**

Sub-Basin B-2

Description	Area (ac.)	CN	rational 'c'
Impervious	1.6	98	0.95
Landscaped	0.3	61	0.35
Wooded	0.0	55	0.30
Total Area	**1.9**	**92**	**0.86**

Sub-Basin B-3

Description	Area (ac.)	CN	rational 'c'
Impervious	0.5	98	0.95
Landscaped	1.3	61	0.35
Wooded	1.4	55	0.30
Total Area	**3.2**	**64**	**0.42**

Basin C

Sub-Basin C-1

Description	Area (ac.)	CN	rational 'c'
Impervious	0.4	98	0.95
Landscaped	1.2	61	0.35
Wooded	2.4	55	0.30
Total Area	**4.0**	**61**	**0.38**

Basin D

Sub-Basin D-1

Description	Area (ac.)	CN	rational 'c'
Impervious	1.1	98	0.95
Landscaped	3.3	61	0.35
Wooded	0.2	55	0.30
Total Area	**4.6**	**70**	**0.49**

Sub-Basin D-2

Description	Area (ac.)	CN	rational 'c'
Impervious	2.8	98	0.95
Landscaped	5.1	61	0.35
Wooded	1.5	55	0.30
Total Area	**9.4**	**71**	**0.52**

Basin E

Sub-Basin E-1

Description	Area (ac.)	CN	rational 'c'
Impervious	0.7	98	0.95
Landscaped	1.0	61	0.35
Wooded	0.0	55	0.30
Total Area	**1.7**	**76**	**0.60**

Sub-Basin E-2

Description	Area (ac.)	CN	rational 'c'
Impervious	1.1	98	0.95
Landscaped	2.0	61	0.35
Wooded	0.0	55	0.30
Total Area	**3.1**	**74**	**0.56**

Basin F

Sub-Basin F-1

Description	Area (ac.)	CN	rational 'c'
Impervious	0.2	98	0.95
Landscaped	1.2	61	0.35
Wooded	0.0	55	0.30
Total Area	**1.4**	**66**	**0.44**

Overall Studied Basin	**44.0**	**73**	**0.55**

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KENSINGTON ROAD DRAINAGE PROJECT

CITY OF AVONDALE ESTATES

DATE	DRAWN	CHECKED
04/22/10	AMF	RJE

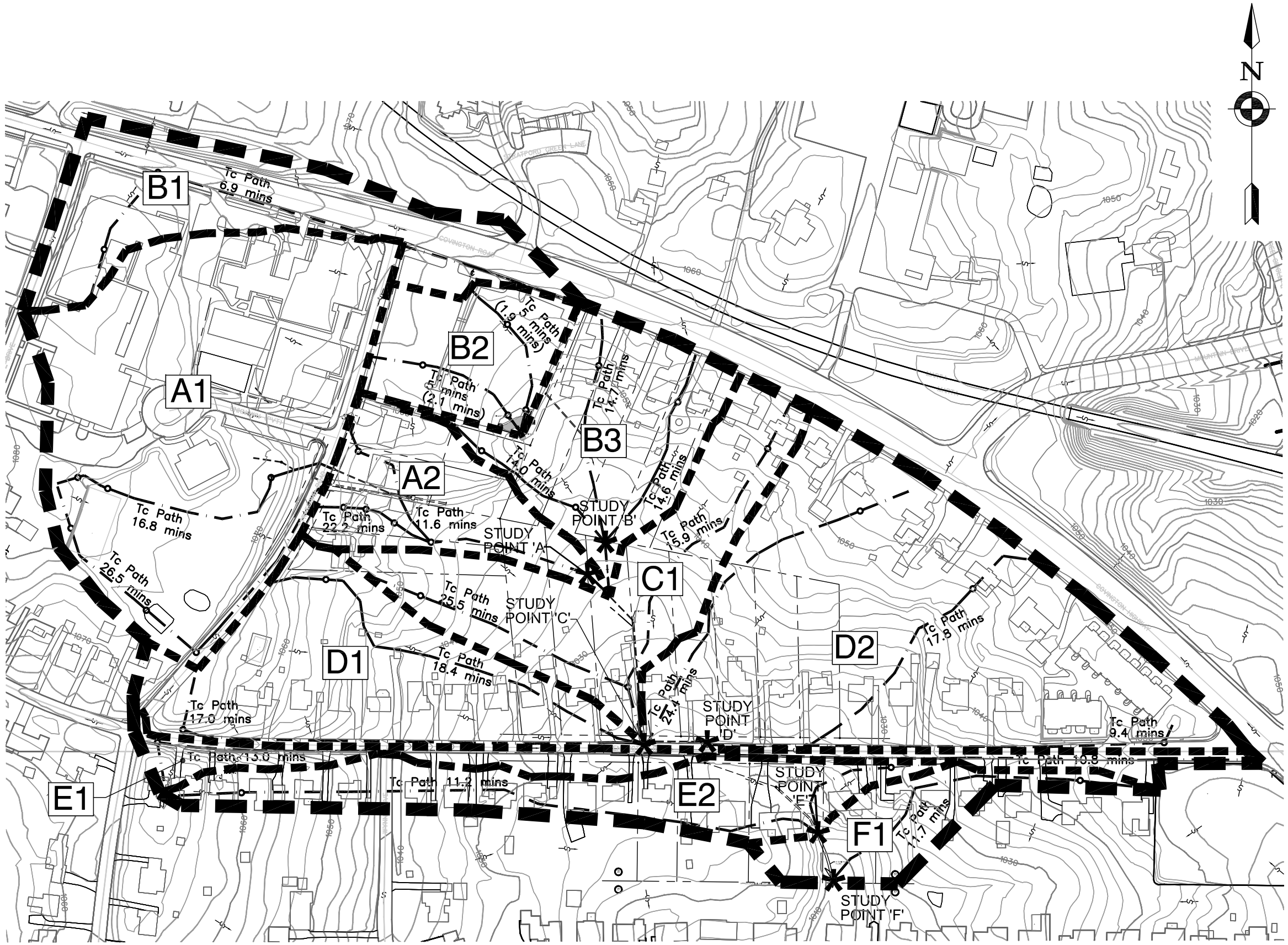
SCALE 1"=200'

SHEET TITLE

BASIN AREAS MAP

PROJECT NUMBER
11827.00

D
01
DRAWING NUMBER



Basin	Tc (minutes)
A-1	26.5
A-2	22.2
B-1	6.9
B-2	5.0
B-3	14.7
C-1	25.5
D-1	18.4
D-2	24.4
E-1	13.0
E-2	11.2
F-1	11.7

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KENSINGTON ROAD DRAINAGE PROJECT

CITY OF AVONDALE ESTATES

DATE	DRAWN	CHECKED
04/22/10	AMF	RJE

SCALE 1"=200'

SHEET TITLE
TIME OF CONCENTRATION MAP

PROJECT NUMBER
11827.00

D
02
DRAWING NUMBER

CN Summary

Project Name Avondale Estates Drainage Study
Project No. 11827.00

Basin A

Sub-Basin A-1

Description	Area (ac.)	CN	rational 'c'
Impervious	4.5	98	0.95
Landscaped	4.2	61	0.35
Wooded	0.2	55	0.30
Total Area	**8.9**	**80**	**0.65**

Sub-Basin A-2

Description	Area (ac.)	CN	rational 'c'
Impervious	0.4	98	0.95
Landscaped	0.7	61	0.35
Wooded	1.2	55	0.30
Total Area	**2.3**	**64**	**0.43**

Basin B

Sub-Basin B-1

Description	Area (ac.)	CN	rational 'c'
Impervious	2.1	98	0.95
Landscaped	1.4	61	0.35
Wooded	0.0	55	0.30
Total Area	**3.5**	**83**	**0.71**

Sub-Basin B-2

Description	Area (ac.)	CN	rational 'c'
Impervious	1.6	98	0.95
Landscaped	0.3	61	0.35
Wooded	0.0	55	0.30
Total Area	**1.9**	**92**	**0.86**

Sub-Basin B-3

Description	Area (ac.)	CN	rational 'c'
Impervious	0.5	98	0.95
Landscaped	1.3	61	0.35
Wooded	1.4	55	0.30
Total Area	**3.2**	**64**	**0.42**

Basin C

Sub-Basin C-1

Description	Area (ac.)	CN	rational 'c'
Impervious	0.4	98	0.95
Landscaped	1.2	61	0.35
Wooded	2.4	55	0.30
Total Area	**4.0**	**61**	**0.38**

CN Summary

Project Name Avondale Estates Drainage Study
Project No. 11827.00

Basin D

Sub-Basin D-1

Description	Area (ac.)	CN	rational 'c'
Impervious	1.1	98	0.95
Landscaped	3.3	61	0.35
Wooded	0.2	55	0.30
Total Area	**4.6**	**70**	**0.49**

Sub-Basin D-2

Description	Area (ac.)	CN	rational 'c'
Impervious	2.8	98	0.95
Landscaped	5.1	61	0.35
Wooded	1.5	55	0.30
Total Area	**9.4**	**71**	**0.52**

Basin E

Sub-Basin E-1

Description	Area (ac.)	CN	rational 'c'
Impervious	0.7	98	0.95
Landscaped	1.0	61	0.35
Wooded	0.0	55	0.30
Total Area	**1.7**	**76**	**0.60**

Sub-Basin E-2

Description	Area (ac.)	CN	rational 'c'
Impervious	1.1	98	0.95
Landscaped	2.0	61	0.35
Wooded	0.0	55	0.30
Total Area	**3.1**	**74**	**0.56**

Basin F

Sub-Basin F-1

Description	Area (ac.)	CN	rational 'c'
Impervious	0.2	98	0.95
Landscaped	1.2	61	0.35
Wooded	0.0	55	0.30
Total Area	**1.4**	**66**	**0.44**

Overall Studied Basin	**44.0**	**73**	**0.55**

Tc Summary

Project Name Avondale Estates Drainage Study
Project No. 11827.00

Basin	Tc (minutes)
A-1	26.5
A-2	22.2
B-1	6.9
B-2	5.0
B-3	14.7
C-1	25.5
D-1	18.4
D-2	24.4
E-1	13.0
E-2	11.2
F-1	11.7

TR55 Tc Worksheet

Hyd. No. 1

A-1

Description		A		B		C		Totals
Sheet Flow								
Manning's n-value	=	0.800		0.200		0.011		
Flow length (ft)	=	83.0		0.0		0.0		
Two-year 24-hr precip. (in)	=	3.84		3.84		0.00		
Land slope (%)	=	3.80		0.00		0.00		
Travel Time (min)	**=**	**22.75**	**+**	**0.00**	**+**	**0.00**	**=**	**22.75**
Shallow Concentrated Flow								
Flow length (ft)	=	217.00		405.00		0.00		
Watercourse slope (%)	=	2.10		2.20		0.00		
Surface description	=	Unpaved		Paved		Paved		
Average velocity (ft/s)	=	2.34		3.02		0.00		
Travel Time (min)	**=**	**1.55**	**+**	**2.24**	**+**	**0.00**	**=**	**3.79**
Channel Flow								
X sectional flow area (sqft)	=	0.00		0.00		0.00		
Wetted perimeter (ft)	=	0.00		0.00		0.00		
Channel slope (%)	=	0.00		0.00		0.00		
Manning's n-value	=	0.015		0.015		0.015		
Velocity (ft/s)	=	0.00		0.00		0.00		
Flow length (ft)	=	0.0		0.0		0.0		
Travel Time (min)	**=**	**0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**

Total Travel Time, Tc ..... 26.53 min

TR55 Tc Worksheet

Hyd. No. 2

A-2

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.240		0.200		0.400		
Flow length (ft)	= 45.0		40.0		60.0		
Two-year 24-hr precip. (in)	= 3.84		3.84		3.84		
Land slope (%)	= 1.70		20.00		3.30		
Travel Time (min)	**= 7.34**	**+**	**2.15**	**+**	**10.66**	**=**	**20.15**
Shallow Concentrated Flow							
Flow length (ft)	= 385.00		55.00		0.00		
Watercourse slope (%)	= 5.20		2.50		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	= 3.68		3.21		0.00		
Travel Time (min)	**= 1.74**	**+**	**0.29**	**+**	**0.00**	**=**	**2.03**
Channel Flow							
X sectional flow area (sqft)	= 0.00		0.00		0.00		
Wetted perimeter (ft)	= 0.00		0.00		0.00		
Channel slope (%)	= 0.00		0.00		0.00		
Manning's n-value	= 0.300		0.015		0.015		
Velocity (ft/s)	= 0.00		0.00		0.00		
Flow length (ft)	= 0.0		0.0		0.0		
Travel Time (min)	**= 0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**

Total Travel Time, Tc ..... 22.18 min

TR55 Tc Worksheet

Hyd. No. 3

B-1

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.011		0.011		0.011		
Flow length (ft)	= 100.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 3.84		0.00		0.00		
Land slope (%)	= 2.00		0.00		0.00		
Travel Time (min)	**= 1.11**	**+**	**0.00**	**+**	**0.00**	**=**	**1.11**
Shallow Concentrated Flow							
Flow length (ft)	= 175.00		840.00		0.00		
Watercourse slope (%)	= 3.70		1.90		0.00		
Surface description	= Paved		Paved		Paved		
Average velocity (ft/s)	= 3.91		2.80		0.00		
Travel Time (min)	**= 0.75**	**+**	**5.00**	**+**	**0.00**	**=**	**5.74**
Channel Flow							
X sectional flow area (sqft)	= 0.00		0.00		0.00		
Wetted perimeter (ft)	= 0.00		0.00		0.00		
Channel slope (%)	= 0.00		0.00		0.00		
Manning's n-value	= 0.015		0.015		0.015		
Velocity (ft/s)	= 0.00		0.00		0.00		
Flow length (ft)	= 0.0		0.0		0.0		
Travel Time (min)	**= 0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**

Total Travel Time, Tc ..... 6.85 min

TR55 Tc Worksheet

Hyd. No. 3

B-1

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.011		0.011		0.011		
Flow length (ft)	= 100.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 3.84		0.00		0.00		
Land slope (%)	= 1.50		0.00		0.00		
Travel Time (min)	**= 1.24**	**+**	**0.00**	**+**	**0.00**	**=**	**1.24**
Shallow Concentrated Flow							
Flow length (ft)	= 195.00		30.00		0.00		
Watercourse slope (%)	= 5.80		3.30		0.00		
Surface description	= Paved		Unpaved		Paved		
Average velocity (ft/s)	= 4.90		2.93		0.00		
Travel Time (min)	**= 0.66**	**+**	**0.17**	**+**	**0.00**	**=**	**0.83**
Channel Flow							
X sectional flow area (sqft)	= 0.00		0.00		0.00		
Wetted perimeter (ft)	= 0.00		0.00		0.00		
Channel slope (%)	= 0.00		0.00		0.00		
Manning's n-value	= 0.015		0.015		0.015		
Velocity (ft/s)	= 0.00		0.00		0.00		
Flow length (ft)	= 0.0		0.0		0.0		
Travel Time (min)	**= 0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**

Total Travel Time, Tc ..... 2.08 min

TR55 Tc Worksheet

Hyd. No. 4

B-2

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.400		0.011		0.011		
Flow length (ft)	= 100.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 3.84		0.00		0.00		
Land slope (%)	= 6.00		0.00		0.00		
Travel Time (min)	**= 12.63**	**+**	**0.00**	**+**	**0.00**	**=**	**12.63**
Shallow Concentrated Flow							
Flow length (ft)	= 340.00		100.00		0.00		
Watercourse slope (%)	= 4.70		3.20		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	= 3.50		3.64		0.00		
Travel Time (min)	**= 1.62**	**+**	**0.46**	**+**	**0.00**	**=**	**2.08**
Channel Flow							
X sectional flow area (sqft)	= 0.00		0.00		0.00		
Wetted perimeter (ft)	= 0.00		0.00		0.00		
Channel slope (%)	= 0.00		0.00		0.00		
Manning's n-value	= 0.015		0.015		0.015		
Velocity (ft/s)	= 0.00		0.00		0.00		
Flow length (ft)	= 0.0		0.0		0.0		
Travel Time (min)	**= 0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**

Total Travel Time, Tc ..... 14.71 min

TR55 Tc Worksheet

Hyd. No. 5

C-1

Description		A		B		C		Totals
Sheet Flow								
Manning's n-value	=	0.800		0.011		0.011		
Flow length (ft)	=	100.0		0.0		0.0		
Two-year 24-hr precip. (in)	=	3.84		0.00		0.00		
Land slope (%)	=	5.50		0.00		0.00		
Travel Time (min)	**=**	**22.77**	**+**	**0.00**	**+**	**0.00**	**=**	**22.77**
Shallow Concentrated Flow								
Flow length (ft)	=	430.00		110.00		0.00		
Watercourse slope (%)	=	4.80		1.70		0.00		
Surface description	=	Unpaved		Paved		Paved		
Average velocity (ft/s)	=	3.53		2.65		0.00		
Travel Time (min)	**=**	**2.03**	**+**	**0.69**	**+**	**0.00**	**=**	**2.72**
Channel Flow								
X sectional flow area (sqft)	=	0.00		0.00		0.00		
Wetted perimeter (ft)	=	0.00		0.00		0.00		
Channel slope (%)	=	0.00		0.00		0.00		
Manning's n-value	=	0.015		0.015		0.015		
Velocity (ft/s)	=	0.00		0.00		0.00		
Flow length (ft)	=	0.0		0.0		0.0		
Travel Time (min)	**=**	**0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**

Total Travel Time, Tc ..... 25.49 min

TR55 Tc Worksheet

Hyd. No. 6

D-1

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.600		0.011		0.011		
Flow length (ft)	= 100.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 3.84		0.00		0.00		
Land slope (%)	= 9.00		0.00		0.00		
Travel Time (min)	**= 14.86**	**+**	**0.00**	**+**	**0.00**	**=**	**14.86**
Shallow Concentrated Flow							
Flow length (ft)	= 710.00		0.00		0.00		
Watercourse slope (%)	= 4.30		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	= 3.35		0.00		0.00		
Travel Time (min)	**= 3.54**	**+**	**0.00**	**+**	**0.00**	**=**	**3.54**
Channel Flow							
X sectional flow area (sqft)	= 0.00		0.00		0.00		
Wetted perimeter (ft)	= 0.00		0.00		0.00		
Channel slope (%)	= 0.00		0.00		0.00		
Manning's n-value	= 0.015		0.015		0.015		
Velocity (ft/s)	= 0.00		0.00		0.00		
Flow length (ft)	= 0.0		0.0		0.0		
Travel Time (min)	**= 0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**

Total Travel Time, Tc ..... 18.39 min

TR55 Tc Worksheet

Hyd. No. 7

D-2

Description		A		B		C		Totals
Sheet Flow								
Manning's n-value	=	0.400		0.011		0.011		
Flow length (ft)	=	100.0		0.0		0.0		
Two-year 24-hr precip. (in)	=	3.84		0.00		0.00		
Land slope (%)	=	2.00		0.00		0.00		
Travel Time (min)	**=**	**19.60**	**+**	**0.00**	**+**	**0.00**	**=**	**19.60**
Shallow Concentrated Flow								
Flow length (ft)	=	630.00		115.00		0.00		
Watercourse slope (%)	=	4.40		0.30		0.00		
Surface description	=	Unpaved		Paved		Paved		
Average velocity (ft/s)	=	3.38		1.11		0.00		
Travel Time (min)	**=**	**3.10**	**+**	**1.72**	**+**	**0.00**	**=**	**4.82**
Channel Flow								
X sectional flow area (sqft)	=	0.00		0.00		0.00		
Wetted perimeter (ft)	=	0.00		0.00		0.00		
Channel slope (%)	=	0.00		0.00		0.00		
Manning's n-value	=	0.015		0.015		0.015		
Velocity (ft/s)	=	0.00		0.00		0.00		
Flow length (ft)	=	0.0		0.0		0.0		
Travel Time (min)	**=**	**0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**

Total Travel Time, Tc ..... 24.43 min

TR55 Tc Worksheet

Hyd. No. 8

E-1

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.400		0.011		0.011		
Flow length (ft)	= 80.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 3.84		0.00		0.00		
Land slope (%)	= 10.00		0.00		0.00		
Travel Time (min)	**= 8.61**	**+**	**0.00**	**+**	**0.00**	**=**	**8.61**
Shallow Concentrated Flow							
Flow length (ft)	= 1040.00		0.00		0.00		
Watercourse slope (%)	= 3.70		0.00		0.00		
Surface description	= Paved		Paved		Paved		
Average velocity (ft/s)	= 3.91		0.00		0.00		
Travel Time (min)	**= 4.43**	**+**	**0.00**	**+**	**0.00**	**=**	**4.43**
Channel Flow							
X sectional flow area (sqft)	= 0.00		0.00		0.00		
Wetted perimeter (ft)	= 0.00		0.00		0.00		
Channel slope (%)	= 0.00		0.00		0.00		
Manning's n-value	= 0.015		0.015		0.015		
Velocity (ft/s)	= 0.00		0.00		0.00		
Flow length (ft)	= 0.0		0.0		0.0		
Travel Time (min)	**= 0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**

Total Travel Time, Tc ..... 13.05 min

TR55 Tc Worksheet

Hyd. No. 9

E-2

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.170		0.011		0.011		
Flow length (ft)	= 100.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 3.84		0.00		0.00		
Land slope (%)	= 8.00		0.00		0.00		
Travel Time (min)	**= 5.68**	**+**	**0.00**	**+**	**0.00**	**=**	**5.68**
Shallow Concentrated Flow							
Flow length (ft)	= 1100.00		0.00		0.00		
Watercourse slope (%)	= 4.30		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	= 3.35		0.00		0.00		
Travel Time (min)	**= 5.48**	**+**	**0.00**	**+**	**0.00**	**=**	**5.48**
Channel Flow							
X sectional flow area (sqft)	= 0.00		0.00		0.00		
Wetted perimeter (ft)	= 0.00		0.00		0.00		
Channel slope (%)	= 0.00		0.00		0.00		
Manning's n-value	= 0.015		0.015		0.015		
Velocity (ft/s)	= 0.00		0.00		0.00		
Flow length (ft)	= 0.0		0.0		0.0		
Travel Time (min)	**= 0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**

Total Travel Time, Tc ..... 11.16 min

TR55 Tc Worksheet

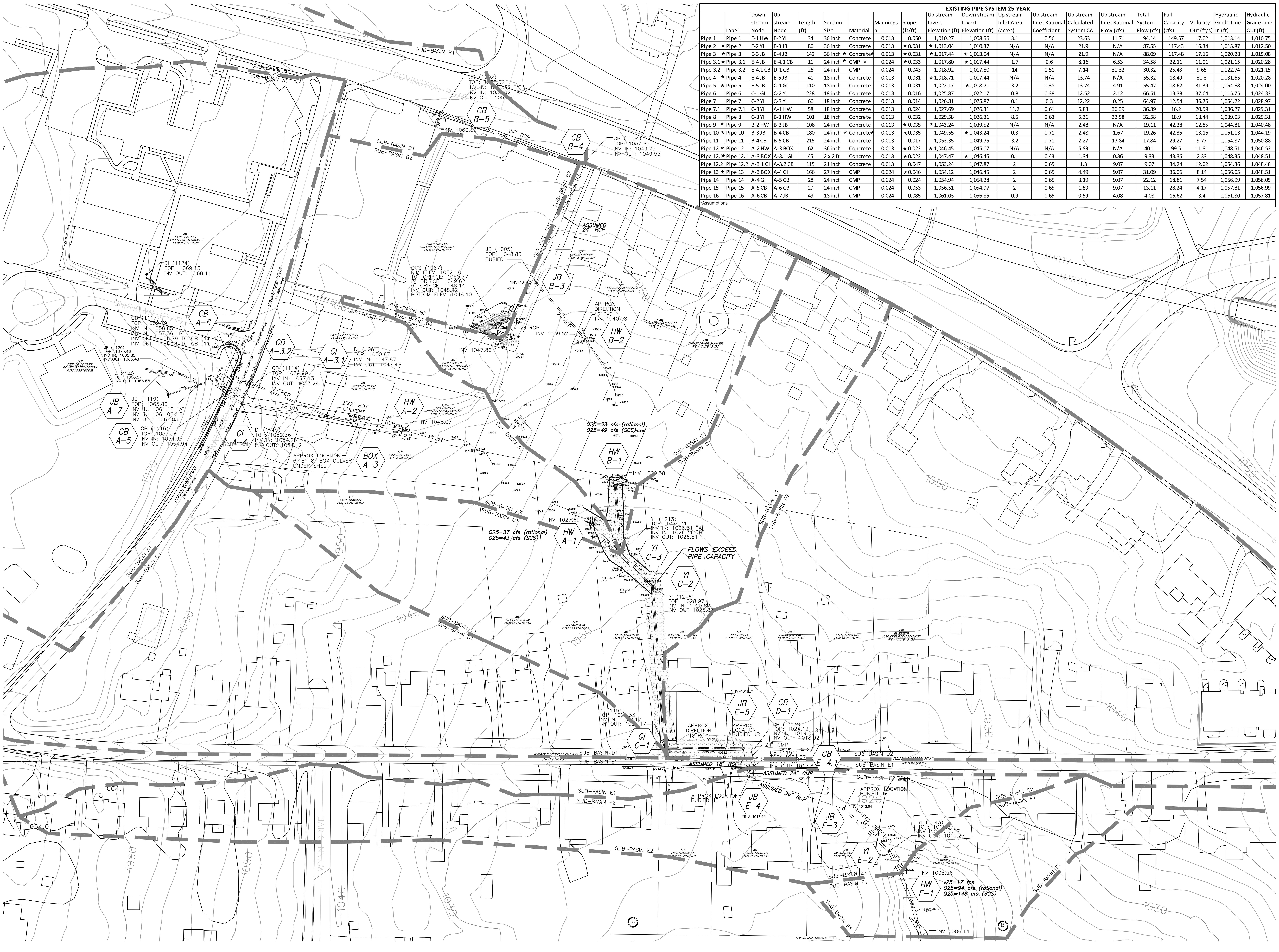
Hyd. No. 10

E-3

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.240		0.011		0.011		
Flow length (ft)	= 100.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 3.84		0.00		0.00		
Land slope (%)	= 5.00		0.00		0.00		
Travel Time (min)	**= 9.03**	**+**	**0.00**	**+**	**0.00**	**=**	**9.03**
Shallow Concentrated Flow							
Flow length (ft)	= 550.00		0.00		0.00		
Watercourse slope (%)	= 4.70		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	= 3.50		0.00		0.00		
Travel Time (min)	**= 2.62**	**+**	**0.00**	**+**	**0.00**	**=**	**2.62**
Channel Flow							
X sectional flow area (sqft)	= 0.00		0.00		0.00		
Wetted perimeter (ft)	= 0.00		0.00		0.00		
Channel slope (%)	= 0.00		0.00		0.00		
Manning's n-value	= 0.015		0.015		0.015		
Velocity (ft/s)	= 0.00		0.00		0.00		
Flow length (ft)	= 0.0		0.0		0.0		
Travel Time (min)	**= 0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**

Total Travel Time, Tc ..... 11.65 min

STORM SYSTEM DATA



EXISTING PIPE SYSTEM 25-YEAR

	Label	Down stream Node	Up stream Node	Length (ft)	Section Size	Material	Mannings n	Slope (ft/ft)	Up stream Invert Elevation (ft)	Down stream Invert Elevation (ft)	Up stream Inlet Area (acres)	Up stream Inlet Rational Coefficient	Up stream Calculated System CA	Up stream Inlet Rational Flow (cfs)	Total System Flow (cfs)	Full Capacity (cfs)	Velocity Out (ft/s)	Hydraulic Grade Line In (ft)	Hydraulic Grade Line Out (ft)
Pipe 1	Pipe 1	E-1 HW	E-2 YI	34	36 inch	Concrete	0.013	0.050	1,010.27	1,008.56	3.1	0.56	23.63	11.71	94.14	149.57	17.02	1,013.14	1,010.75
Pipe 2 *	Pipe 2	E-2 YI	E-3 JB	86	36 inch	Concrete	0.013	* 0.031	* 1,013.04	1,010.37	N/A	N/A	21.9	N/A	87.55	117.43	16.34	1,015.87	1,012.50
Pipe 3 *	Pipe 3	E-3 JB	E-4 JB	142	36 inch *	Concrete*	0.013	* 0.031	* 1,017.44	* 1,013.04	N/A	N/A	21.9	N/A	88.09	117.48	17.16	1,020.28	1,015.08
Pipe 3.1 *	Pipe 3.1	E-4 JB	E-4.1 CB	11	24 inch *	CMP *	0.024	* 0.033	1,017.80	* 1,017.44	1.7	0.6	8.16	6.53	34.58	22.11	11.01	1,021.15	1,020.28
Pipe 3.2	Pipe 3.2	E-4.1 CB	D-1 CB	26	24 inch	CMP	0.024	0.043	1,018.92	1,017.80	14	0.51	7.14	30.32	30.32	25.43	9.65	1,022.74	1,021.15
Pipe 4 *	Pipe 4	E-4 JB	E-5 JB	41	18 inch	Concrete	0.013	0.031	* 1,018.71	1,017.44	N/A	N/A	13.74	N/A	55.32	18.49	31.3	1,031.65	1,020.28
Pipe 5 *	Pipe 5	E-5 JB	C-1 GI	110	18 inch	Concrete	0.013	0.031	1,022.17	*1,018.71	3.2	0.38	13.74	4.91	55.47	18.62	31.39	1,054.68	1,024.00
Pipe 6	Pipe 6	C-1 GI	C-2 YI	228	18 inch	Concrete	0.013	0.016	1,025.87	1,022.17	0.8	0.38	12.52	2.12	66.51	13.38	37.64	1,115.75	1,024.33
Pipe 7	Pipe 7	C-2 YI	C-3 YI	66	18 inch	Concrete	0.013	0.014	1,026.81	1,025.87	0.1	0.3	12.22	0.25	64.97	12.54	36.76	1,054.22	1,028.97
Pipe 7.1	Pipe 7.1	C-3 YI	A-1 HW	58	18 inch	Concrete	0.013	0.024	1,027.69	1,026.31	11.2	0.61	6.83	36.39	36.39	16.2	20.59	1,036.27	1,029.31
Pipe 8	Pipe 8	C-3 YI	B-1 HW	101	18 inch	Concrete	0.013	0.032	1,029.58	1,026.31	8.5	0.63	5.36	32.58	32.58	18.9	18.44	1,039.03	1,029.31
Pipe 9 *	Pipe 9	B-2 HW	B-3 JB	106	24 inch	Concrete	0.013	* 0.035	*1,043.24	1,039.52	N/A	N/A	2.48	N/A	19.11	42.38	12.85	1,044.81	1,040.48
Pipe 10 *	Pipe 10	B-3 JB	B-4 CB	180	24 inch *	Concrete*	0.013	*0.035	1,049.55	* 1,043.24	0.3	0.71	2.48	1.67	19.26	42.35	13.16	1,051.13	1,044.19
Pipe 11	Pipe 11	B-4 CB	B-5 CB	215	24 inch	Concrete	0.013	0.017	1,053.35	1,049.75	3.2	0.71	2.27	17.84	17.84	29.27	9.77	1,054.87	1,050.88
Pipe 12 *	Pipe 12	A-2 HW	A-3 BOX	62	36 inch	Concrete	0.013	* 0.022	* 1,046.45	1,045.07	N/A	N/A	5.83	N/A	40.1	99.5	11.81	1,048.51	1,046.52
Pipe 12.1 *	Pipe 12.1	A-3 BOX	A-3.1 GI	45	2 x 2 ft	Concrete	0.013	* 0.023	1,047.47	* 1,046.45	0.1	0.43	1.34	0.36	9.33	43.36	2.33	1,048.35	1,048.51
Pipe 12.2	Pipe 12.2	A-3.1 GI	A-3.2 CB	115	21 inch	Concrete	0.013	0.047	1,053.24	1,047.87	2	0.65	1.3	9.07	9.07	34.24	12.02	1,054.36	1,048.48
Pipe 13 *	Pipe 13	A-3 BOX	A-4 GI	166	27 inch	CMP	0.024	* 0.046	1,054.12	1,046.45	2	0.65	4.49	9.07	31.09	36.06	8.14	1,056.05	1,048.51
Pipe 14	Pipe 14	A-4 GI	A-5 CB	28	24 inch	CMP	0.024	0.024	1,054.94	1,054.28	2	0.65	3.19	9.07	22.12	18.81	7.54	1,056.99	1,056.05
Pipe 15	Pipe 15	A-5 CB	A-6 CB	29	24 inch	CMP	0.024	0.053	1,056.51	1,054.97	2	0.65	1.89	9.07	13.11	28.24	4.17	1,057.81	1,056.99
Pipe 16	Pipe 16	A-6 CB	A-7 JB	49	18 inch	CMP	0.024	0.085	1,061.03	1,056.85	0.9	0.65	0.59	4.08	4.08	16.62	3.4	1,061.80	1,057.81

*Assumptions

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REVISIONS

NO.	DATE	BY	CHKED	DESCRIPTION
1	04/22/10	AMF	RJE	DRAINAGE ANALYSIS

KENSINGTON ROAD
DRAINAGE PROJECT
CITY OF AVONDALE ESTATES

DATE	DRAWN	CHECKED
04/22/10	AMF	RJE

SCALE 1"=60'

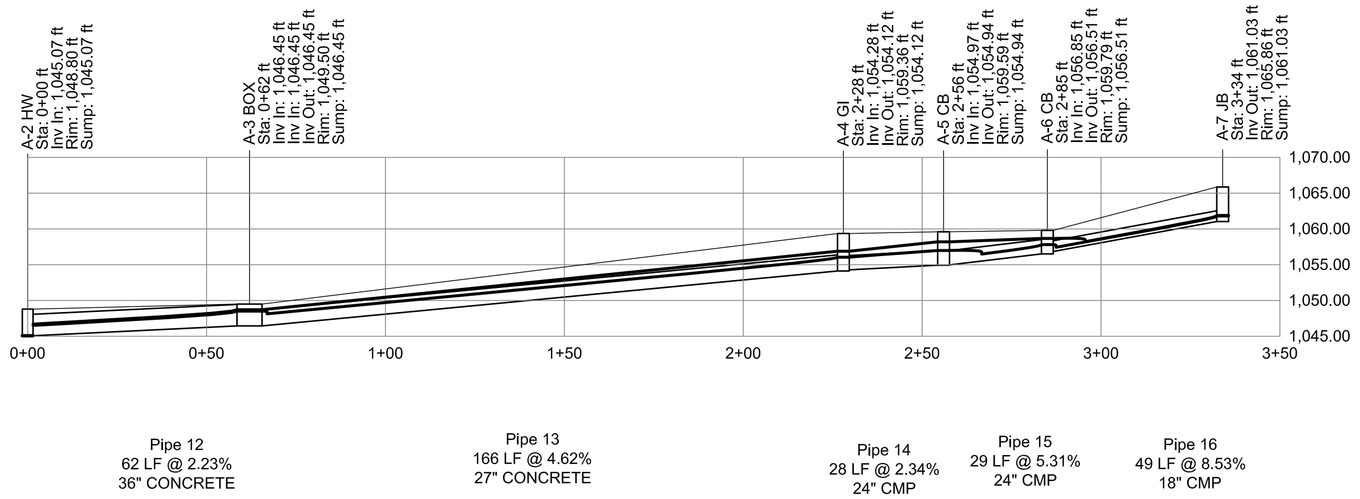
SHEET TITLE
EXISTING STORM PIPE SYSTEMS

PROJECT NUMBER
11827.00

STM 01

DRAWING NUMBER

Profile: System A 01



Pipe 12
62 LF @ 2.23%
36" CONCRETE

Pipe 13
166 LF @ 4.62%
27" CONCRETE

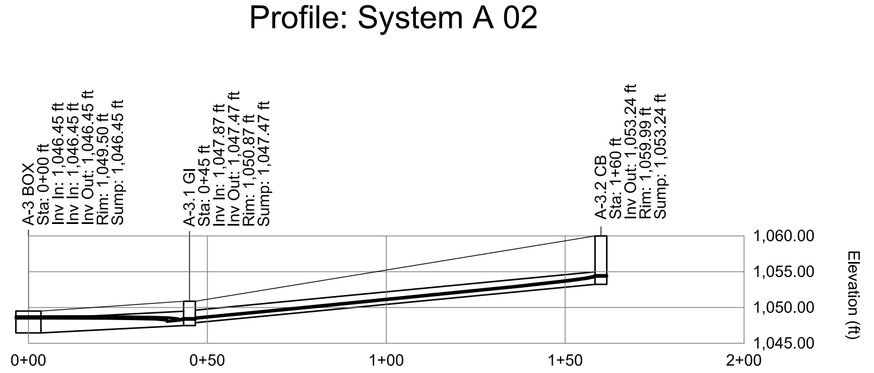
Pipe 14
28 LF @ 2.34%
24" CMP

Pipe 15
29 LF @ 5.31%
24" CMP

Pipe 16
49 LF @ 8.53%
18" CMP

Station (ft)

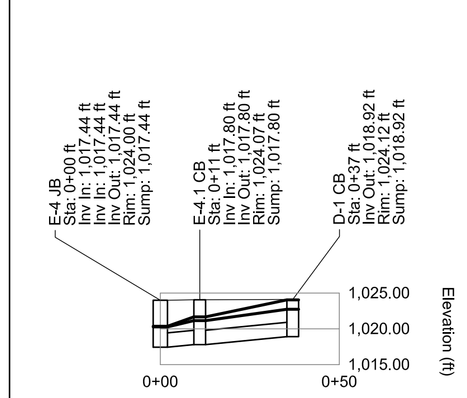
Profile: System A 02



Pipe 12.1
45 LF @ 2.27%
24"x24" CONCRETE

Pipe 12.2
115 LF @ 4.67%
21" CONCRETE

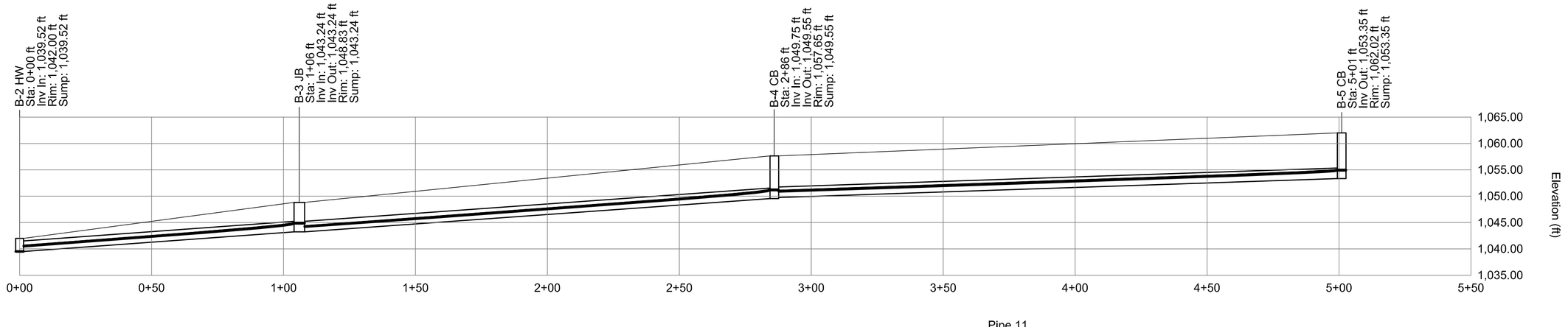
Station (ft)



Pipe 3.1
11 LF @ 3.25%
24" CMP

Pipe 3.2
26 LF @ 4.31%
24" CMP

Elevation (ft)

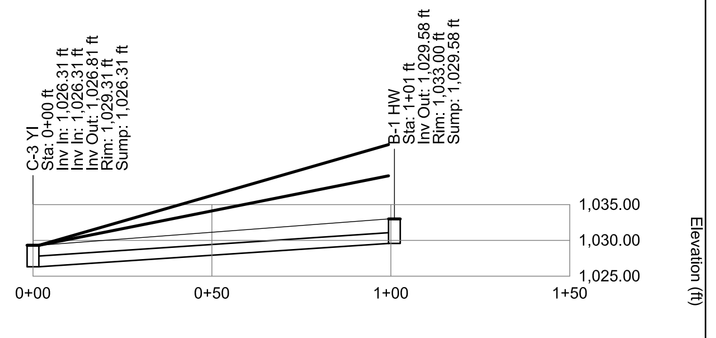


Pipe 9
106 LF @ 3.50%
24" CONCRETE

Pipe 10
180 LF @ 3.50%
24" CONCRETE

Pipe 11
215 LF @ 1.67%
24" CONCRETE

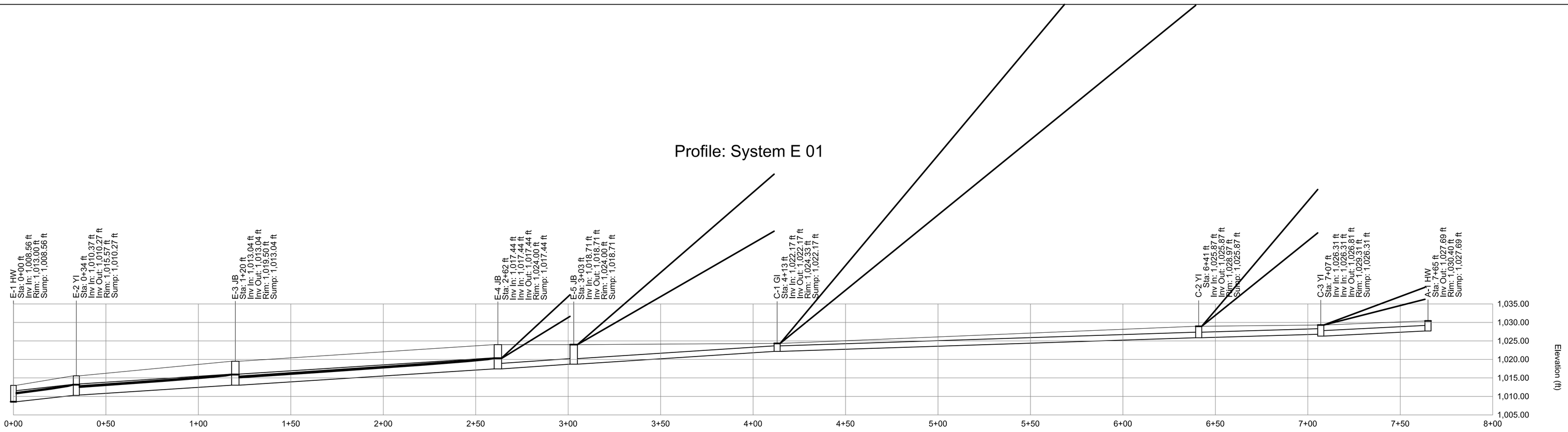
Station (ft)



Pipe 8
101 LF @ 3.24%
18" CONCRETE

Elevation (ft)

Profile: System E 01



Pipe 1
34 LF @ 5.03%
36" CONCRETE

Pipe 2
86 LF @ 3.10%
36" CONCRETE

Pipe 3
142 LF @ 3.10%
36" CONCRETE

Pipe 4
41 LF @ 3.10%
18" CONCRETE

Pipe 5
110 LF @ 3.10%
18" CONCRETE

Pipe 6
228 LF @ 1.62%
18" CONCRETE

Pipe 7
66 LF @ 1.42%
18" CONCRETE

Pipe 7.1
58 LF @ 2.38%
18" CONCRETE

Elevation (ft)

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REVISIONS				
NO.	DATE	BY	CHKD	DESCRIPTION
1	04/22/10	AMF	RJE	DRAINAGE ANALYSIS

KENSINGTON ROAD
DRAINAGE PROJECT
CITY OF AVONDALE ESTATES

DATE	DRAWN	CHECKED
04/22/10	AMF	RJE

SCALE H-1"=30' V-1"=10'

SHEET TITLE
EXISTING STORM PIPE PROFILES

PROJECT NUMBER
11827.00

STM 02
DRAWING NUMBER

Rectangular Concrete Flume - 25yr

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.02500	ft/ft
Bottom Width	4.00	ft
Discharge	94.14	ft^3/s

Results

Normal Depth	1.46	ft
Flow Area	5.83	ft^2
Wetted Perimeter	6.92	ft
Hydraulic Radius	0.84	ft
Top Width	4.00	ft
Critical Depth	2.58	ft
Critical Slope	0.00542	ft/ft
Velocity	16.14	ft/s
Velocity Head	4.05	ft
Specific Energy	5.50	ft
Froude Number	2.36	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.46	ft
Critical Depth	2.58	ft
Channel Slope	0.02500	ft/ft
Critical Slope	0.00542	ft/ft

Triangular Concrete Flume - 25yr

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.02500	ft/ft
Left Side Slope	4.00	ft/ft (H:V)
Right Side Slope	4.00	ft/ft (H:V)
Discharge	94.14	ft^3/s

Results

Normal Depth	1.32	ft
Flow Area	7.00	ft^2
Wetted Perimeter	10.91	ft
Hydraulic Radius	0.64	ft
Top Width	10.58	ft
Critical Depth	2.03	ft
Critical Slope	0.00255	ft/ft
Velocity	13.45	ft/s
Velocity Head	2.81	ft
Specific Energy	4.13	ft
Froude Number	2.92	
Flow Type	Supercritical	

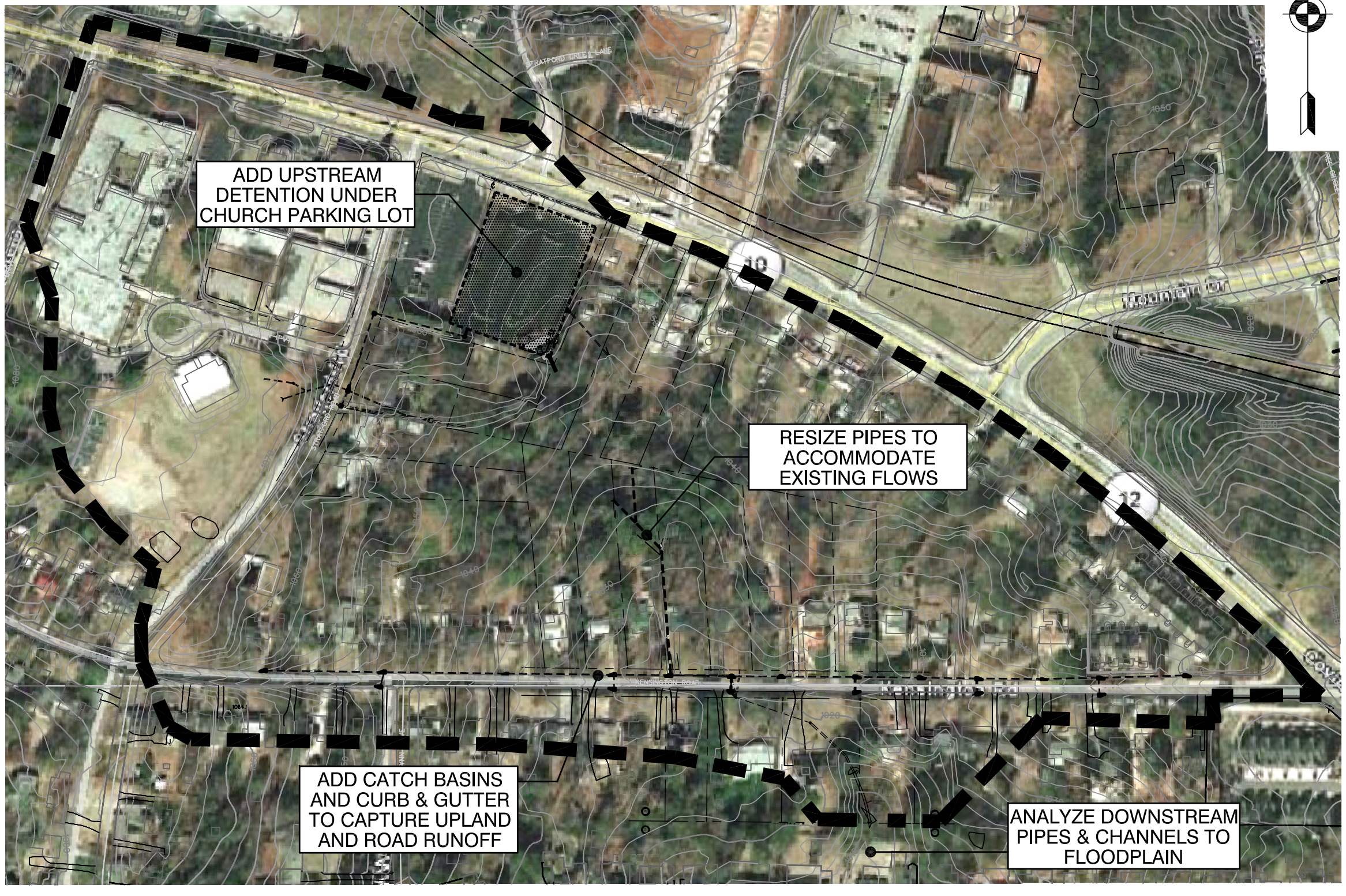
GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.32	ft
Critical Depth	2.03	ft
Channel Slope	0.02500	ft/ft
Critical Slope	0.00255	ft/ft

ANALYSIS



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KENSINGTON ROAD DRAINAGE PROJECT

CITY OF AVONDALE ESTATES

DATE	DRAWN	CHECKED
04/22/10	AMF	RJE

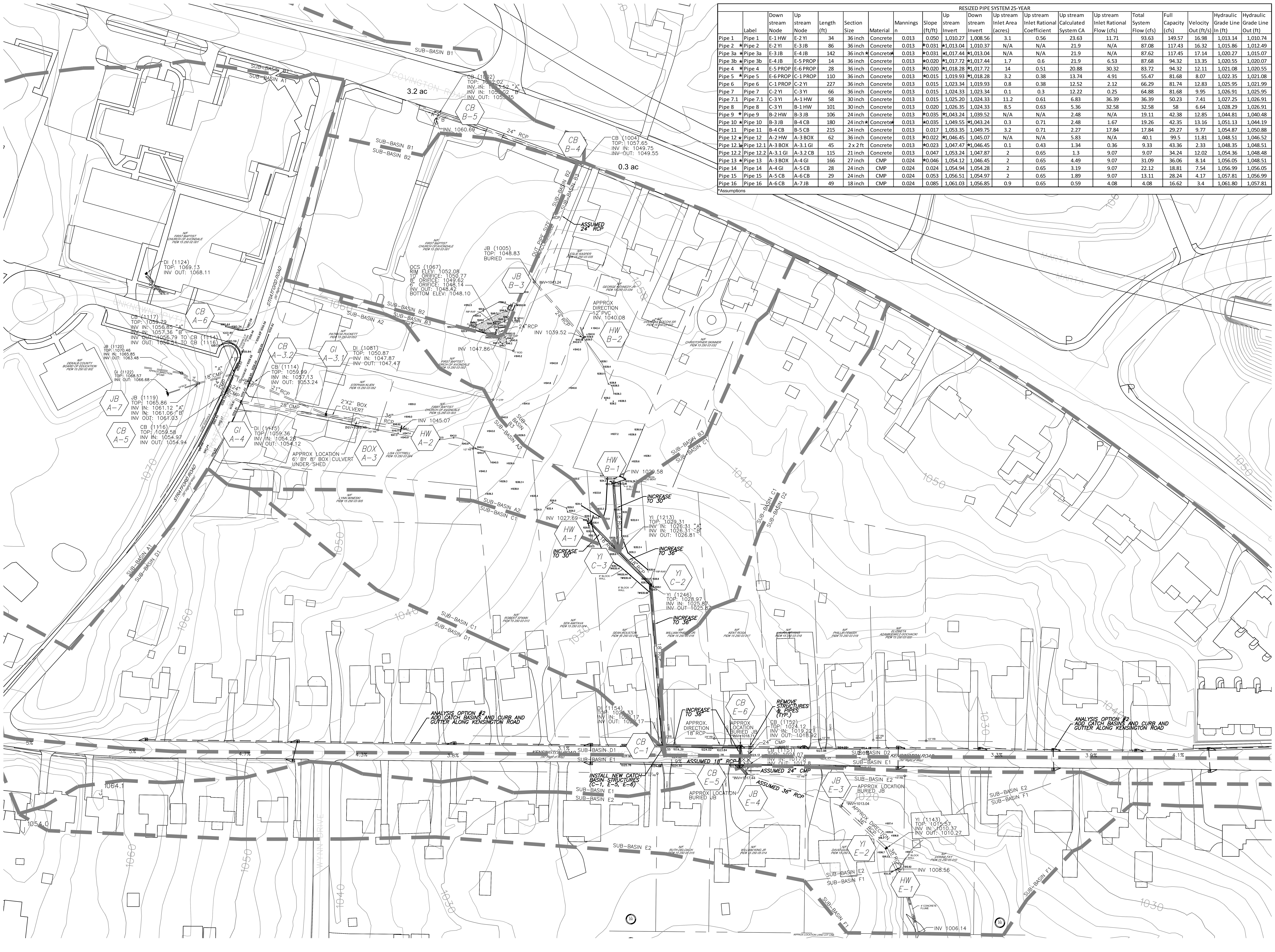
SCALE 1"=200'

SHEET TITLE

ANALYSIS OF DRAINAGE IMPROVEMENT OPTIONS

PROJECT NUMBER
11827.00

D
03
DRAWING NUMBER



RESIZED PIPE SYSTEM 25-YEAR																				
	Label	Down stream Node	Up stream Node	Length (ft)	Section Size	Material	Mannings n	Slope (ft/ft)	Up stream Invert	Down stream Invert	Up stream Inlet Area (acres)	Up stream Inlet Rational Coefficient	Up stream Calculated System CA	Up stream Inlet Rational Flow (cfs)	Total System Flow (cfs)	Full Capacity (cfs)	Velocity Out (ft/s)	Hydraulic Grade Line In (ft)	Hydraulic Grade Line Out (ft)
Pipe 1	Pipe 1	E-1 HW	E-2 YI	34	36 inch	Concrete	0.013	0.050	1,010.27	1,008.56	3.1	0.56	23.63	11.71	93.63	149.57	16.98	1,013.14	1,010.74
Pipe 2 *	Pipe 2	E-2 YI	E-3 JB	86	36 inch	Concrete	0.013	*0.031	*1,013.04	1,010.37	N/A	N/A	21.9	N/A	87.08	117.43	16.32	1,015.86	1,012.49
Pipe 3a *	Pipe 3a	E-3 JB	E-4 JB	142	36 inch *	Concrete *	0.013	*0.031	*1,017.44	*1,013.04	N/A	N/A	21.9	N/A	87.62	117.45	17.14	1,020.27	1,015.07
Pipe 3b *	Pipe 3b	E-4 JB	E-5 PROP	14	36 inch	Concrete	0.013	*0.020	*1,017.72	*1,017.44	1.7	0.6	21.9	6.53	87.68	94.32	13.35	1,020.55	1,020.07
Pipe 4 *	Pipe 4	E-5 PROP	E-6 PROP	28	36 inch	Concrete	0.013	*0.020	*1,018.28	*1,017.72	14	0.51	20.88	30.32	83.72	94.32	12.11	1,021.08	1,020.55
Pipe 5 *	Pipe 5	E-6 PROP	C-1 PROP	110	36 inch	Concrete	0.013	*0.015	1,019.93	*1,018.28	3.2	0.38	13.74	4.91	55.47	81.68	8.07	1,022.35	1,021.08
Pipe 6	Pipe 6	C-1 PROP	C-2 YI	227	36 inch	Concrete	0.013	0.015	1,023.34	1,019.93	0.8	0.38	12.52	2.12	66.29	81.74	12.83	1,025.95	1,021.99
Pipe 7	Pipe 7	C-2 YI	C-3 YI	66	36 inch	Concrete	0.013	0.015	1,024.33	1,023.34	0.1	0.3	12.22	0.25	64.88	81.68	9.95	1,026.91	1,025.95
Pipe 7.1	Pipe 7.1	C-3 YI	A-1 HW	58	30 inch	Concrete	0.013	0.015	1,025.20	1,024.33	11.2	0.61	6.83	36.39	36.39	50.23	7.41	1,027.25	1,026.91
Pipe 8	Pipe 8	C-3 YI	B-1 HW	101	30 inch	Concrete	0.013	0.020	1,026.35	1,024.33	8.5	0.63	5.36	32.58	32.58	58	6.64	1,028.29	1,026.91
Pipe 9 *	Pipe 9	B-2 HW	B-3 JB	106	24 inch	Concrete	0.013	*0.035	*1,043.24	1,039.52	N/A	N/A	2.48	N/A	19.11	42.38	12.85	1,044.81	1,040.48
Pipe 10 *	Pipe 10	B-3 JB	B-4 CB	180	24 inch *	Concrete *	0.013	*0.035	1,049.55	*1,043.24	0.3	0.71	2.48	1.67	19.26	42.35	13.16	1,051.13	1,044.19
Pipe 11	Pipe 11	B-4 CB	B-5 CB	215	24 inch	Concrete	0.013	0.017	1,053.35	1,049.75	3.2	0.71	2.27	17.84	17.84	29.27	9.77	1,054.87	1,050.88
Pipe 12 *	Pipe 12	A-2 HW	A-3 BOX	62	36 inch	Concrete	0.013	*0.022	*1,046.45	1,045.07	N/A	N/A	5.83	N/A	40.1	99.5	11.81	1,048.51	1,046.52
Pipe 12.1 *	Pipe 12.1	A-3 BOX	A-3.1 GI	45	2 x 2 ft	Concrete	0.013	*0.023	1,047.47	*1,046.45	0.1	0.43	1.34	0.36	9.33	43.36	2.33	1,048.35	1,048.51
Pipe 12.2	Pipe 12.2	A-3.1 GI	A-3.2 CB	115	21 inch	Concrete	0.013	0.047	1,053.24	1,047.87	2	0.65	1.3	9.07	9.07	34.24	12.02	1,054.36	1,048.48
Pipe 13 *	Pipe 13	A-3 BOX	A-4 GI	166	27 inch	CMP	0.024	*0.046	1,054.12	1,046.45	2	0.65	4.49	9.07	31.09	36.06	8.14	1,056.05	1,048.51
Pipe 14	Pipe 14	A-4 GI	A-5 CB	28	24 inch	CMP	0.024	0.024	1,054.94	1,054.28	2	0.65	3.19	9.07	22.12	18.81	7.54	1,056.99	1,056.05
Pipe 15	Pipe 15	A-5 CB	A-6 CB	29	24 inch	CMP	0.024	0.053	1,056.51	1,054.97	2	0.65	1.89	9.07	13.11	28.24	4.17	1,057.81	1,056.99
Pipe 16	Pipe 16	A-6 CB	A-7 JB	49	18 inch	CMP	0.024	0.085	1,061.03	1,056.85	0.9	0.65	0.59	4.08	4.08	16.62	3.4	1,061.80	1,057.81

*Assumptions

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REVISIONS				
NO.	DATE	BY	CHKED	DESCRIPTION
1	04/22/10	AMF	RJE	DRAINAGE ANALYSIS

KENSINGTON ROAD
DRAINAGE PROJECT
CITY OF AVONDALE ESTATES

DATE	DRAWN	CHECKED
04/22/10	AMF	RJE

SCALE 1"=60'

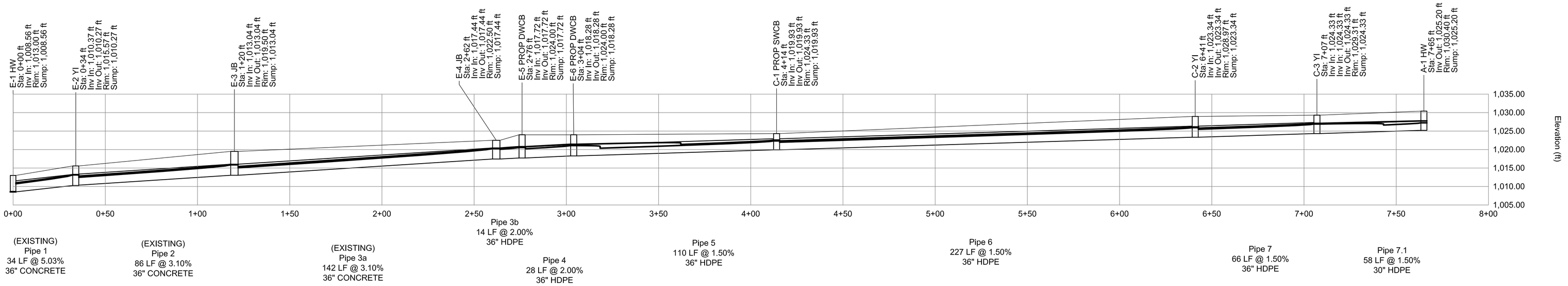
SHEET TITLE
RESIZED STORM PIPE SYSTEMS

PROJECT NUMBER 11827.00

STM 03

DRAWING NUMBER

Profile: System E 01
Scenario: 25-YEAR



(EXISTING)
Pipe 1
34 LF @ 5.03%
36" CONCRETE

(EXISTING)
Pipe 2
86 LF @ 3.10%
36" CONCRETE

(EXISTING)
Pipe 3a
142 LF @ 3.10%
36" CONCRETE

Pipe 3b
14 LF @ 2.00%
36" HDPE

Pipe 4
28 LF @ 2.00%
36" HDPE

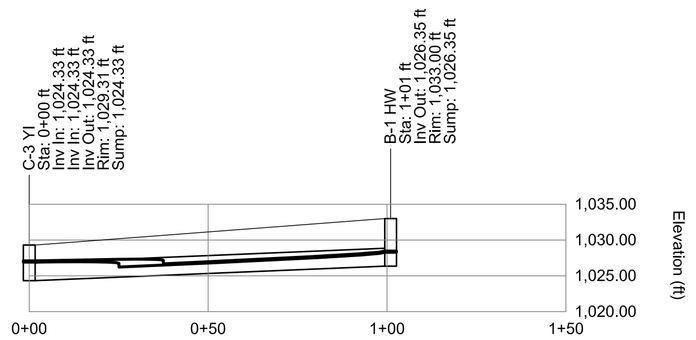
Pipe 5
110 LF @ 1.50%
36" HDPE

Pipe 6
227 LF @ 1.50%
36" HDPE

Pipe 7
66 LF @ 1.50%
36" HDPE

Pipe 7.1
58 LF @ 1.50%
30" HDPE

Profile: System E 02
Scenario: 25-YEAR



Pipe 8
101 LF @ 2.00%
30" HDPE

RESIZED PIPE SYSTEM 25-YEAR

	Label	Down stream Node	Up stream Node	Length (ft)	Section Size	Material	Mannings n	Slope (ft/ft)	Up stream Invert	Down stream Invert	Up stream Inlet Area (acres)	Up stream Inlet Rational Coefficient	Up stream Calculated System CA	Up stream Inlet Rational Flow (cfs)	Total System Flow (cfs)	Full Capacity (cfs)	Velocity Out (ft/s)	Hydraulic Grade Line In (ft)	Hydraulic Grade Line Out (ft)
Pipe 1	Pipe 1	E-1 HW	E-2 YI	34	36 inch	Concrete	0.013	0.050	1,010.27	1,008.56	3.1	0.56	23.63	11.71	93.63	149.57	16.98	1,013.14	1,010.74
Pipe 2 *	Pipe 2	E-2 YI	E-3 JB	86	36 inch	Concrete	0.013	*0.031	*1,013.04	1,010.37	N/A	N/A	21.9	N/A	87.08	117.43	16.32	1,015.86	1,012.49
Pipe 3a *	Pipe 3a	E-3 JB	E-4 JB	142	36 inch *	Concrete*	0.013	*0.031	*1,017.44	*1,013.04	N/A	N/A	21.9	N/A	87.62	117.45	17.14	1,020.27	1,015.07
Pipe 3b *	Pipe 3b	E-4 JB	E-5 PROP	14	36 inch	Concrete	0.013	*0.020	*1,017.72	*1,017.44	1.7	0.6	21.9	6.53	87.68	94.32	13.35	1,020.55	1,020.07
Pipe 4 *	Pipe 4	E-5 PROP	E-6 PROP	28	36 inch	Concrete	0.013	*0.020	*1,018.28	*1,017.72	14	0.51	20.88	30.32	83.72	94.32	12.11	1,021.08	1,020.55
Pipe 5 *	Pipe 5	E-6 PROP	C-1 PROP	110	36 inch	Concrete	0.013	*0.015	1,019.93	*1,018.28	3.2	0.38	13.74	4.91	55.47	81.68	8.07	1,022.35	1,021.08
Pipe 6	Pipe 6	C-1 PROP	C-2 YI	227	36 inch	Concrete	0.013	0.015	1,023.34	1,019.93	0.8	0.38	12.52	2.12	66.29	81.74	12.83	1,025.95	1,021.99
Pipe 7	Pipe 7	C-2 YI	C-3 YI	66	36 inch	Concrete	0.013	0.015	1,024.33	1,023.34	0.1	0.3	12.22	0.25	64.88	81.68	9.95	1,026.91	1,025.95
Pipe 7.1	Pipe 7.1	C-3 YI	A-1 HW	58	30 inch	Concrete	0.013	0.015	1,025.20	1,024.33	11.2	0.61	6.83	36.39	36.39	50.23	7.41	1,027.25	1,026.91
Pipe 8	Pipe 8	C-3 YI	B-1 HW	101	30 inch	Concrete	0.013	0.020	1,026.35	1,024.33	8.5	0.63	5.36	32.58	32.58	58	6.64	1,028.29	1,026.91
Pipe 9 *	Pipe 9	B-2 HW	B-3 JB	106	24 inch	Concrete	0.013	*0.035	*1,043.24	1,039.52	N/A	N/A	2.48	N/A	19.11	42.38	12.85	1,044.81	1,040.48
Pipe 10 *	Pipe 10	B-3 JB	B-4 CB	180	24 inch *	Concrete*	0.013	*0.035	1,049.55	*1,043.24	0.3	0.71	2.48	1.67	19.26	42.35	13.16	1,051.13	1,044.19
Pipe 11	Pipe 11	B-4 CB	B-5 CB	215	24 inch	Concrete	0.013	0.017	1,053.35	1,049.75	3.2	0.71	2.27	17.84	17.84	29.27	9.77	1,054.87	1,050.88
Pipe 12 *	Pipe 12	A-2 HW	A-3 BOX	62	36 inch	Concrete	0.013	*0.022	*1,046.45	1,045.07	N/A	N/A	5.83	N/A	40.1	99.5	11.81	1,048.51	1,046.52
Pipe 12.1*	Pipe 12.1	A-3 BOX	A-3.1 GI	45	2 x 2 ft	Concrete	0.013	*0.023	1,047.47	*1,046.45	0.1	0.43	1.34	0.36	9.33	43.36	2.33	1,048.35	1,048.51
Pipe 12.2	Pipe 12.2	A-3.1 GI	A-3.2 CB	115	21 inch	Concrete	0.013	0.047	1,053.24	1,047.87	2	0.65	1.3	9.07	9.07	34.24	12.02	1,054.36	1,048.48
Pipe 13 *	Pipe 13	A-3 BOX	A-4 GI	166	27 inch	CMP	0.024	*0.046	1,054.12	1,046.45	2	0.65	4.49	9.07	31.09	36.06	8.14	1,056.05	1,048.51
Pipe 14	Pipe 14	A-4 GI	A-5 CB	28	24 inch	CMP	0.024	0.024	1,054.94	1,054.28	2	0.65	3.19	9.07	22.12	18.81	7.54	1,056.99	1,056.05
Pipe 15	Pipe 15	A-5 CB	A-6 CB	29	24 inch	CMP	0.024	0.053	1,056.51	1,054.97	2	0.65	1.89	9.07	13.11	28.24	4.17	1,057.81	1,056.99
Pipe 16	Pipe 16	A-6 CB	A-7 JB	49	18 inch	CMP	0.024	0.085	1,061.03	1,056.85	0.9	0.65	0.59	4.08	4.08	16.62	3.4	1,061.80	1,057.81

*Assumptions

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REVISIONS			
NO.	DATE	BY	CHKD
1	04/22/10	AMF	RJE

DESCRIPTION: DRAINAGE ANALYSIS

KENSINGTON ROAD
DRAINAGE PROJECT
CITY OF AVONDALE ESTATES

DATE	DRAWN	CHECKED
04/22/10	AMF	RJE

SCALE H:1"=30' V:1"=10'

SHEET TITLE
RESIZED STORM PIPE PROFILES

PROJECT NUMBER
11827.00

STM
04
DRAWING NUMBER

Gutter Spread Calculations - NORTH EAST

Road Name Kensington Road
Job Number 11827.00
Tc 24 (min.)
Frequency 10 (yrs)
Intensity 3.61 (in/hr)

Inlet Descriptor	Impervious Area (ac)	Landsc. Area (ac)	Wooded Area (ac)	Contrib. Flow (cfs)	Flow to Inlet (cfs)	Long. Slope (ft/ft)	X-Slope (ft/ft)	Inlet Length (ft)	Inlet Efficiency %	Bypass Flow (cfs)	Gutter Width (ft)	Gutter X-Slope (ft/ft)	Gutter Spread (ft)	Calculated Flow (cfs)	Flow to Inlet (cfs)
1	0.29	0.75		1.94	1.94	0.0420	0.0208	12.00	82%	0.36	1.50	0.0625	6.44	1.94	1.94
2	0.29	0.75		1.94	2.30	0.0410	0.0208	12.00	82%	0.42	1.50	0.0625	6.96	2.30	2.30
3	0.29	0.75		1.94	2.36	0.0390	0.0208	12.00	83%	0.41	1.50	0.0625	7.10	2.36	2.36
4	0.29	0.75		1.94	2.35	0.0330	0.0208	12.00	87%	0.31	1.50	0.0625	7.34	2.35	2.35
5	0.29	0.75		1.94	2.25	0.0250	0.0208	12.00	93%	0.16	1.50	0.0625	7.64	2.25	2.25
6	0.29	0.75		1.94	2.10	0.0200	0.0208	12.00	97%	0.06	1.50	0.0625	7.77	2.10	2.10
7	0.29	0.75		1.94	2.01	0.0150	0.0208	12.00	100%	0.00	1.50	0.0625	8.10	2.01	2.01
8	0.29	0.75		1.94	1.94	0.0100	0.0208	12.00	100%		1.50	0.0625	8.66	1.94	1.94
9-LP	0.29	0.75		1.94	1.94	0.0000	0.0208	12.00	100%		1.50	0.0625	3.37	1.94	1.94

Gutter Spread Calculations - SOUTH EAST

Road Name Kensington Road
Job Number 11827.00
Tc 5 (min.)
Frequency 10 (yrs)
Intensity 3.61 (in/hr)

Inlet Descriptor	Impervious Area (ac)	Landsc. Area (ac)	Wooded Area (ac)	Contrib. Flow (cfs)	Flow to Inlet (cfs)	Long. Slope (ft/ft)	X-Slope (ft/ft)	Inlet Length (ft)	Inlet Efficiency %	Bypass Flow (cfs)	Gutter Width (ft)	Gutter X-Slope (ft/ft)	Gutter Spread (ft)	Calculated Flow (cfs)	Flow to Inlet (cfs)
1	0.47			1.59	1.59	0.0400	0.0208	12.00	83%	0.27	1.50	0.0625	5.97	1.59	1.59
2	0.47			1.59	1.86	0.0300	0.0208	12.00	90%	0.19	1.50	0.0625	6.79	1.86	1.86
3	0.47			1.59	1.78	0.0200	0.0208	12.00	97%	0.04	1.50	0.0625	7.26	1.78	1.78
4	0.47			1.59	1.64	0.0000	0.0208	12.00	100%		1.50	0.0625	2.69	1.64	1.64

Gutter Spread Calculations - NORTH WEST

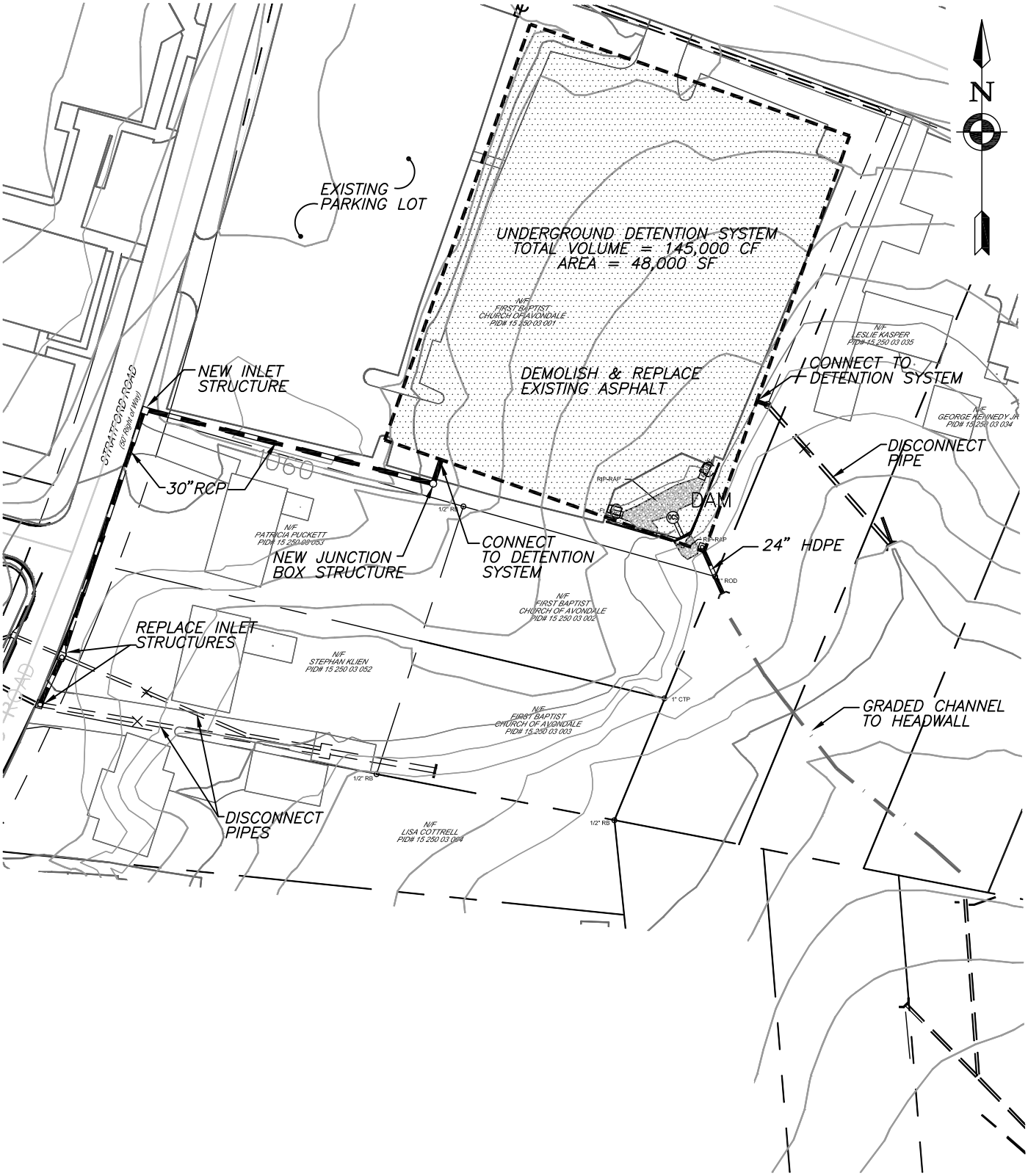
Road Name Kensington Road
Job Number 11827.00
Tc 16 (min.)
Frequency 10 (yrs)
Intensity 4.43 (in/hr)

Inlet Descriptor	Impervious Area (ac)	Landsc. Area (ac)	Wooded Area (ac)	Contrib. Flow (cfs)	Flow to Inlet (cfs)	Long. Slope (ft/ft)	X-Slope (ft/ft)	Inlet Length (ft)	Inlet Efficiency %	Bypass Flow (cfs)	Gutter Width (ft)	Gutter X-Slope (ft/ft)	Gutter Spread (ft)	Calculated Flow (cfs)	Flow to Inlet (cfs)
1	0.26	0.66		2.12	2.12	0.0500	0.0208	12.00	91%	0.20	1.50	0.0625	6.44	2.12	2.12
2	0.26	0.66		2.12	2.32	0.0430	0.0208	12.00	97%	0.06	1.50	0.0625	6.91	2.32	2.32
3	0.26	0.66		2.12	2.18	0.0310	0.0208	12.00	88%	0.27	1.50	0.0625	7.21	2.18	2.18
4	0.26	0.66		2.12	2.39	0.0190	0.0208	12.00	92%	0.20	1.50	0.0625	8.28	2.39	2.39
5-LP	0.26	0.66		2.12	2.32	0.0000	0.0208	12.00	100%		1.50	0.0625	4.18	2.32	2.32

Gutter Spread Calculations - SOUTH WEST

Road Name Kensington Road
Job Number 11827.00
Tc 5 (min.)
Frequency 10 (yrs)
Intensity 4.43 (in/hr)

Inlet Descriptor	Impervious Area (ac)	Landsc. Area (ac)	Wooded Area (ac)	Contrib. Flow (cfs)	Flow to Inlet (cfs)	Long. Slope (ft/ft)	X-Slope (ft/ft)	Inlet Length (ft)	Inlet Efficiency %	Bypass Flow (cfs)	Gutter Width (ft)	Gutter X-Slope (ft/ft)	Gutter Spread (ft)	Calculated Flow (cfs)	Flow to Inlet (cfs)
1	0.25	0.30		1.52	1.52	0.0250	0.0208	12.00	88%	0.19	1.50	0.0625	6.48	1.52	1.52
2	0.25	0.30		1.52	1.71	0.0000	0.0208	12.00	100%		1.50	0.0625	2.84	1.17	1.71



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KENSINGTON ROAD DRAINAGE
CITY OF AVONDALE ESTATES

UPSTREAM DETENTION SYSTEM
SCALE: 1"=80'
4/22/2010 11827.00

Pond Report

Pond No. 4 - UG HDPE

Pond Data

Pond storage is based on user-defined values.

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	1048.00	n/a	0	0
1.00	1049.00	n/a	8,374	8,374
2.00	1050.00	n/a	25,292	33,666
3.00	1051.00	n/a	33,474	67,140
4.00	1052.00	n/a	34,145	101,285
5.00	1053.00	n/a	26,952	128,237
6.00	1054.00	n/a	12,139	140,376
7.00	1055.00	n/a	996	141,372

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 24.00	3.00	0.00	0.00
Span (in)	= 24.00	3.00	0.00	0.00
No. Barrels	= 1	1	0	0
Invert El. (ft)	= 1048.00	1049.50	0.00	0.00
Length (ft)	= 20.00	0.00	0.00	0.00
Slope (%)	= 1.00	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	Yes	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 12.50	Inactive	0.00	0.00
Crest El. (ft)	= 1052.00	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= Riser	Rect	---	---
Multi-Stage	= Yes	No	No	No

Exfil.(in/hr) = 0.000 (by Wet area)

TW Elev. (ft) = 0.00

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.00	0	1048.00	0.00	0.00	---	---	0.00	---	---	---	---	---	0.000
0.10	837	1048.10	0.00	0.00	---	---	0.00	---	---	---	---	---	0.000
0.20	1,675	1048.20	0.00	0.00	---	---	0.00	---	---	---	---	---	0.000
0.30	2,512	1048.30	0.00	0.00	---	---	0.00	---	---	---	---	---	0.000
0.40	3,350	1048.40	0.00	0.00	---	---	0.00	---	---	---	---	---	0.000
0.50	4,187	1048.50	0.00	0.00	---	---	0.00	---	---	---	---	---	0.000
0.60	5,024	1048.60	0.00	0.00	---	---	0.00	---	---	---	---	---	0.000
0.70	5,862	1048.70	0.00	0.00	---	---	0.00	---	---	---	---	---	0.000
0.80	6,699	1048.80	0.00	0.00	---	---	0.00	---	---	---	---	---	0.000
0.90	7,537	1048.90	0.00	0.00	---	---	0.00	---	---	---	---	---	0.000
1.00	8,374	1049.00	0.00	0.00	---	---	0.00	---	---	---	---	---	0.000
1.10	10,903	1049.10	0.00	0.00	---	---	0.00	---	---	---	---	---	0.000
1.20	13,432	1049.20	0.00	0.00	---	---	0.00	---	---	---	---	---	0.000
1.30	15,962	1049.30	0.00	0.00	---	---	0.00	---	---	---	---	---	0.000
1.40	18,491	1049.40	0.00	0.00	---	---	0.00	---	---	---	---	---	0.000
1.50	21,020	1049.50	0.00	0.00	---	---	0.00	---	---	---	---	---	0.000
1.60	23,549	1049.60	0.02 ic	0.02 ic	---	---	0.00	---	---	---	---	---	0.020
1.70	26,078	1049.70	0.06 ic	0.06 ic	---	---	0.00	---	---	---	---	---	0.064
1.80	28,608	1049.80	0.11 ic	0.10 ic	---	---	0.00	---	---	---	---	---	0.099
1.90	31,137	1049.90	0.13 ic	0.12 ic	---	---	0.00	---	---	---	---	---	0.124
2.00	33,666	1050.00	0.15 ic	0.14 ic	---	---	0.00	---	---	---	---	---	0.145
2.10	37,013	1050.10	0.16 ic	0.16 ic	---	---	0.00	---	---	---	---	---	0.163
2.20	40,361	1050.20	0.18 ic	0.18 ic	---	---	0.00	---	---	---	---	---	0.179
2.30	43,708	1050.30	0.20 ic	0.19 ic	---	---	0.00	---	---	---	---	---	0.194
2.40	47,056	1050.40	0.22 ic	0.21 ic	---	---	0.00	---	---	---	---	---	0.208
2.50	50,403	1050.50	0.22 ic	0.22 ic	---	---	0.00	---	---	---	---	---	0.221
2.60	53,750	1050.60	0.24 ic	0.23 ic	---	---	0.00	---	---	---	---	---	0.233
2.70	57,098	1050.70	0.25 ic	0.25 ic	---	---	0.00	---	---	---	---	---	0.245
2.80	60,445	1050.80	0.27 ic	0.26 ic	---	---	0.00	---	---	---	---	---	0.256
2.90	63,793	1050.90	0.27 ic	0.27 ic	---	---	0.00	---	---	---	---	---	0.267
3.00	67,140	1051.00	0.29 ic	0.28 ic	---	---	0.00	---	---	---	---	---	0.277
3.10	70,555	1051.10	0.29 ic	0.29 ic	---	---	0.00	---	---	---	---	---	0.287
3.20	73,969	1051.20	0.30 ic	0.30 ic	---	---	0.00	---	---	---	---	---	0.297
3.30	77,384	1051.30	0.32 ic	0.31 ic	---	---	0.00	---	---	---	---	---	0.306
3.40	80,798	1051.40	0.32 ic	0.31 ic	---	---	0.00	---	---	---	---	---	0.315
3.50	84,213	1051.50	0.32 ic	0.32 ic	---	---	0.00	---	---	---	---	---	0.324
3.60	87,627	1051.60	0.35 ic	0.33 ic	---	---	0.00	---	---	---	---	---	0.332

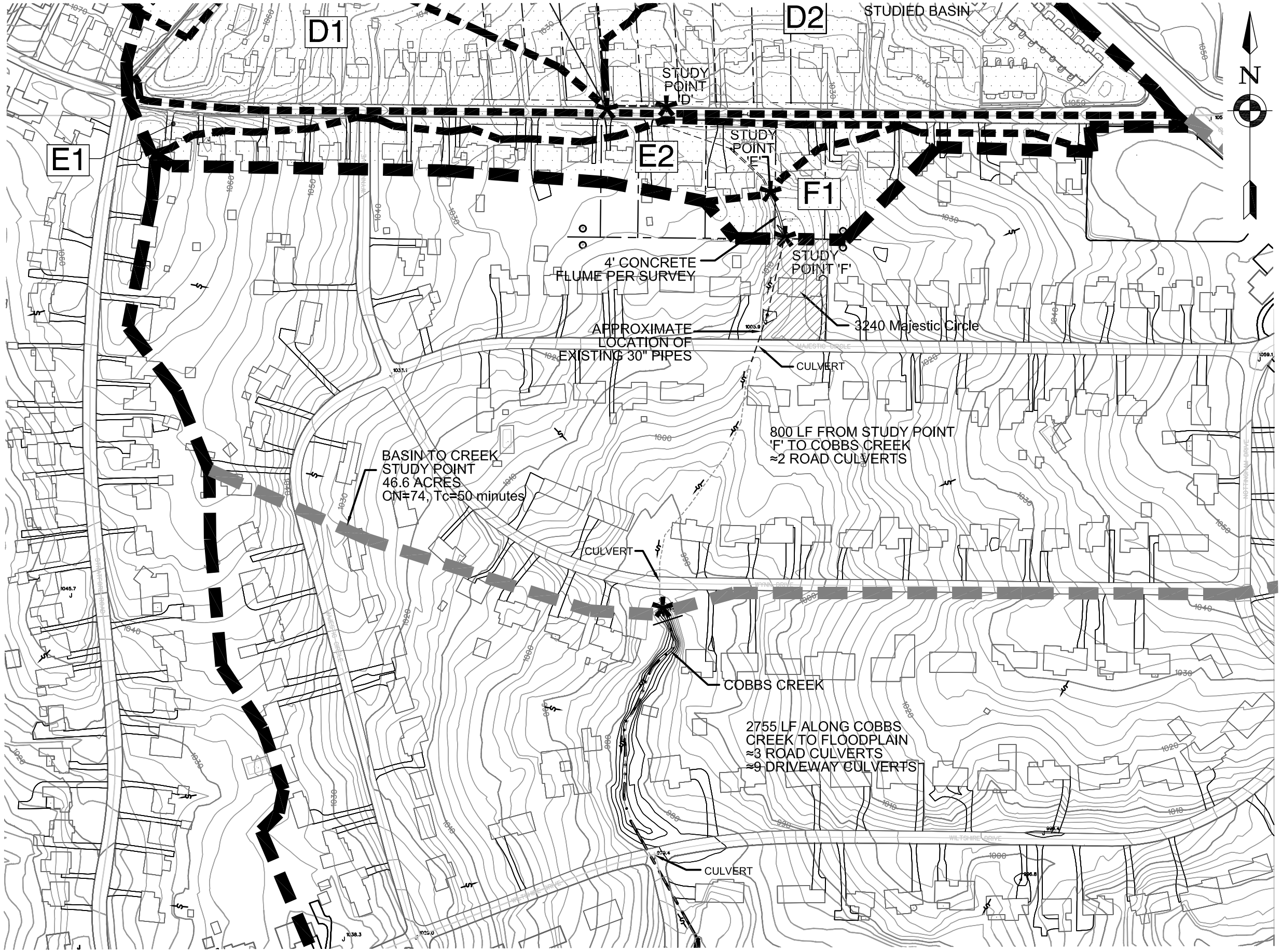
Continues on next page...

UG HDPE

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
3.70	91,042	1051.70	0.35 ic	0.34 ic	---	---	0.00	---	---	---	---	---	0.340
3.80	94,456	1051.80	0.35 ic	0.35 ic	---	---	0.00	---	---	---	---	---	0.349
3.90	97,871	1051.90	0.38 ic	0.36 ic	---	---	0.00	---	---	---	---	---	0.356
4.00	101,285	1052.00	0.38 ic	0.36 ic	---	---	0.00	---	---	---	---	---	0.364
4.10	103,980	1052.10	1.73 ic	0.37 ic	---	---	1.32	---	---	---	---	---	1.688
4.20	106,675	1052.20	4.18 oc	0.38 ic	---	---	3.72	---	---	---	---	---	4.101
4.30	109,371	1052.30	7.27 oc	0.39 ic	---	---	6.84	---	---	---	---	---	7.228
4.40	112,066	1052.40	10.89 oc	0.36 ic	---	---	10.53	---	---	---	---	---	10.89
4.50	114,761	1052.50	15.06 oc	0.34 ic	---	---	14.72	---	---	---	---	---	15.06
4.60	117,456	1052.60	19.66 oc	0.31 ic	---	---	19.34	---	---	---	---	---	19.66
4.70	120,151	1052.70	24.62 ic	0.24 ic	---	---	24.38	---	---	---	---	---	24.62
4.80	122,847	1052.80	27.40 ic	0.17 ic	---	---	27.23 s	---	---	---	---	---	27.40
4.90	125,542	1052.90	28.41 ic	0.14 ic	---	---	28.26 s	---	---	---	---	---	28.41
5.00	128,237	1053.00	29.16 ic	0.13 ic	---	---	29.03 s	---	---	---	---	---	29.16
5.10	129,451	1053.10	29.79 ic	0.11 ic	---	---	29.67 s	---	---	---	---	---	29.79
5.20	130,665	1053.20	30.33 ic	0.10 ic	---	---	30.23 s	---	---	---	---	---	30.33
5.30	131,879	1053.30	30.83 ic	0.09 ic	---	---	30.73 s	---	---	---	---	---	30.82
5.40	133,093	1053.40	31.28 ic	0.08 ic	---	---	31.20 s	---	---	---	---	---	31.28
5.50	134,307	1053.50	31.72 ic	0.08 ic	---	---	31.63 s	---	---	---	---	---	31.71
5.60	135,520	1053.60	32.13 ic	0.07 ic	---	---	32.06 s	---	---	---	---	---	32.13
5.70	136,734	1053.70	32.52 ic	0.07 ic	---	---	32.45 s	---	---	---	---	---	32.52
5.80	137,948	1053.80	32.91 ic	0.06 ic	---	---	32.83 s	---	---	---	---	---	32.89
5.90	139,162	1053.90	33.28 ic	0.06 ic	---	---	33.21 s	---	---	---	---	---	33.27
6.00	140,376	1054.00	33.65 ic	0.05 ic	---	---	33.58 s	---	---	---	---	---	33.63
6.10	140,476	1054.10	34.00 ic	0.05 ic	---	---	33.93 s	---	---	---	---	---	33.98
6.20	140,575	1054.20	34.35 ic	0.05 ic	---	---	34.29 s	---	---	---	---	---	34.34
6.30	140,675	1054.30	34.70 ic	0.05 ic	---	---	34.62 s	---	---	---	---	---	34.66
6.40	140,774	1054.40	35.04 ic	0.04 ic	---	---	34.98 s	---	---	---	---	---	35.02
6.50	140,874	1054.50	35.37 ic	0.04 ic	---	---	35.30 s	---	---	---	---	---	35.34
6.60	140,974	1054.60	35.70 ic	0.04 ic	---	---	35.62 s	---	---	---	---	---	35.66
6.70	141,073	1054.70	36.03 ic	0.04 ic	---	---	35.98 s	---	---	---	---	---	36.02
6.80	141,173	1054.80	36.35 ic	0.04 ic	---	---	36.31 s	---	---	---	---	---	36.34
6.90	141,272	1054.90	36.67 ic	0.03 ic	---	---	36.60 s	---	---	---	---	---	36.63
7.00	141,372	1055.00	36.99 ic	0.03 ic	---	---	36.93 s	---	---	---	---	---	36.96

...End



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KENSINGTON ROAD DRAINAGE PROJECT

CITY OF AVONDALE ESTATES

DATE	DRAWN	CHECKED
04/22/10	AMF	RJE

SCALE 1"=200'

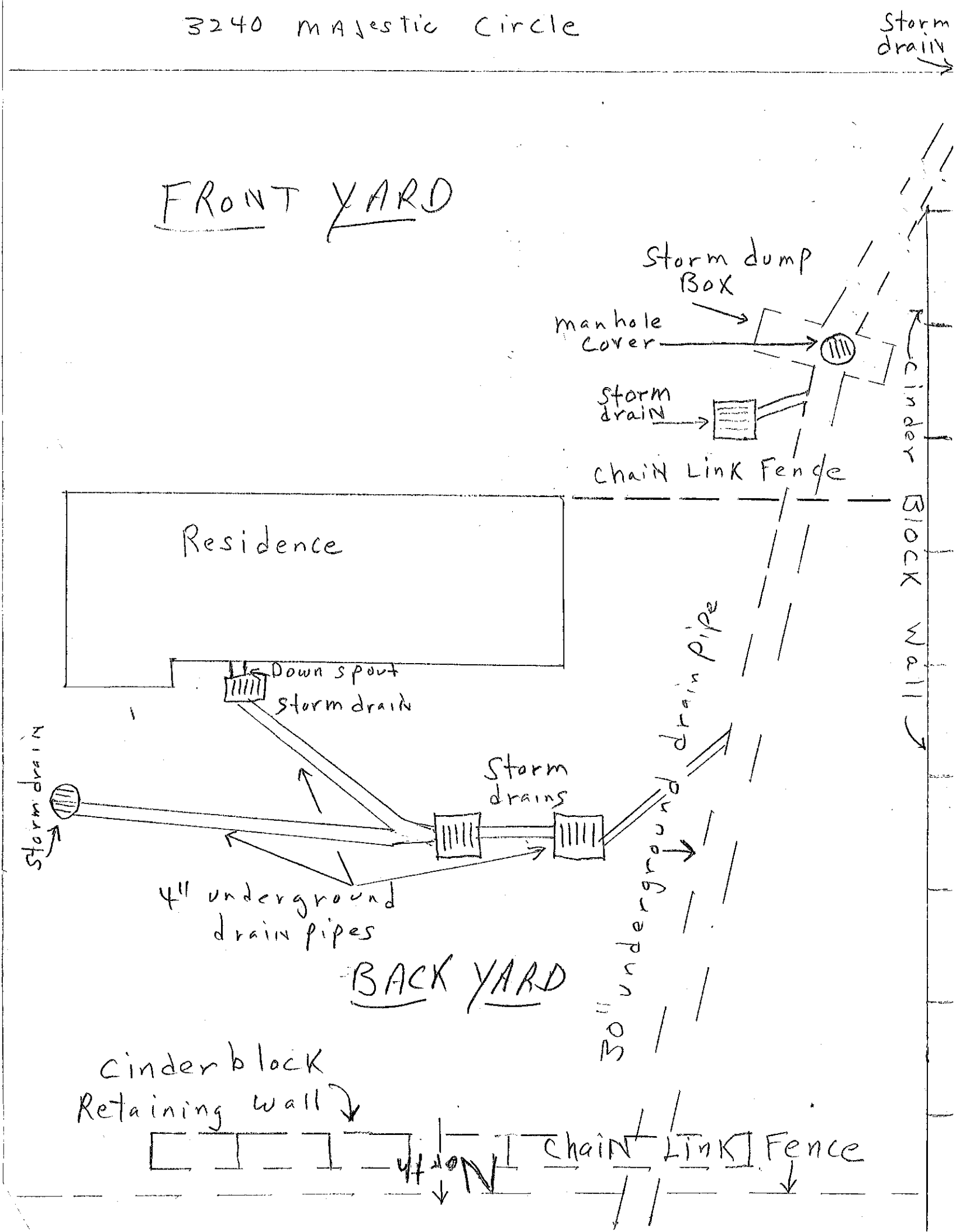
SHEET TITLE

DOWNSTREAM ANALYSIS MAP

PROJECT NUMBER
11827.00

D
04
DRAWING NUMBER

3240 Majestic Circle



DOWNSTREAM PIPE ANALYSIS
CAPACITY OF CIRCULAR PIPE FLOWING FULL

MANNING'S n 0.013 (RCP)

FLOW (cfs)
VELOCITY (fps)

DIAM (in)	30	36	42	48	54
AREA (sq ft)	4.909	7.069	9.621	12.566	15.904
1.0%	**41.02**	66.70	100.61	143.64	196.65
	8.36	9.44	10.46	11.43	12.36
1.5%	50.24	81.69	123.22	175.93	240.85
	10.23	11.56	12.81	14.00	15.14
2.0%	58.01	94.33	142.28	203.14	278.10
	11.82	13.34	14.79	16.17	17.49

MANNING'S n 0.021 (CMP)

FLOW (cfs)
VELOCITY (fps)

DIAM (in)	30	36	42	48	54	60
AREA (sq ft)	4.909	7.069	9.621	12.566	15.904	19.635
1.0%	**25.39**	41.29	62.28	88.92	121.74	161.23
	5.17	5.84	6.47	7.08	7.65	8.21
1.5%	31.10	50.57	76.28	108.91	149.09	197.46
	6.34	7.15	7.93	8.67	9.37	10.06
2.0%	35.91	58.39	88.08	125.75	172.16	228.01
	7.32	8.26	9.15	10.01	10.82	11.61

Existing Downstream pipe is 30" per sketch of 3240 Majestic Circle

Q_{25} = 154 cfs (Existing)

Q_{25} = 96 cfs (With upstream Detention)

Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph description
1	SCS Runoff	36.44	2	728	134,111	------	------	------	A-1
2	SCS Runoff	6.272	2	728	22,194	------	------	------	A-2
3	SCS Runoff	24.56	2	718	57,667	------	------	------	B-1
4	SCS Runoff	16.06	2	716	35,834	------	------	------	B-2
5	SCS Runoff	10.38	2	722	29,579	------	------	------	B-3
6	SCS Runoff	8.712	2	730	33,350	------	------	------	C-1
7	SCS Runoff	16.97	2	724	53,280	------	------	------	D-1
8	SCS Runoff	29.98	2	728	110,511	------	------	------	D-2
9	SCS Runoff	9.303	2	720	24,169	------	------	------	E-1
10	SCS Runoff	16.07	2	720	41,690	------	------	------	E-2
11	SCS Runoff	5.613	2	720	14,682	------	------	------	F-1
13	Combine	42.71	2	728	156,305	1, 2,	------	------	Study Point A
14	Combine	48.46	2	718	123,079	3, 4, 5,	------	------	Study Point B
15	Combine	84.29	2	720	312,733	6, 13, 14	------	------	Study Point C
16	Combine	45.89	2	726	163,791	7, 8,	------	------	Study Point D
17	Combine	147.97	2	722	542,383	9, 10, 15, 16	------	------	Study Point E
18	Combine	153.58	2	722	557,065	11, 17	------	------	Study Point F
20	Combine	64.15	2	718	227,611	1, 3, 4,	------	------	A1-B1-B2
21	Reservoir	22.56	2	744	192,630	20	1052.66	119,031	Upstream UG Detention
22	Combine	27.41	2	742	244,403	2, 5, 21	------	------	A & B w/ Upstream Det.
23	Combine	33.19	2	740	277,753	6, 22	------	------	C w/ Upstream Det.
24	Combine	45.89	2	726	163,791	7, 8,	------	------	Study Point D
25	Combine	91.20	2	724	507,402	9, 10, 23, 24	------	------	E w/ Upstream Det.
26	Combine	96.34	2	724	522,084	11, 25	------	------	F w/ Upstream Det.
28	Combine	78.36	2	720	279,384	13, 14,	------	------	A+B UNDET
30	SCS Runoff	107.15	2	744	607,699	------	------	------	Downstream Basin
31	Combine	210.88	2	724	1,164,764	18, 30	------	------	Basin at Creek
32	Combine	170.45	2	738	1,129,783	26, 30,	------	------	Basin at Creek w/ Upstream Detentio

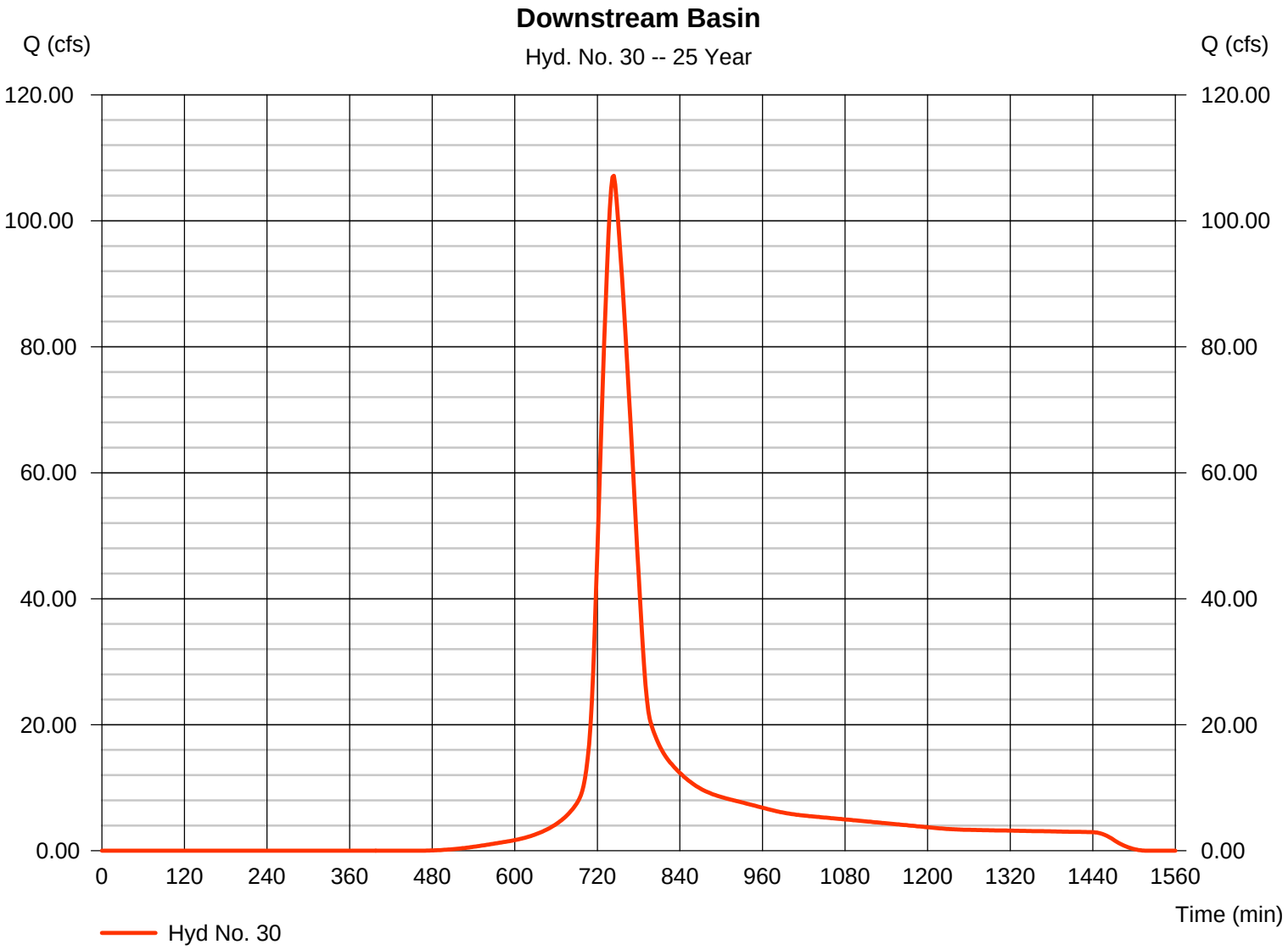
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 Wednesday, Apr 21, 2010

Hyd. No. 30

Downstream Basin

Hydrograph type	=	SCS Runoff	Peak discharge	=	107.15 cfs
Storm frequency	=	25 yrs	Time to peak	=	744 min
Time interval	=	2 min	Hyd. volume	=	607,699 cuft
Drainage area	=	46.600 ac	Curve number	=	74
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	49.90 min
Total precip.	=	6.48 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484



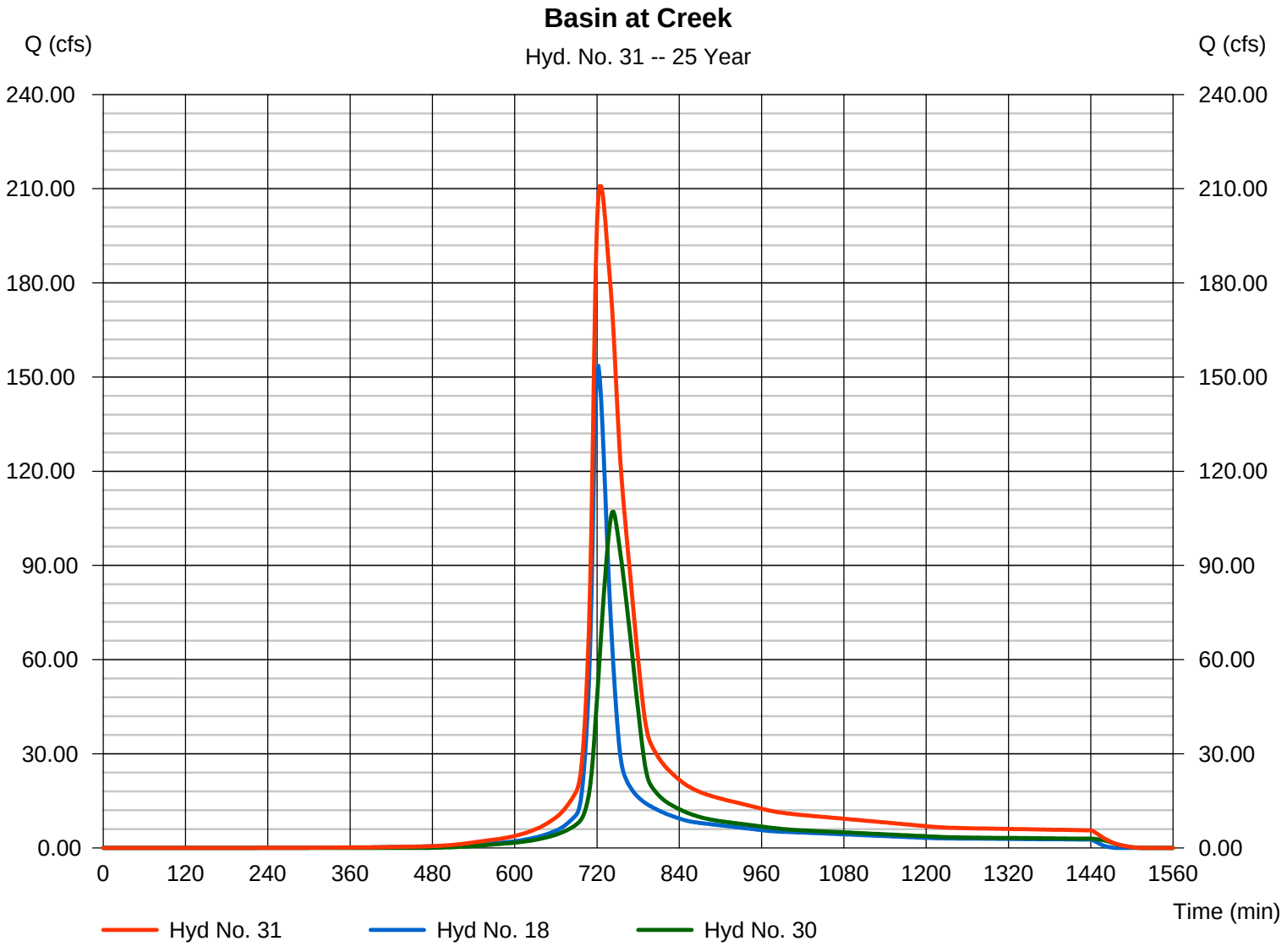
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 Wednesday, Apr 21, 2010

Hyd. No. 31

Basin at Creek

Hydrograph type	=	Combine	Peak discharge	=	210.88 cfs
Storm frequency	=	25 yrs	Time to peak	=	724 min
Time interval	=	2 min	Hyd. volume	=	1,164,764 cuft
Inflow hyds.	=	18, 30	Contrib. drain. area	=	46.600 ac



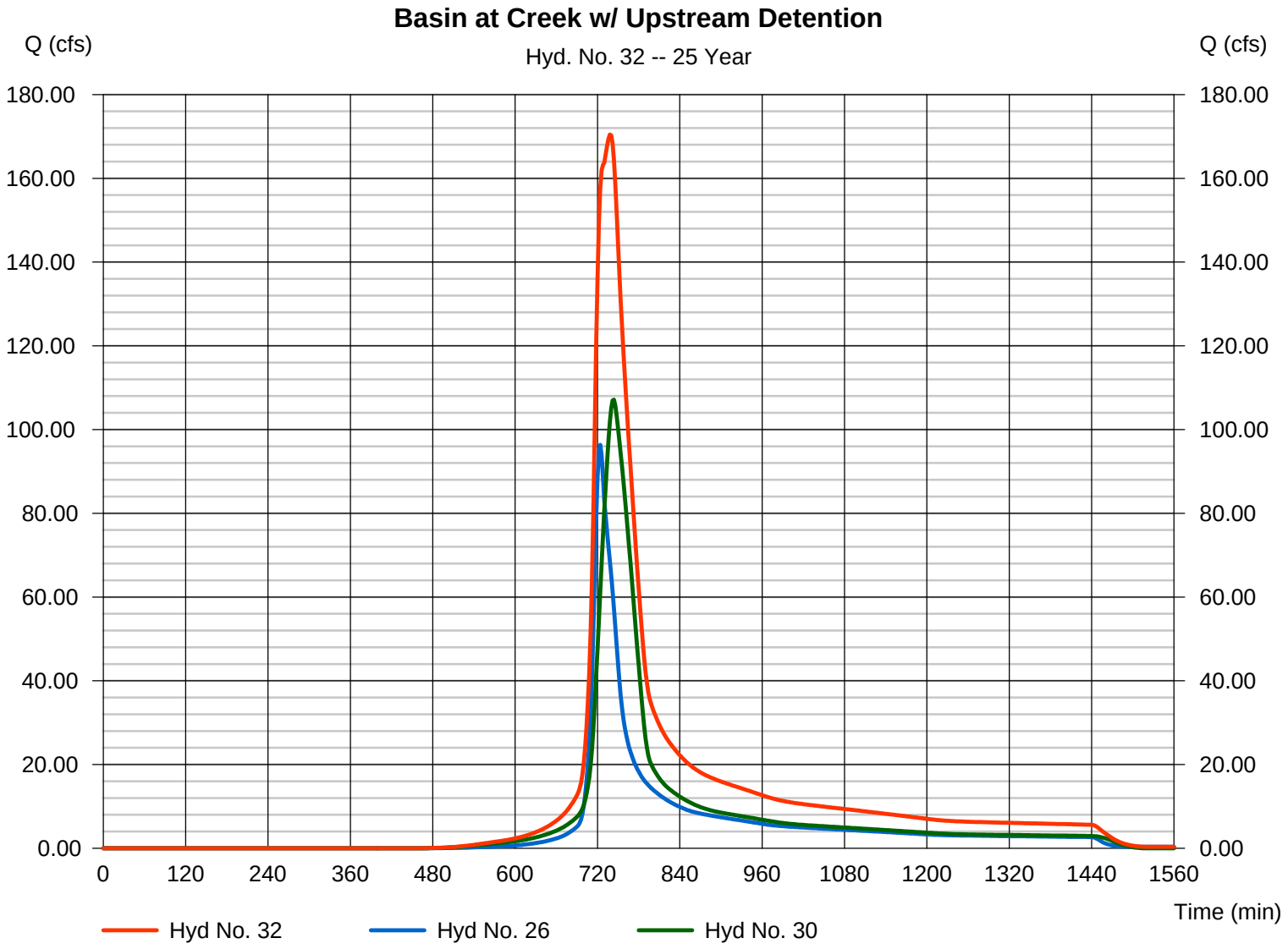
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 Wednesday, Apr 21, 2010

Hyd. No. 32

Basin at Creek w/ Upstream Detention

Hydrograph type	= Combine	Peak discharge	= 170.45 cfs
Storm frequency	= 25 yrs	Time to peak	= 738 min
Time interval	= 2 min	Hyd. volume	= 1,129,783 cuft
Inflow hyds.	= 26, 30	Contrib. drain. area	= 46.600 ac



Downstream Creek Study Point

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00100	ft/ft
Discharge	210.00	ft^3/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	983.00
0+10	982.00
0+29	975.00
0+31	975.00
0+50	986.00
0+60	987.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 983.00)	(0+60, 987.00)	0.050

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	6.42	ft
Elevation Range	975.00 to 987.00 ft	
Flow Area	104.48	ft^2
Wetted Perimeter	33.40	ft
Hydraulic Radius	3.13	ft
Top Width	30.53	ft
Normal Depth	6.42	ft

Downstream Creek Study Point

Results

Critical Depth		3.12	ft
Critical Slope		0.03377	ft/ft
Velocity		2.01	ft/s
Velocity Head		0.06	ft
Specific Energy		6.49	ft
Froude Number		0.19	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	6.42	ft
Critical Depth	3.12	ft
Channel Slope	0.00100	ft/ft
Critical Slope	0.03377	ft/ft

Downstream Creek Cross Section (Existing)

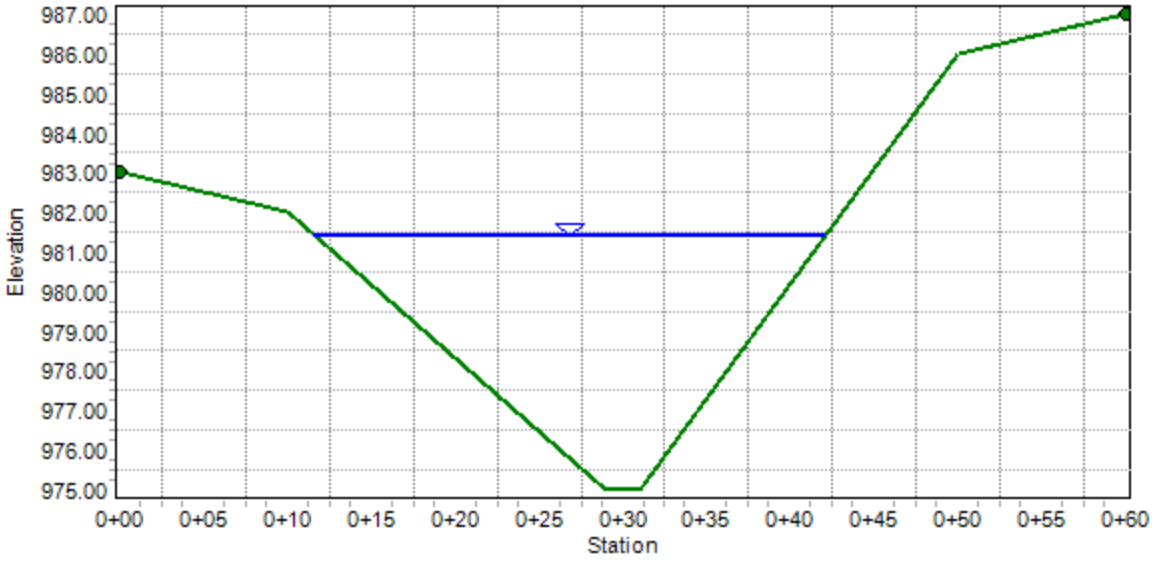
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00100	ft/ft
Normal Depth	6.42	ft
Discharge	210.00	ft³/s

Cross Section Image



Downstream Creek Study Point (with Upstream Detention)

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00100	ft/ft
Discharge	170.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	983.00
0+10	982.00
0+29	975.00
0+31	975.00
0+50	986.00
0+60	987.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 983.00)	(0+60, 987.00)	0.050

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	5.90	ft
Elevation Range	975.00 to 987.00 ft	
Flow Area	89.16	ft²
Wetted Perimeter	30.85	ft
Hydraulic Radius	2.89	ft
Top Width	28.21	ft
Normal Depth	5.90	ft

Downstream Creek Study Point (with Upstream Detention)

Results

Critical Depth		2.84	ft
Critical Slope		0.03470	ft/ft
Velocity		1.91	ft/s
Velocity Head		0.06	ft
Specific Energy		5.96	ft
Froude Number		0.19	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	5.90	ft
Critical Depth	2.84	ft
Channel Slope	0.00100	ft/ft
Critical Slope	0.03470	ft/ft

Downstream Creek Cross Section (With Upstream Detention)

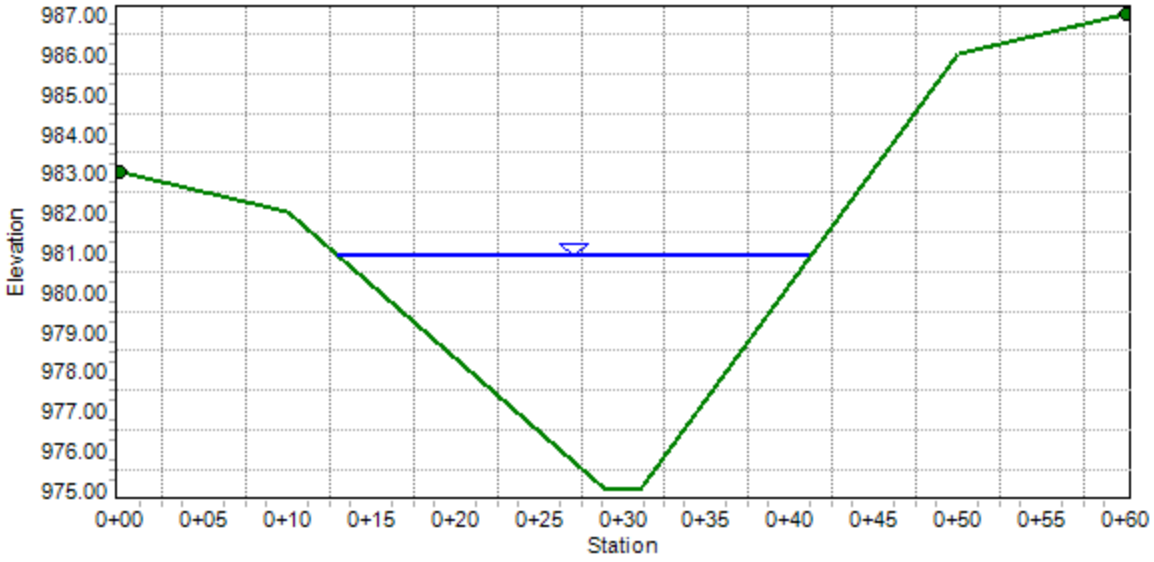
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.00100	ft/ft
Normal Depth	5.90	ft
Discharge	170.00	ft³/s

Cross Section Image



RESULTS

SCS FLOW SUMMARIES

Project Name Avondale Estates Drainage Study
Project No. 11827.00

EXISTING FLOWS									
Basin		A	B	A+B	C	D	E	F	
Storm Event	1	14.26	18.41	27.23	27.83	12.42	44.59	45.89	
	2	18.32	22.78	34.5	35.64	16.96	58.79	60.66	
	5	26.89	31.87	49.88	52.52	26.86	89.56	92.69	
	10	33.58	38.9	61.91	65.87	34.8	114.05	118.22	
	25	42.71	48.46	78.36	84.29	45.89	147.97	153.58	
	50	49.67	55.73	90.92	98.43	54.54	174.08	180.83	
	100	54.34	60.62	99.37	107.98	60.39	191.73	199.24	
ANTICIPATED FLOWS WITH UPSTREAM DETENTION									Total Basin Reduction (%)
Storm Event	**1**	*	*	3.329	4.488	12.42	23.03	24.27	47.1
	2	*	*	5.001	6.941	16.96	32.1	33.85	44.2
	5	*	*	8.861	12.72	26.86	52.16	55.07	40.6
	10	*	*	12.06	17.54	34.8	68.42	72.26	38.9
	25	*	*	27.41	33.19	45.89	91.2	96.34	37.3
	50	*	*	39.63	50.05	54.54	115.2	119.44	33.9
	100	*	*	46.56	58.7	60.39	138.43	144.15	27.7

**Flows from Basins A & B are combined, providing detention for a portion of each*

Hydrograph Return Period Recap

Hyd. No.	Hydrograph type (origin)	Inflow Hyd(s)	Peak Outflow (cfs)								Hydrograph description
			1-Yr	2-Yr	3-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr	
1	SCS Runoff	------	13.04	16.46	-------	23.56	29.04	36.44	42.03	45.77	A-1
2	SCS Runoff	------	1.218	1.858	-------	3.324	4.539	6.272	7.636	8.578	A-2
3	SCS Runoff	------	9.668	11.90	-------	16.46	19.92	24.56	28.03	30.35	B-1
4	SCS Runoff	------	7.632	8.943	-------	11.55	13.49	16.06	17.98	19.26	B-2
5	SCS Runoff	------	2.114	3.172	-------	5.558	7.527	10.38	12.63	14.18	B-3
6	SCS Runoff	------	1.361	2.216	-------	4.327	6.120	8.712	10.77	12.19	C-1
7	SCS Runoff	------	4.521	6.191	-------	9.836	12.81	16.97	20.19	22.37	D-1
8	SCS Runoff	------	8.189	11.14	-------	17.56	22.73	29.98	35.58	39.37	D-2
9	SCS Runoff	------	3.055	3.930	-------	5.814	7.289	9.303	10.83	11.86	E-1
10	SCS Runoff	------	4.996	6.530	-------	9.828	12.46	16.07	18.84	20.70	E-2
11	SCS Runoff	------	1.301	1.869	-------	3.132	4.162	5.613	6.772	7.561	F-1
13	Combine	1, 2,	14.26	18.32	-------	26.89	33.58	42.71	49.67	54.34	Study Point A
14	Combine	3, 4, 5,	18.41	22.78	-------	31.87	38.90	48.46	55.73	60.62	Study Point B
15	Combine	6, 13, 14	27.83	35.64	-------	52.52	65.87	84.29	98.43	107.98	Study Point C
16	Combine	7, 8,	12.42	16.96	-------	26.86	34.80	45.89	54.54	60.39	Study Point D
17	Combine	9, 10, 15, 16	44.59	58.79	-------	89.56	114.05	147.97	174.08	191.73	Study Point E
18	Combine	11, 17	45.89	60.66	-------	92.69	118.22	153.58	180.83	199.24	Study Point F
20	Combine	1, 3, 4,	25.01	30.81	-------	42.74	51.86	64.15	73.41	79.60	A1-B1-B2
21	Reservoir	20	0.299	0.345	-------	2.202	6.944	22.56	28.82	31.68	Upstream UG Detention
22	Combine	2, 5, 21	3.329	5.001	-------	8.861	12.06	27.41	39.63	46.56	A & B w/ Upstream Det.
23	Combine	6, 22	4.488	6.941	-------	12.72	17.54	33.19	50.05	58.73	C w/ Upstream Det.
24	Combine	7, 8,	12.42	16.96	-------	26.86	34.80	45.89	54.54	60.39	Study Point D
25	Combine	9, 10, 23, 24	23.03	32.10	-------	52.16	68.42	91.20	115.20	138.43	E w/ Upstream Det.
26	Combine	11, 25	24.27	33.85	-------	55.07	72.26	96.34	119.44	144.15	F w/ Upstream Det.

Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph description
1	SCS Runoff	13.04	2	728	48,532	------	------	------	A-1
2	SCS Runoff	1.218	2	728	5,401	------	------	------	A-2
3	SCS Runoff	9.668	2	718	22,125	------	------	------	B-1
4	SCS Runoff	7.632	2	716	16,184	------	------	------	B-2
5	SCS Runoff	2.114	2	724	7,198	------	------	------	B-3
6	SCS Runoff	1.361	2	732	7,305	------	------	------	C-1
7	SCS Runoff	4.521	2	726	15,408	------	------	------	D-1
8	SCS Runoff	8.189	2	730	32,777	------	------	------	D-2
9	SCS Runoff	3.055	2	722	8,048	------	------	------	E-1
10	SCS Runoff	4.996	2	722	13,279	------	------	------	E-2
11	SCS Runoff	1.301	2	722	3,802	------	------	------	F-1
13	Combine	14.26	2	728	53,932	1, 2,	------	------	Study Point A
14	Combine	18.41	2	718	45,507	3, 4, 5,	------	------	Study Point B
15	Combine	27.83	2	720	106,744	6, 13, 14	------	------	Study Point C
16	Combine	12.42	2	728	48,185	7, 8,	------	------	Study Point D
17	Combine	44.59	2	722	176,257	9, 10, 15, 16	------	------	Study Point E
18	Combine	45.89	2	722	180,059	11, 17	------	------	Study Point F
20	Combine	25.01	2	718	86,840	1, 3, 4,	------	------	A1-B1-B2
21	Reservoir	0.299	2	1446	60,759	20	1051.22	74,709	Upstream UG Detention
22	Combine	3.329	2	726	73,358	2, 5, 21	------	------	A & B w/ Upstream Det.
23	Combine	4.488	2	728	80,663	6, 22	------	------	C w/ Upstream Det.
24	Combine	12.42	2	728	48,185	7, 8,	------	------	Study Point D
25	Combine	23.03	2	724	150,175	9, 10, 23, 24	------	------	E w/ Upstream Det.
26	Combine	24.27	2	724	153,977	11, 25	------	------	F w/ Upstream Det.

Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph description
1	SCS Runoff	16.46	2	728	60,749	------	------	------	A-1
2	SCS Runoff	1.858	2	728	7,511	------	------	------	A-2
3	SCS Runoff	11.90	2	718	27,289	------	------	------	B-1
4	SCS Runoff	8.943	2	716	19,160	------	------	------	B-2
5	SCS Runoff	3.172	2	724	10,010	------	------	------	B-3
6	SCS Runoff	2.216	2	730	10,471	------	------	------	C-1
7	SCS Runoff	6.191	2	726	20,440	------	------	------	D-1
8	SCS Runoff	11.14	2	730	43,189	------	------	------	D-2
9	SCS Runoff	3.930	2	722	10,290	------	------	------	E-1
10	SCS Runoff	6.530	2	722	17,174	------	------	------	E-2
11	SCS Runoff	1.869	2	722	5,197	------	------	------	F-1
13	Combine	18.32	2	728	68,259	1, 2,	------	------	Study Point A
14	Combine	22.78	2	718	56,459	3, 4, 5,	------	------	Study Point B
15	Combine	35.64	2	720	135,189	6, 13, 14	------	------	Study Point C
16	Combine	16.96	2	728	63,629	7, 8,	------	------	Study Point D
17	Combine	58.79	2	722	226,282	9, 10, 15, 16	------	------	Study Point E
18	Combine	60.66	2	722	231,479	11, 17	------	------	Study Point F
20	Combine	30.81	2	718	107,198	1, 3, 4,	------	------	A1-B1-B2
21	Reservoir	0.345	2	1446	75,735	20	1051.76	93,008	Upstream UG Detention
22	Combine	5.001	2	726	93,256	2, 5, 21	------	------	A & B w/ Upstream Det.
23	Combine	6.941	2	726	103,726	6, 22	------	------	C w/ Upstream Det.
24	Combine	16.96	2	728	63,629	7, 8,	------	------	Study Point D
25	Combine	32.10	2	724	194,820	9, 10, 23, 24	------	------	E w/ Upstream Det.
26	Combine	33.85	2	724	200,016	11, 25	------	------	F w/ Upstream Det.

Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph description
1	SCS Runoff	23.56	2	728	86,474	------	------	------	A-1
2	SCS Runoff	3.324	2	728	12,341	------	------	------	A-2
3	SCS Runoff	16.46	2	718	38,035	------	------	------	B-1
4	SCS Runoff	11.55	2	716	25,179	------	------	------	B-2
5	SCS Runoff	5.558	2	724	16,447	------	------	------	B-3
6	SCS Runoff	4.327	2	730	17,875	------	------	------	C-1
7	SCS Runoff	9.836	2	726	31,547	------	------	------	D-1
8	SCS Runoff	17.56	2	730	66,053	------	------	------	D-2
9	SCS Runoff	5.814	2	720	15,093	------	------	------	E-1
10	SCS Runoff	9.828	2	720	25,597	------	------	------	E-2
11	SCS Runoff	3.132	2	722	8,348	------	------	------	F-1
13	Combine	26.89	2	728	98,815	1, 2,	------	------	Study Point A
14	Combine	31.87	2	718	79,662	3, 4, 5,	------	------	Study Point B
15	Combine	52.52	2	720	196,352	6, 13, 14	------	------	Study Point C
16	Combine	26.86	2	728	97,600	7, 8,	------	------	Study Point D
17	Combine	89.56	2	722	334,642	9, 10, 15, 16	------	------	Study Point E
18	Combine	92.69	2	722	342,991	11, 17	------	------	Study Point F
20	Combine	42.74	2	718	149,688	1, 3, 4,	------	------	A1-B1-B2
21	Reservoir	2.202	2	852	114,815	20	1052.12	104,555	Upstream UG Detention
22	Combine	8.861	2	724	143,603	2, 5, 21	------	------	A & B w/ Upstream Det.
23	Combine	12.72	2	726	161,478	6, 22	------	------	C w/ Upstream Det.
24	Combine	26.86	2	728	97,600	7, 8,	------	------	Study Point D
25	Combine	52.16	2	724	299,769	9, 10, 23, 24	------	------	E w/ Upstream Det.
26	Combine	55.07	2	724	308,117	11, 25	------	------	F w/ Upstream Det.

Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph description
1	SCS Runoff	29.04	2	728	106,573	------	------	------	A-1
2	SCS Runoff	4.539	2	728	16,382	------	------	------	A-2
3	SCS Runoff	19.92	2	718	46,350	------	------	------	B-1
4	SCS Runoff	13.49	2	716	29,732	------	------	------	B-2
5	SCS Runoff	7.527	2	724	21,833	------	------	------	B-3
6	SCS Runoff	6.120	2	730	24,177	------	------	------	C-1
7	SCS Runoff	12.81	2	724	40,571	------	------	------	D-1
8	SCS Runoff	22.73	2	728	84,546	------	------	------	D-2
9	SCS Runoff	7.289	2	720	18,900	------	------	------	E-1
10	SCS Runoff	12.46	2	720	32,326	------	------	------	E-2
11	SCS Runoff	4.162	2	722	10,957	------	------	------	F-1
13	Combine	33.58	2	728	122,955	1, 2,	------	------	Study Point A
14	Combine	38.90	2	718	97,915	3, 4, 5,	------	------	Study Point B
15	Combine	65.87	2	720	245,046	6, 13, 14	------	------	Study Point C
16	Combine	34.80	2	728	125,117	7, 8,	------	------	Study Point D
17	Combine	114.05	2	722	421,389	9, 10, 15, 16	------	------	Study Point E
18	Combine	118.22	2	722	432,347	11, 17	------	------	Study Point F
20	Combine	51.86	2	718	182,655	1, 3, 4,	------	------	A1-B1-B2
21	Reservoir	6.944	2	760	147,730	20	1052.29	109,126	Upstream UG Detention
22	Combine	12.06	2	724	185,946	2, 5, 21	------	------	A & B w/ Upstream Det.
23	Combine	17.54	2	726	210,122	6, 22	------	------	C w/ Upstream Det.
24	Combine	34.80	2	728	125,117	7, 8,	------	------	Study Point D
25	Combine	68.42	2	724	386,465	9, 10, 23, 24	------	------	E w/ Upstream Det.
26	Combine	72.26	2	724	397,422	11, 25	------	------	F w/ Upstream Det.

Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph description
1	SCS Runoff	36.44	2	728	134,111	------	------	------	A-1
2	SCS Runoff	6.272	2	728	22,194	------	------	------	A-2
3	SCS Runoff	24.56	2	718	57,667	------	------	------	B-1
4	SCS Runoff	16.06	2	716	35,834	------	------	------	B-2
5	SCS Runoff	10.38	2	722	29,579	------	------	------	B-3
6	SCS Runoff	8.712	2	730	33,350	------	------	------	C-1
7	SCS Runoff	16.97	2	724	53,280	------	------	------	D-1
8	SCS Runoff	29.98	2	728	110,511	------	------	------	D-2
9	SCS Runoff	9.303	2	720	24,169	------	------	------	E-1
10	SCS Runoff	16.07	2	720	41,690	------	------	------	E-2
11	SCS Runoff	5.613	2	720	14,682	------	------	------	F-1
13	Combine	42.71	2	728	156,305	1, 2,	------	------	Study Point A
14	Combine	48.46	2	718	123,079	3, 4, 5,	------	------	Study Point B
15	Combine	84.29	2	720	312,733	6, 13, 14	------	------	Study Point C
16	Combine	45.89	2	726	163,791	7, 8,	------	------	Study Point D
17	Combine	147.97	2	722	542,383	9, 10, 15, 16	------	------	Study Point E
18	Combine	153.58	2	722	557,065	11, 17	------	------	Study Point F
20	Combine	64.15	2	718	227,611	1, 3, 4,	------	------	A1-B1-B2
21	Reservoir	22.56	2	744	192,630	20	1052.66	119,031	Upstream UG Detention
22	Combine	27.41	2	742	244,403	2, 5, 21	------	------	A & B w/ Upstream Det.
23	Combine	33.19	2	740	277,753	6, 22	------	------	C w/ Upstream Det.
24	Combine	45.89	2	726	163,791	7, 8,	------	------	Study Point D
25	Combine	91.20	2	724	507,402	9, 10, 23, 24	------	------	E w/ Upstream Det.
26	Combine	96.34	2	724	522,084	11, 25	------	------	F w/ Upstream Det.

Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph description
1	SCS Runoff	42.03	2	728	155,174	------	------	------	A-1
2	SCS Runoff	7.636	2	728	26,806	------	------	------	A-2
3	SCS Runoff	28.03	2	718	66,280	------	------	------	B-1
4	SCS Runoff	17.98	2	716	40,427	------	------	------	B-2
5	SCS Runoff	12.63	2	722	35,725	------	------	------	B-3
6	SCS Runoff	10.77	2	730	40,695	------	------	------	C-1
7	SCS Runoff	20.19	2	724	63,206	------	------	------	D-1
8	SCS Runoff	35.58	2	728	130,741	------	------	------	D-2
9	SCS Runoff	10.83	2	720	28,229	------	------	------	E-1
10	SCS Runoff	18.84	2	720	48,936	------	------	------	E-2
11	SCS Runoff	6.772	2	720	17,621	------	------	------	F-1
13	Combine	49.67	2	728	181,980	1, 2,	------	------	Study Point A
14	Combine	55.73	2	718	142,431	3, 4, 5,	------	------	Study Point B
15	Combine	98.43	2	720	365,105	6, 13, 14	------	------	Study Point C
16	Combine	54.54	2	726	193,947	7, 8,	------	------	Study Point D
17	Combine	174.08	2	722	636,217	9, 10, 15, 16	------	------	Study Point E
18	Combine	180.83	2	722	653,838	11, 17	------	------	Study Point F
20	Combine	73.41	2	718	261,881	1, 3, 4,	------	------	A1-B1-B2
21	Reservoir	28.82	2	742	226,863	20	1052.96	127,014	Upstream UG Detention
22	Combine	39.63	2	732	289,394	2, 5, 21	------	------	A & B w/ Upstream Det.
23	Combine	50.05	2	732	330,088	6, 22	------	------	C w/ Upstream Det.
24	Combine	54.54	2	726	193,947	7, 8,	------	------	Study Point D
25	Combine	115.20	2	728	601,200	9, 10, 23, 24	------	------	E w/ Upstream Det.
26	Combine	119.44	2	728	618,821	11, 25	------	------	F w/ Upstream Det.

Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph description
1	SCS Runoff	45.77	2	728	169,368	------	------	------	A-1
2	SCS Runoff	8.578	2	726	29,979	------	------	------	A-2
3	SCS Runoff	30.35	2	718	72,067	------	------	------	B-1
4	SCS Runoff	19.26	2	716	43,495	------	------	------	B-2
5	SCS Runoff	14.18	2	722	39,954	------	------	------	B-3
6	SCS Runoff	12.19	2	730	45,776	------	------	------	C-1
7	SCS Runoff	22.37	2	724	69,974	------	------	------	D-1
8	SCS Runoff	39.37	2	728	144,516	------	------	------	D-2
9	SCS Runoff	11.86	2	720	30,977	------	------	------	E-1
10	SCS Runoff	20.70	2	720	53,851	------	------	------	E-2
11	SCS Runoff	7.561	2	720	19,637	------	------	------	F-1
13	Combine	54.34	2	728	199,347	1, 2,	------	------	Study Point A
14	Combine	60.62	2	718	155,516	3, 4, 5,	------	------	Study Point B
15	Combine	107.98	2	720	400,639	6, 13, 14	------	------	Study Point C
16	Combine	60.39	2	726	214,490	7, 8,	------	------	Study Point D
17	Combine	191.73	2	722	699,957	9, 10, 15, 16	------	------	Study Point E
18	Combine	199.24	2	722	719,594	11, 17	------	------	Study Point F
20	Combine	79.60	2	718	284,930	1, 3, 4,	------	------	A1-B1-B2
21	Reservoir	31.68	2	742	249,891	20	1053.50	134,240	Upstream UG Detention
22	Combine	46.56	2	728	319,824	2, 5, 21	------	------	A & B w/ Upstream Det.
23	Combine	58.73	2	728	365,599	6, 22	------	------	C w/ Upstream Det.
24	Combine	60.39	2	726	214,490	7, 8,	------	------	Study Point D
25	Combine	138.43	2	728	664,918	9, 10, 23, 24	------	------	E w/ Upstream Det.
26	Combine	144.15	2	726	684,555	11, 25	------	------	F w/ Upstream Det.

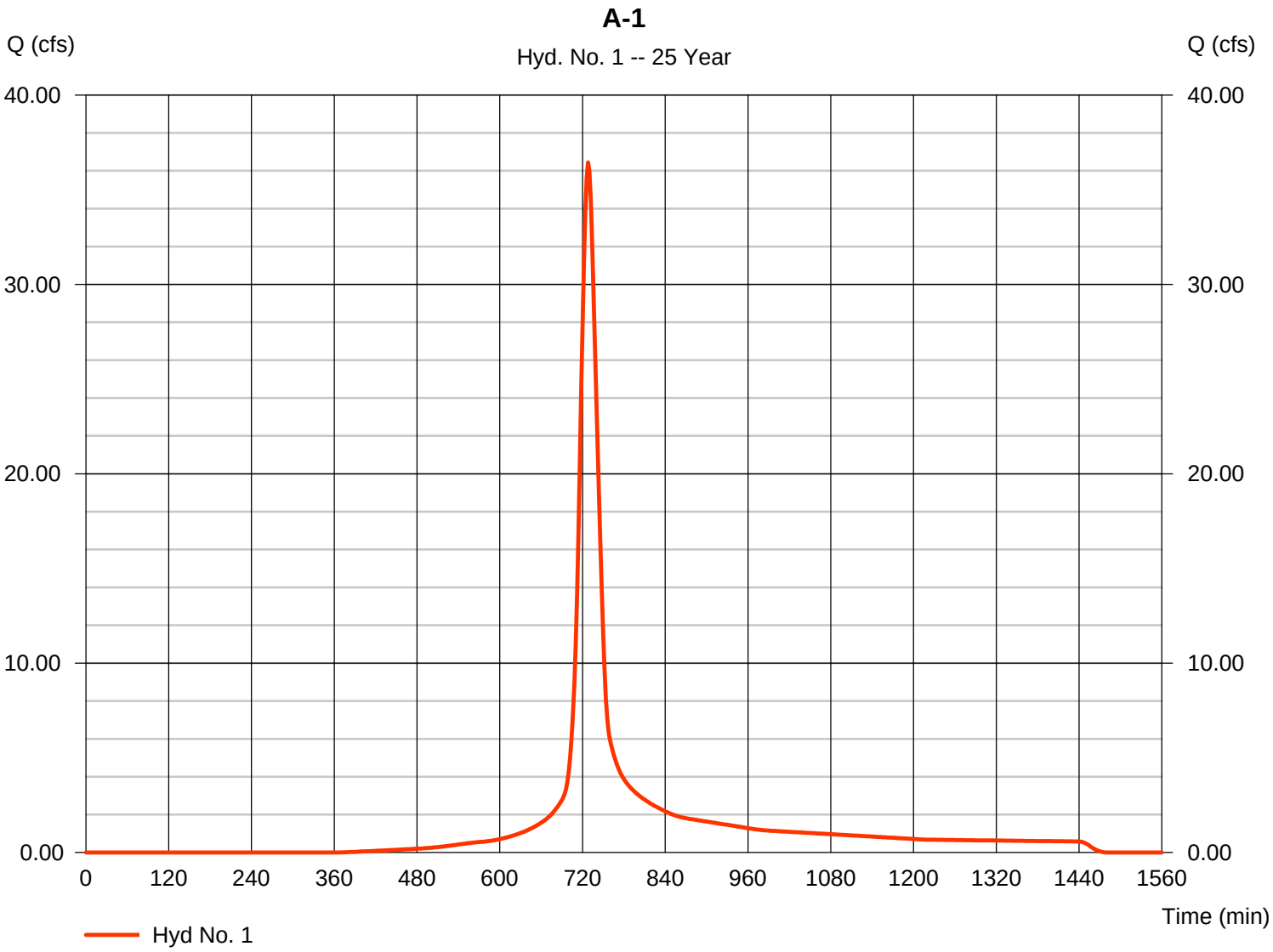
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 Tuesday, Apr 20, 2010

Hyd. No. 1

A-1

Hydrograph type	=	SCS Runoff	Peak discharge	=	36.44 cfs
Storm frequency	=	25 yrs	Time to peak	=	728 min
Time interval	=	2 min	Hyd. volume	=	134,111 cuft
Drainage area	=	8.900 ac	Curve number	=	80
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	26.53 min
Total precip.	=	6.48 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484



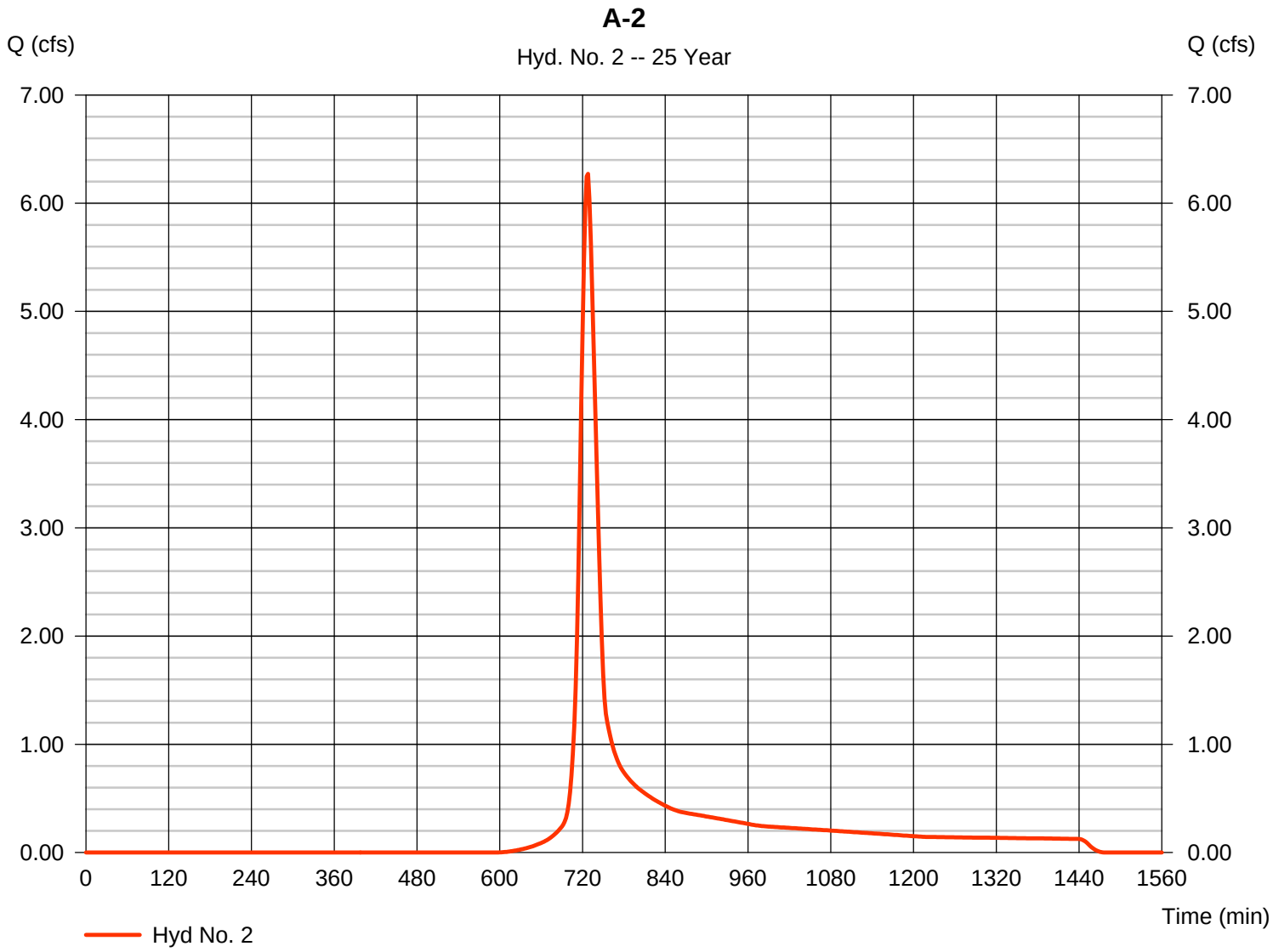
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 Tuesday, Apr 20, 2010

Hyd. No. 2

A-2

Hydrograph type	=	SCS Runoff	Peak discharge	=	6.272 cfs
Storm frequency	=	25 yrs	Time to peak	=	728 min
Time interval	=	2 min	Hyd. volume	=	22,194 cuft
Drainage area	=	2.300 ac	Curve number	=	64
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	22.18 min
Total precip.	=	6.48 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484



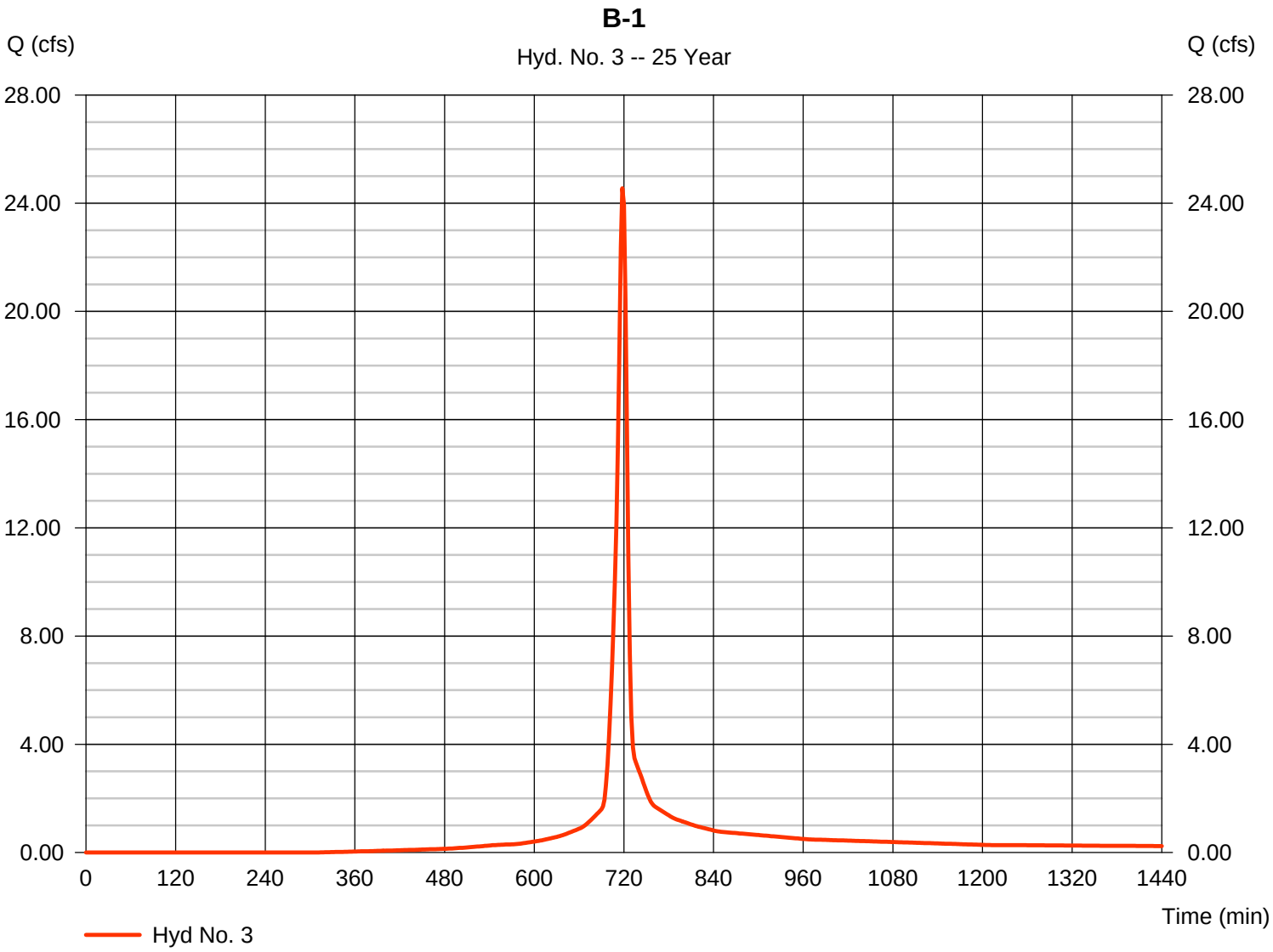
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 Tuesday, Apr 20, 2010

Hyd. No. 3

B-1

Hydrograph type	=	SCS Runoff	Peak discharge	=	24.56 cfs
Storm frequency	=	25 yrs	Time to peak	=	718 min
Time interval	=	2 min	Hyd. volume	=	57,667 cuft
Drainage area	=	3.500 ac	Curve number	=	83
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	6.85 min
Total precip.	=	6.48 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484



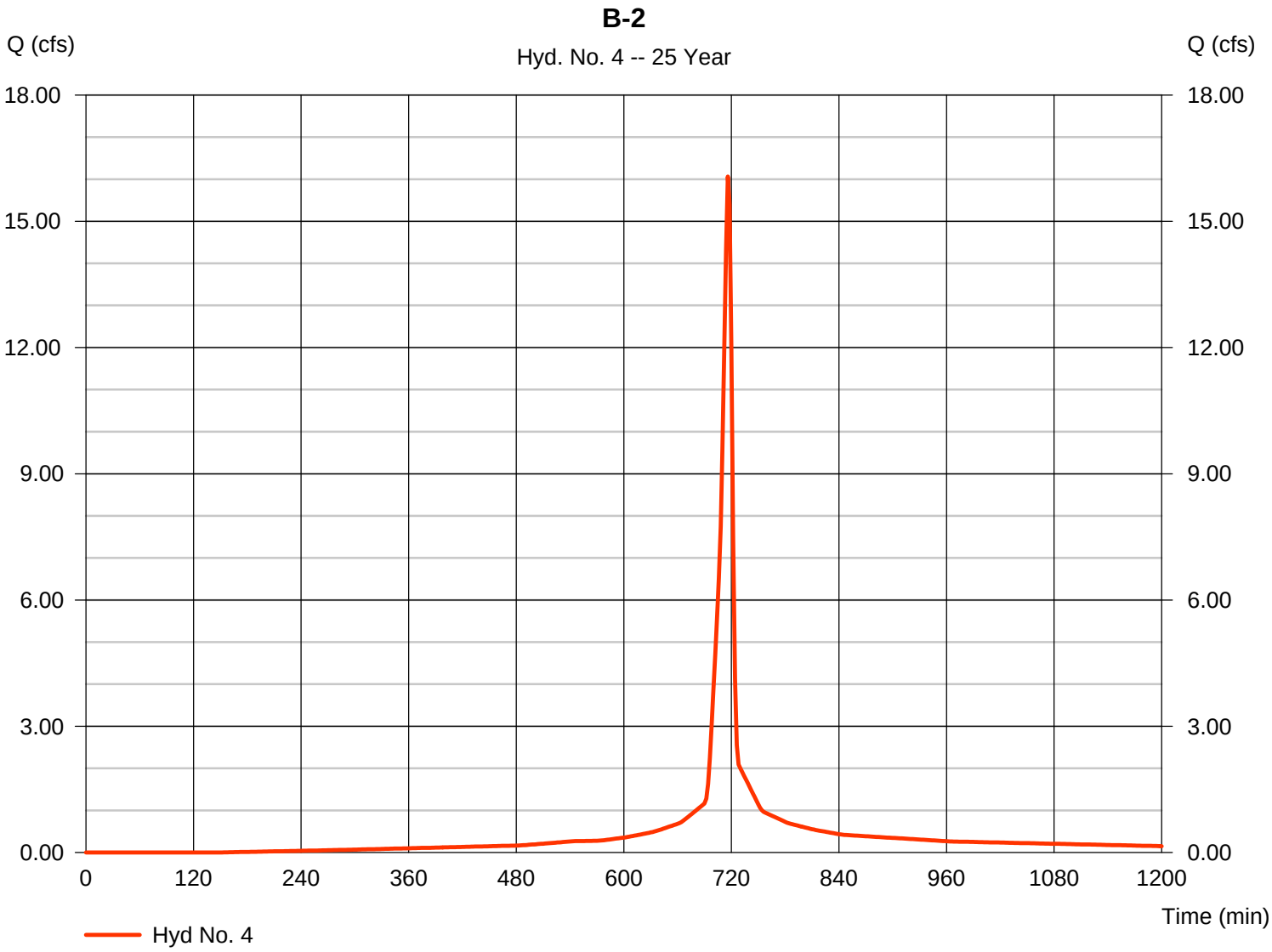
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 Tuesday, Apr 20, 2010

Hyd. No. 4

B-2

Hydrograph type	=	SCS Runoff	Peak discharge	=	16.06 cfs
Storm frequency	=	25 yrs	Time to peak	=	716 min
Time interval	=	2 min	Hyd. volume	=	35,834 cuft
Drainage area	=	1.900 ac	Curve number	=	92
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	USER	Time of conc. (Tc)	=	5.00 min
Total precip.	=	6.48 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484



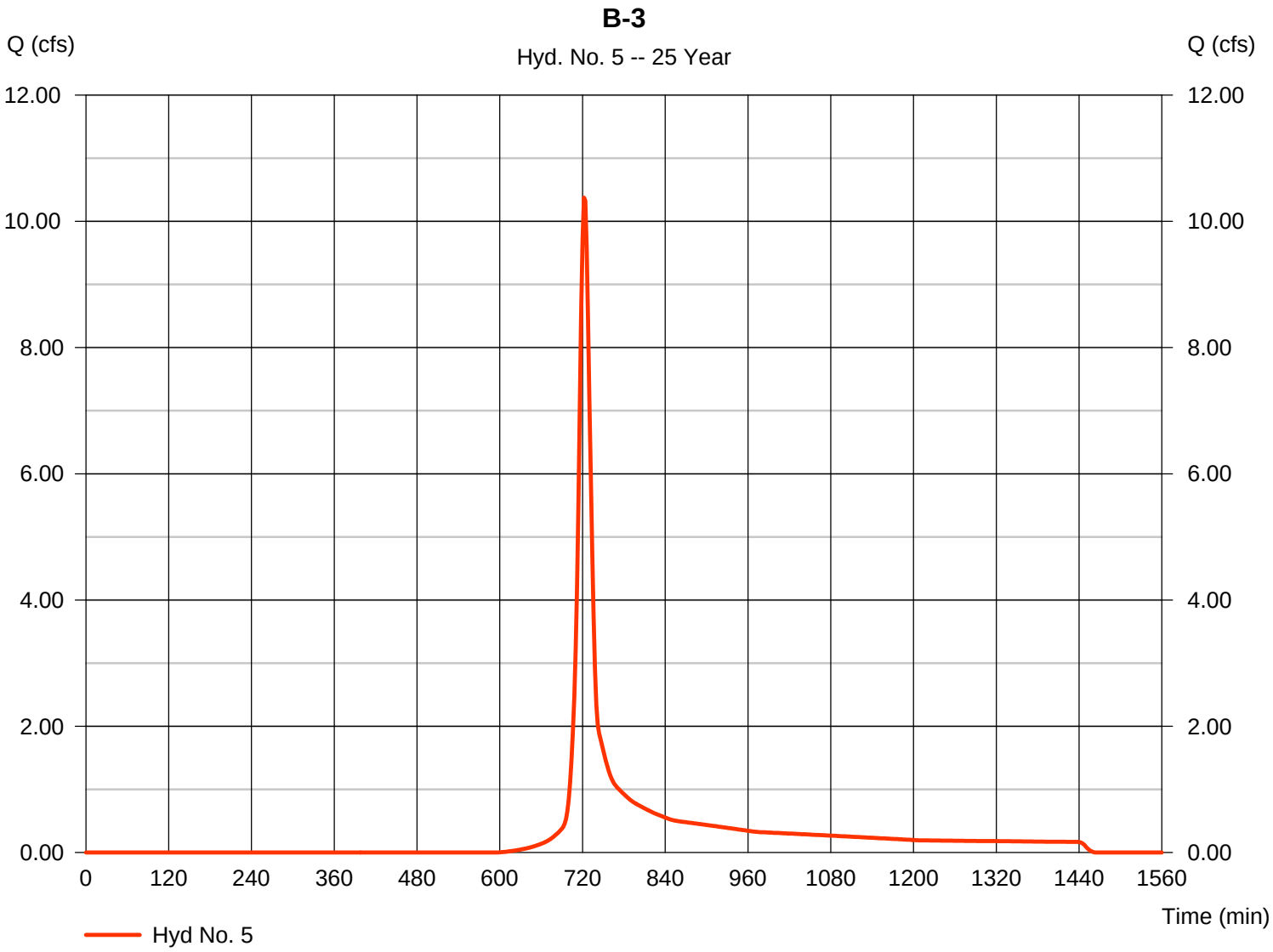
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 Tuesday, Apr 20, 2010

Hyd. No. 5

B-3

Hydrograph type	=	SCS Runoff	Peak discharge	=	10.38 cfs
Storm frequency	=	25 yrs	Time to peak	=	722 min
Time interval	=	2 min	Hyd. volume	=	29,579 cuft
Drainage area	=	3.200 ac	Curve number	=	64
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	14.70 min
Total precip.	=	6.48 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484



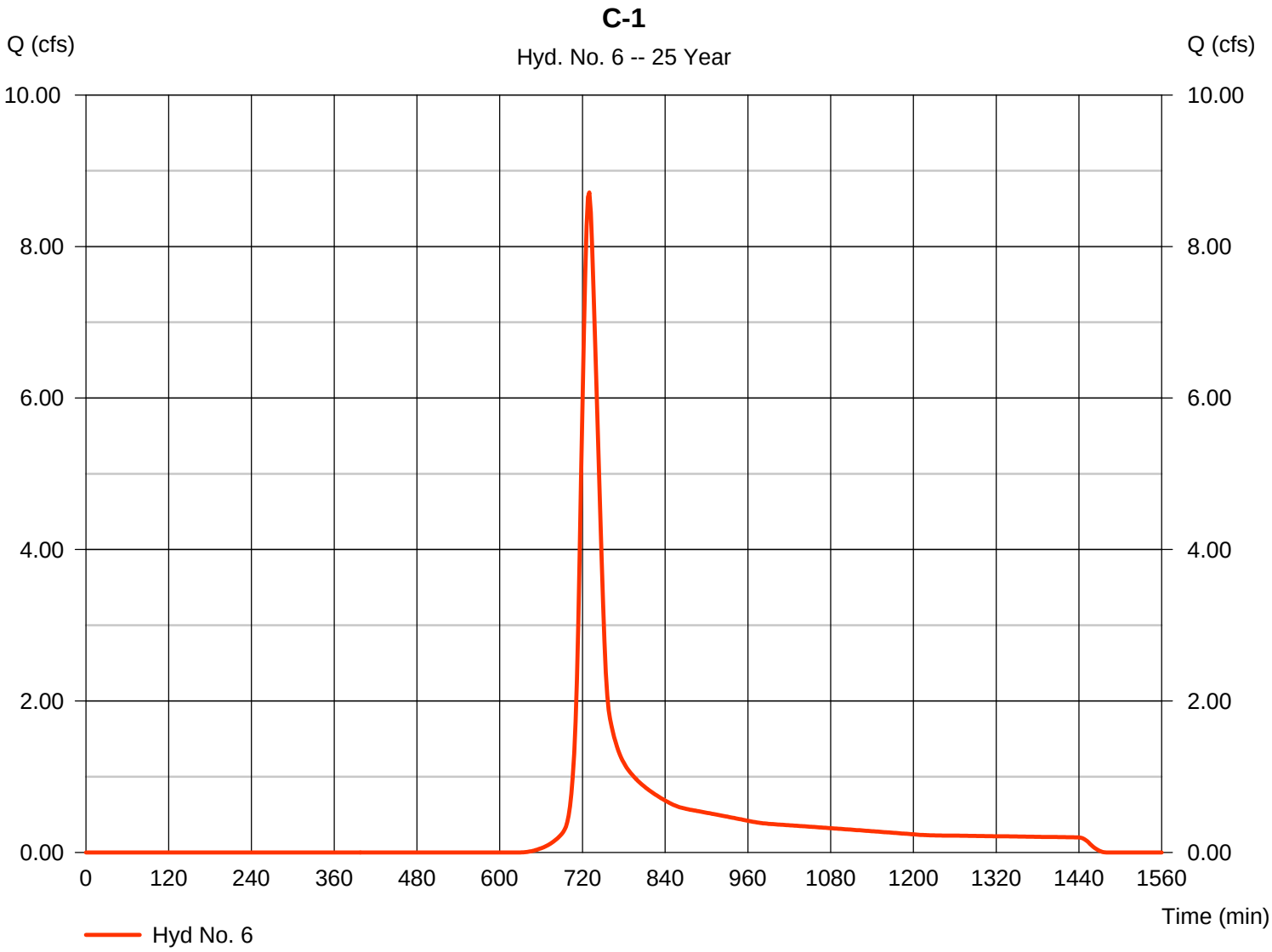
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 Tuesday, Apr 20, 2010

Hyd. No. 6

C-1

Hydrograph type	=	SCS Runoff	Peak discharge	=	8.712 cfs
Storm frequency	=	25 yrs	Time to peak	=	730 min
Time interval	=	2 min	Hyd. volume	=	33,350 cuft
Drainage area	=	4.000 ac	Curve number	=	61
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	25.49 min
Total precip.	=	6.48 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484



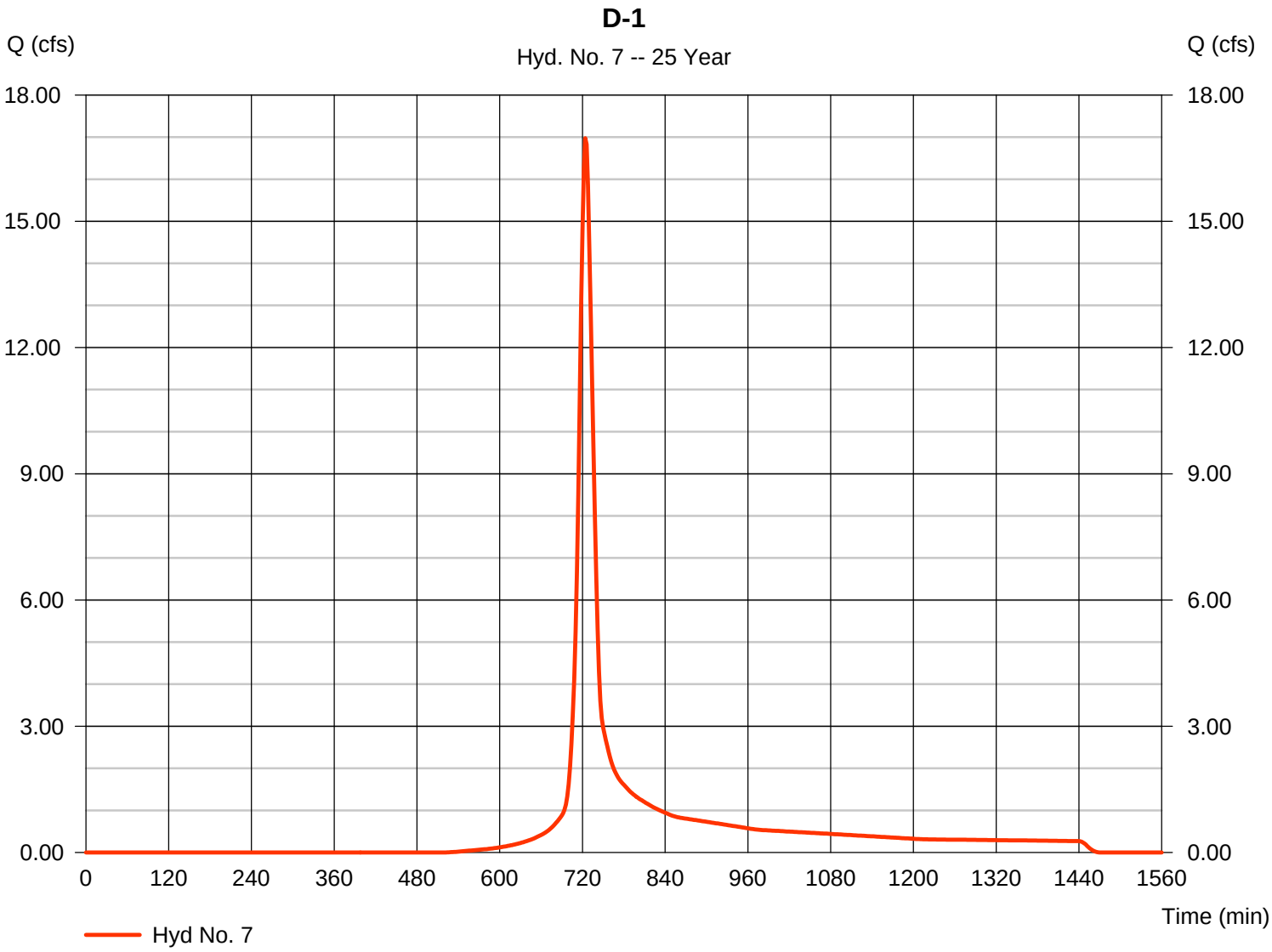
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 Tuesday, Apr 20, 2010

Hyd. No. 7

D-1

Hydrograph type	=	SCS Runoff	Peak discharge	=	16.97 cfs
Storm frequency	=	25 yrs	Time to peak	=	724 min
Time interval	=	2 min	Hyd. volume	=	53,280 cuft
Drainage area	=	4.600 ac	Curve number	=	70
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	18.40 min
Total precip.	=	6.48 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484



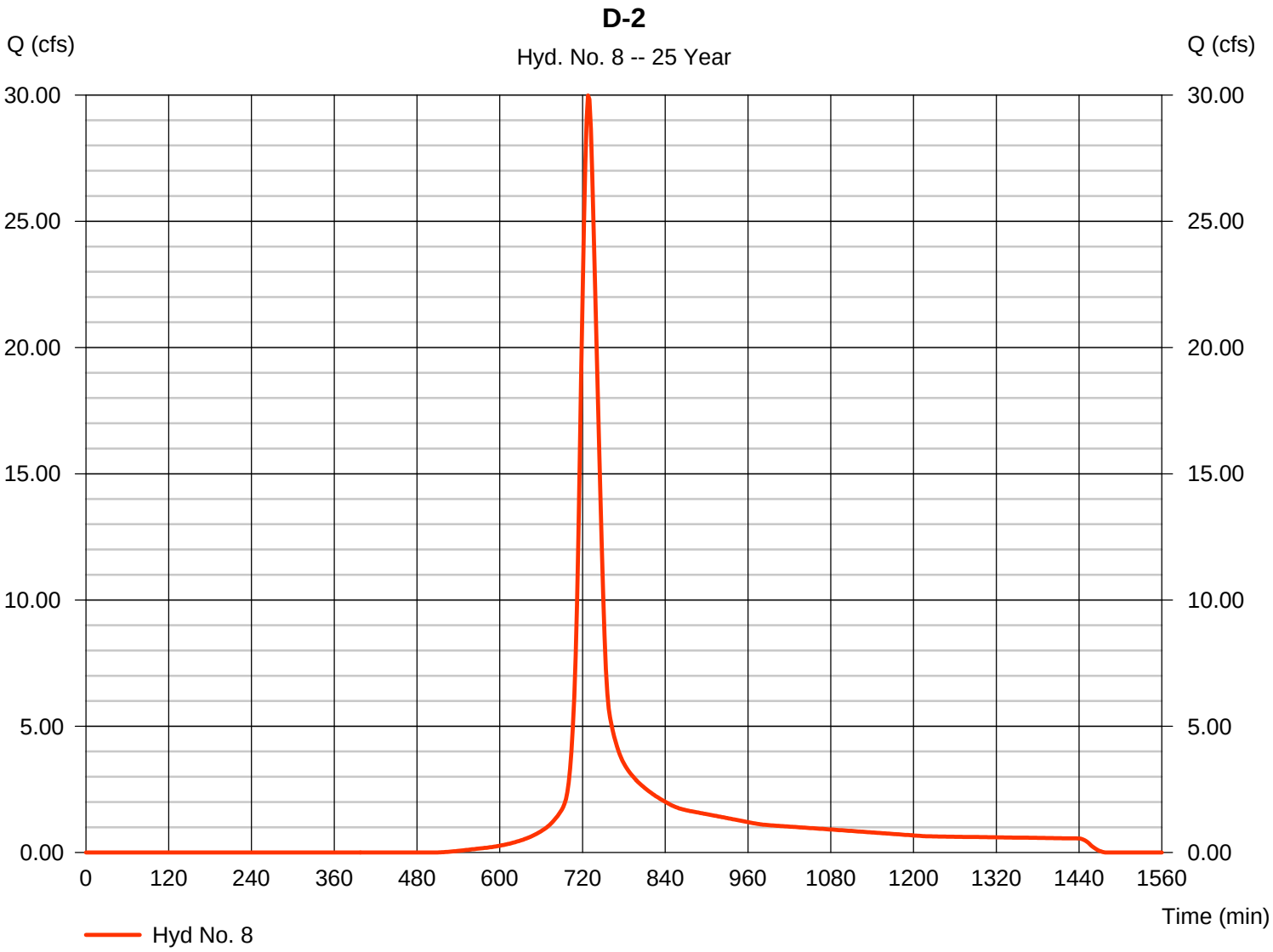
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 Tuesday, Apr 20, 2010

Hyd. No. 8

D-2

Hydrograph type	=	SCS Runoff	Peak discharge	=	29.98 cfs
Storm frequency	=	25 yrs	Time to peak	=	728 min
Time interval	=	2 min	Hyd. volume	=	110,511 cuft
Drainage area	=	9.400 ac	Curve number	=	71
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	24.40 min
Total precip.	=	6.48 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484



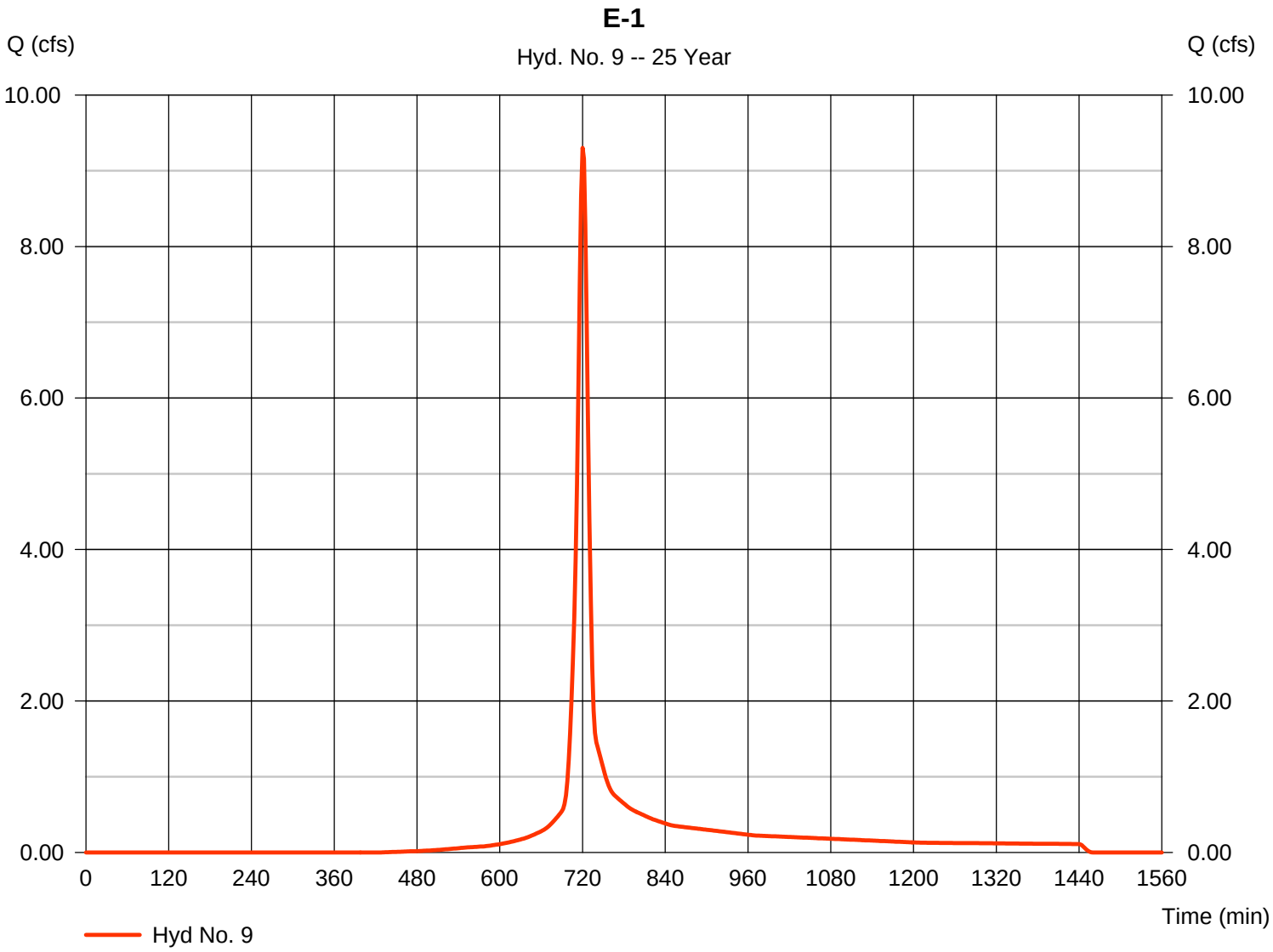
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 Tuesday, Apr 20, 2010

Hyd. No. 9

E-1

Hydrograph type	=	SCS Runoff	Peak discharge	=	9.303 cfs
Storm frequency	=	25 yrs	Time to peak	=	720 min
Time interval	=	2 min	Hyd. volume	=	24,169 cuft
Drainage area	=	1.700 ac	Curve number	=	76
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	13.00 min
Total precip.	=	6.48 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484



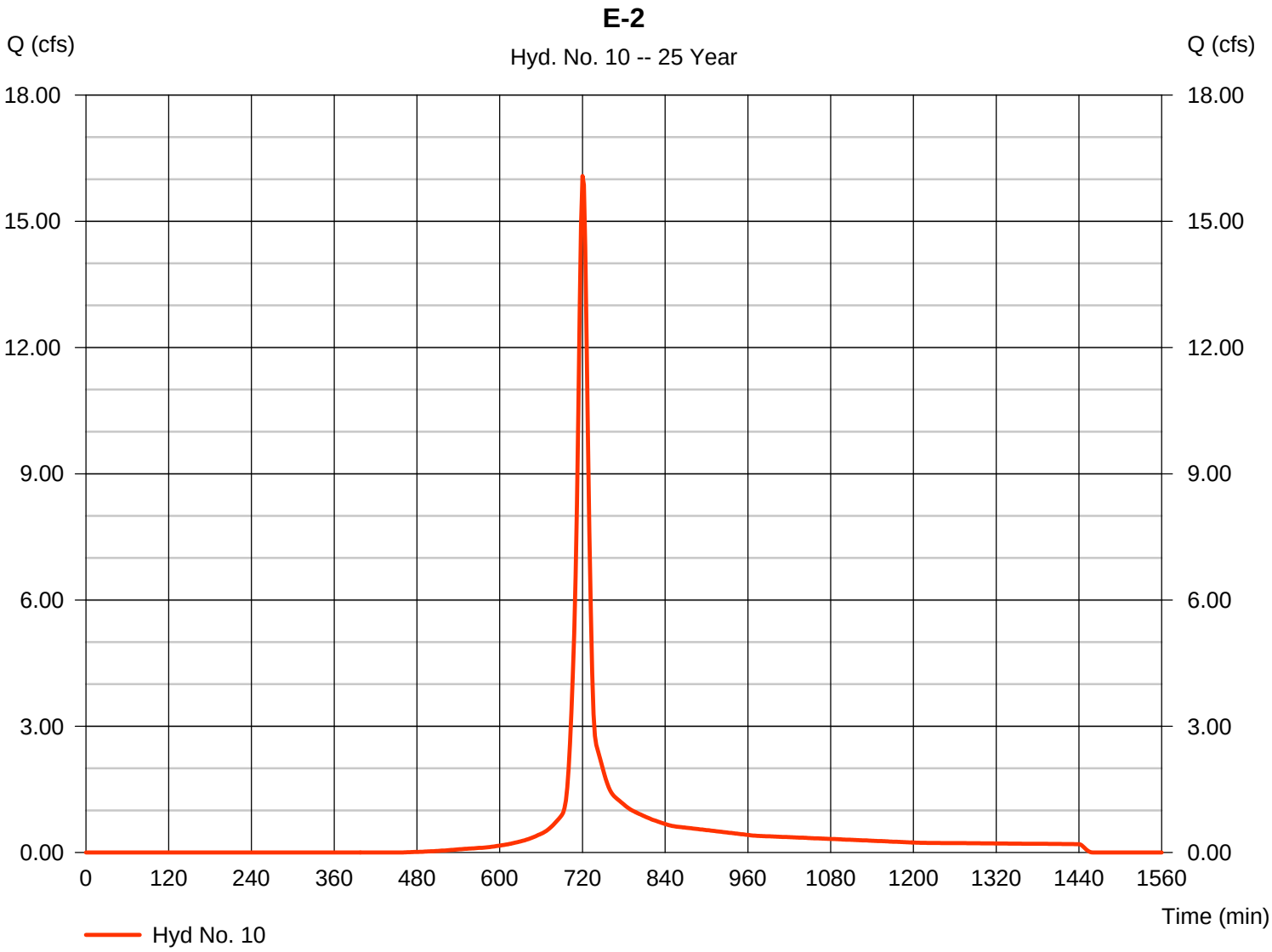
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 Tuesday, Apr 20, 2010

Hyd. No. 10

E-2

Hydrograph type	=	SCS Runoff	Peak discharge	=	16.07 cfs
Storm frequency	=	25 yrs	Time to peak	=	720 min
Time interval	=	2 min	Hyd. volume	=	41,690 cuft
Drainage area	=	3.100 ac	Curve number	=	74
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	11.16 min
Total precip.	=	6.48 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

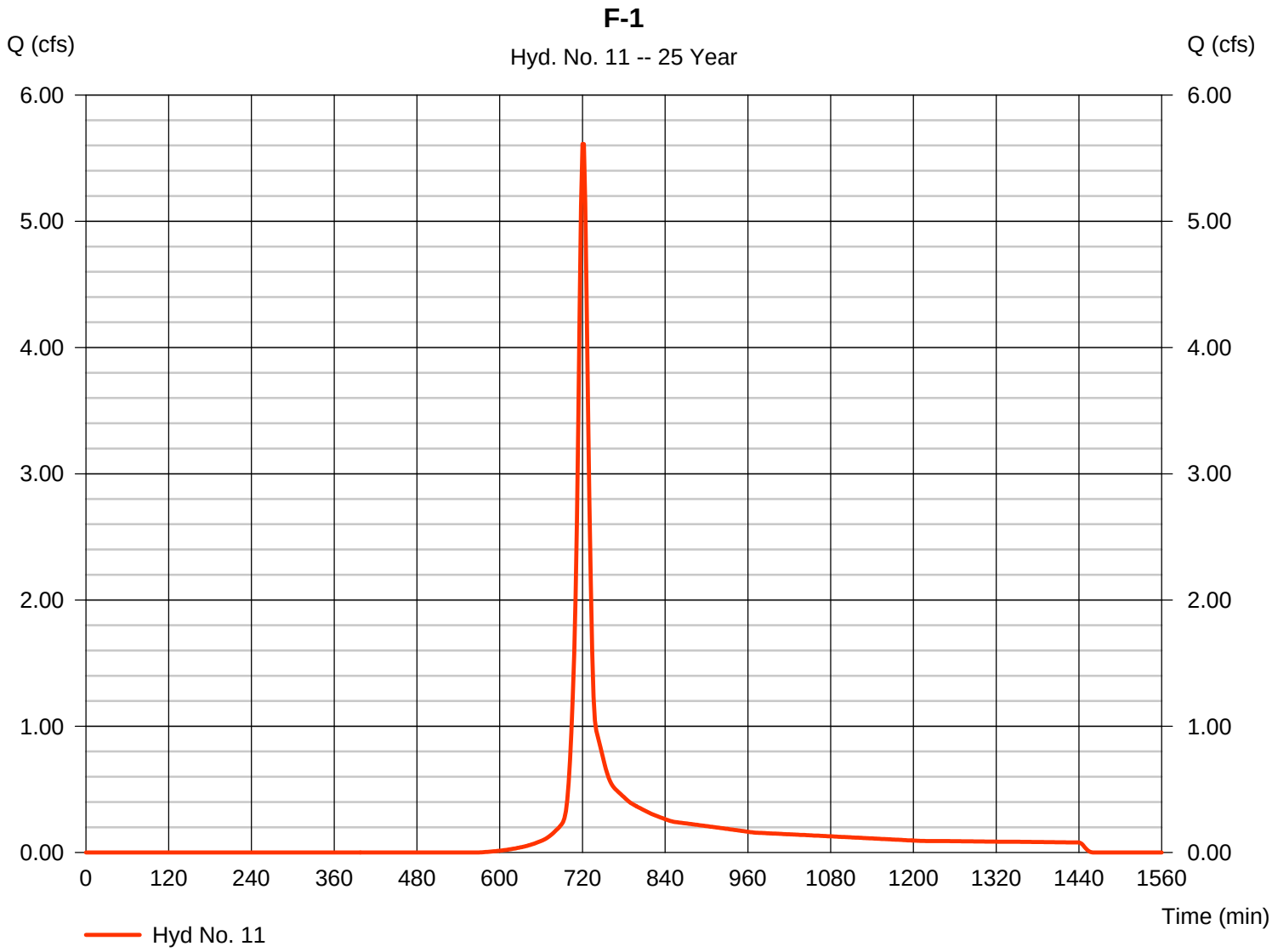


Hydrograph Report

Hyd. No. 11

F-1

Hydrograph type	=	SCS Runoff	Peak discharge	=	5.613 cfs
Storm frequency	=	25 yrs	Time to peak	=	720 min
Time interval	=	2 min	Hyd. volume	=	14,682 cuft
Drainage area	=	1.400 ac	Curve number	=	66
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	11.70 min
Total precip.	=	6.48 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484



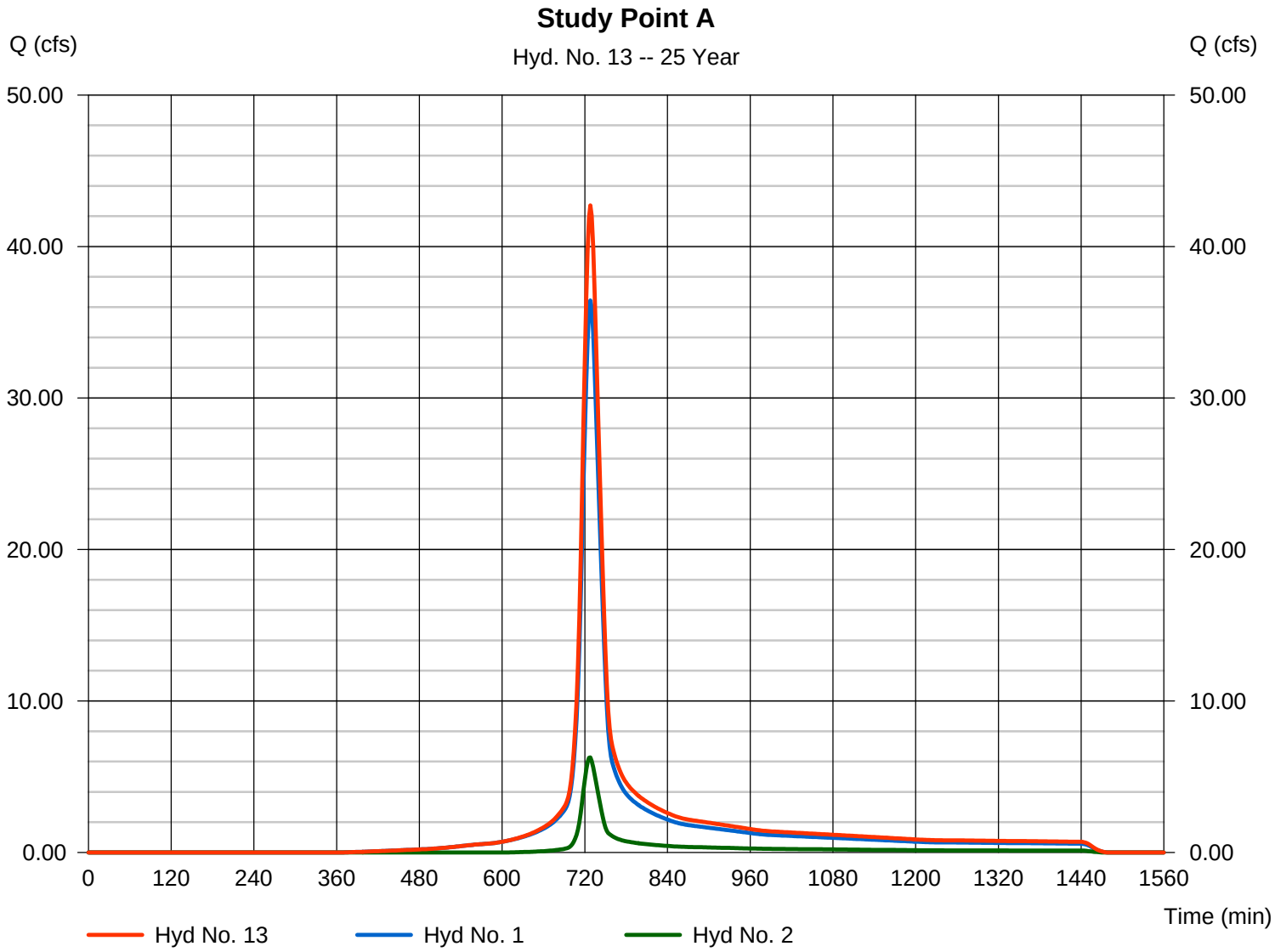
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 Tuesday, Apr 20, 2010

Hyd. No. 13

Study Point A

Hydrograph type	=	Combine	Peak discharge	=	42.71 cfs
Storm frequency	=	25 yrs	Time to peak	=	728 min
Time interval	=	2 min	Hyd. volume	=	156,305 cuft
Inflow hyds.	=	1, 2	Contrib. drain. area	=	11.200 ac



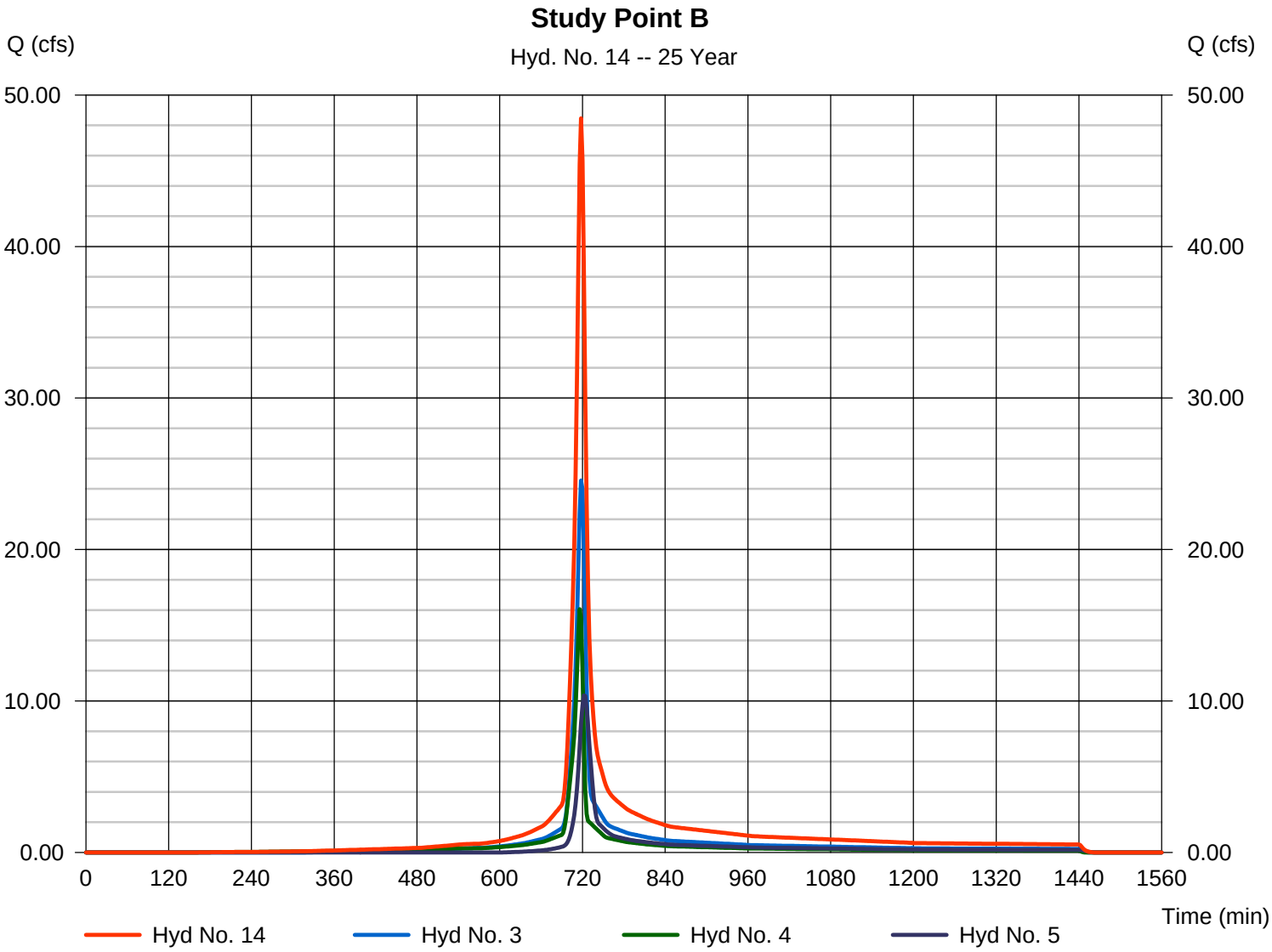
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 Tuesday, Apr 20, 2010

Hyd. No. 14

Study Point B

Hydrograph type	=	Combine	Peak discharge	=	48.46 cfs
Storm frequency	=	25 yrs	Time to peak	=	718 min
Time interval	=	2 min	Hyd. volume	=	123,079 cuft
Inflow hyds.	=	3, 4, 5	Contrib. drain. area	=	8.600 ac

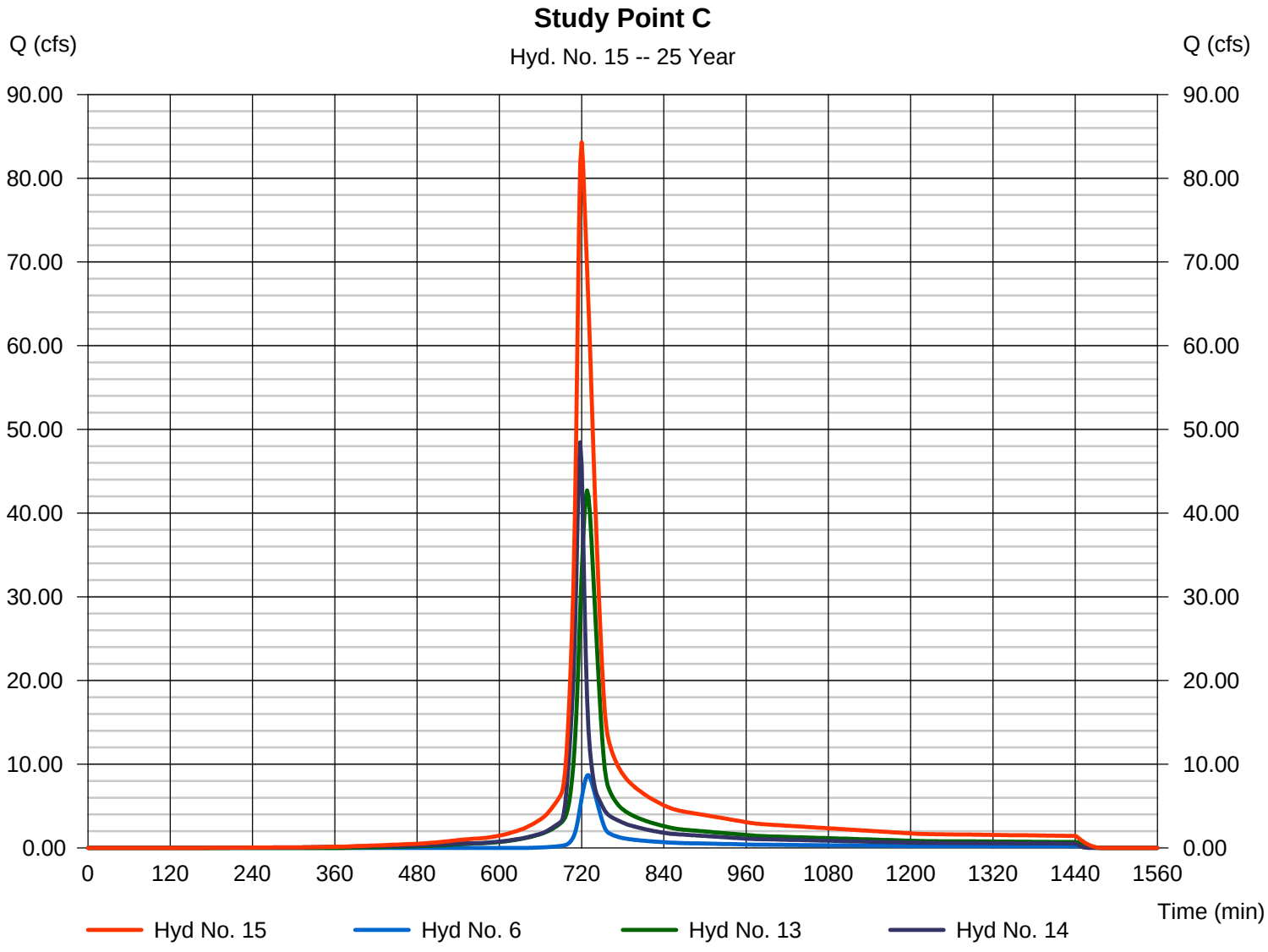


Hydrograph Report

Hyd. No. 15

Study Point C

Hydrograph type	=	Combine	Peak discharge	=	84.29 cfs
Storm frequency	=	25 yrs	Time to peak	=	720 min
Time interval	=	2 min	Hyd. volume	=	312,733 cuft
Inflow hyds.	=	6, 13, 14	Contrib. drain. area	=	4.000 ac



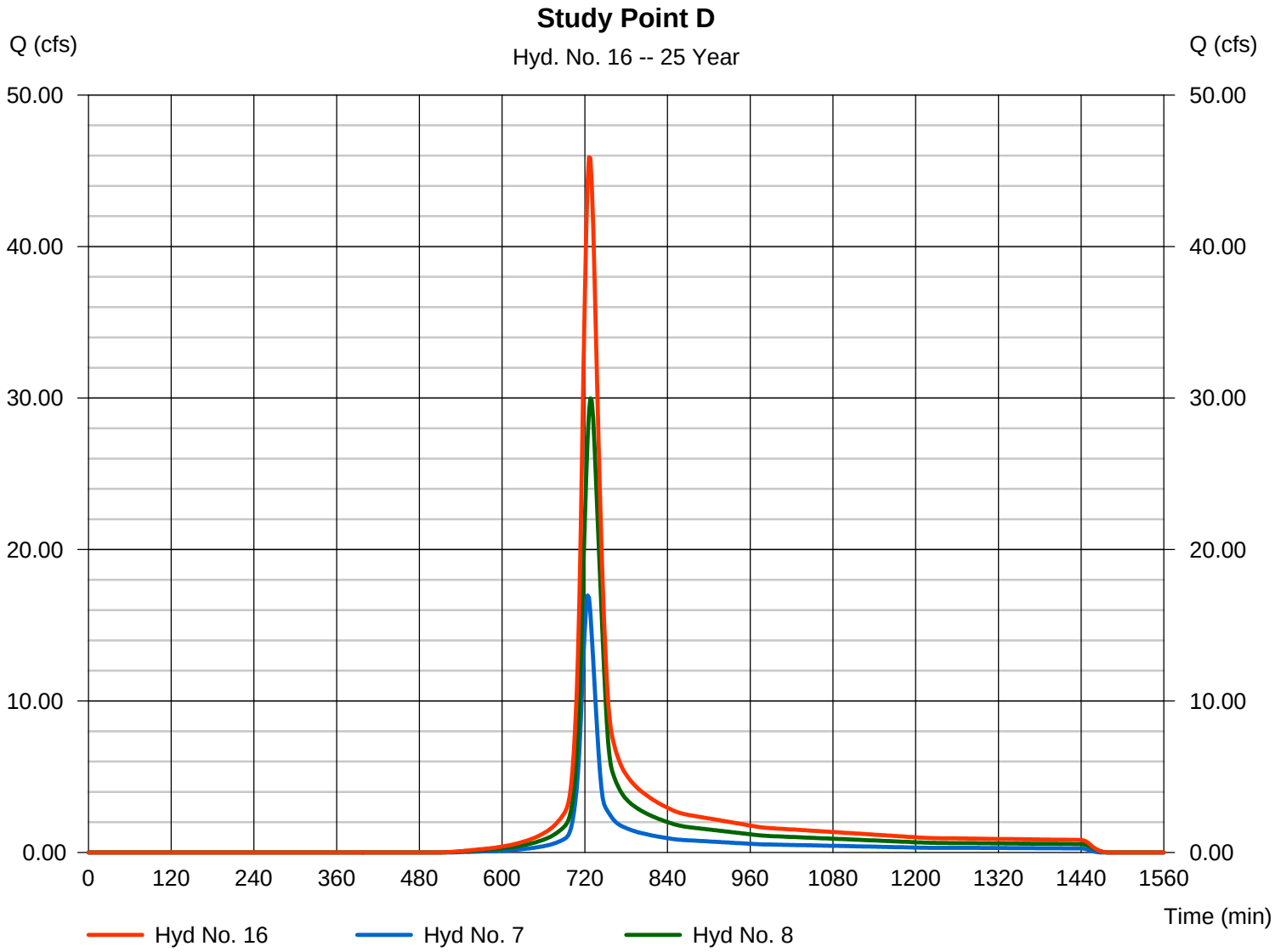
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 Tuesday, Apr 20, 2010

Hyd. No. 16

Study Point D

Hydrograph type	=	Combine	Peak discharge	=	45.89 cfs
Storm frequency	=	25 yrs	Time to peak	=	726 min
Time interval	=	2 min	Hyd. volume	=	163,791 cuft
Inflow hyds.	=	7, 8	Contrib. drain. area	=	14.000 ac



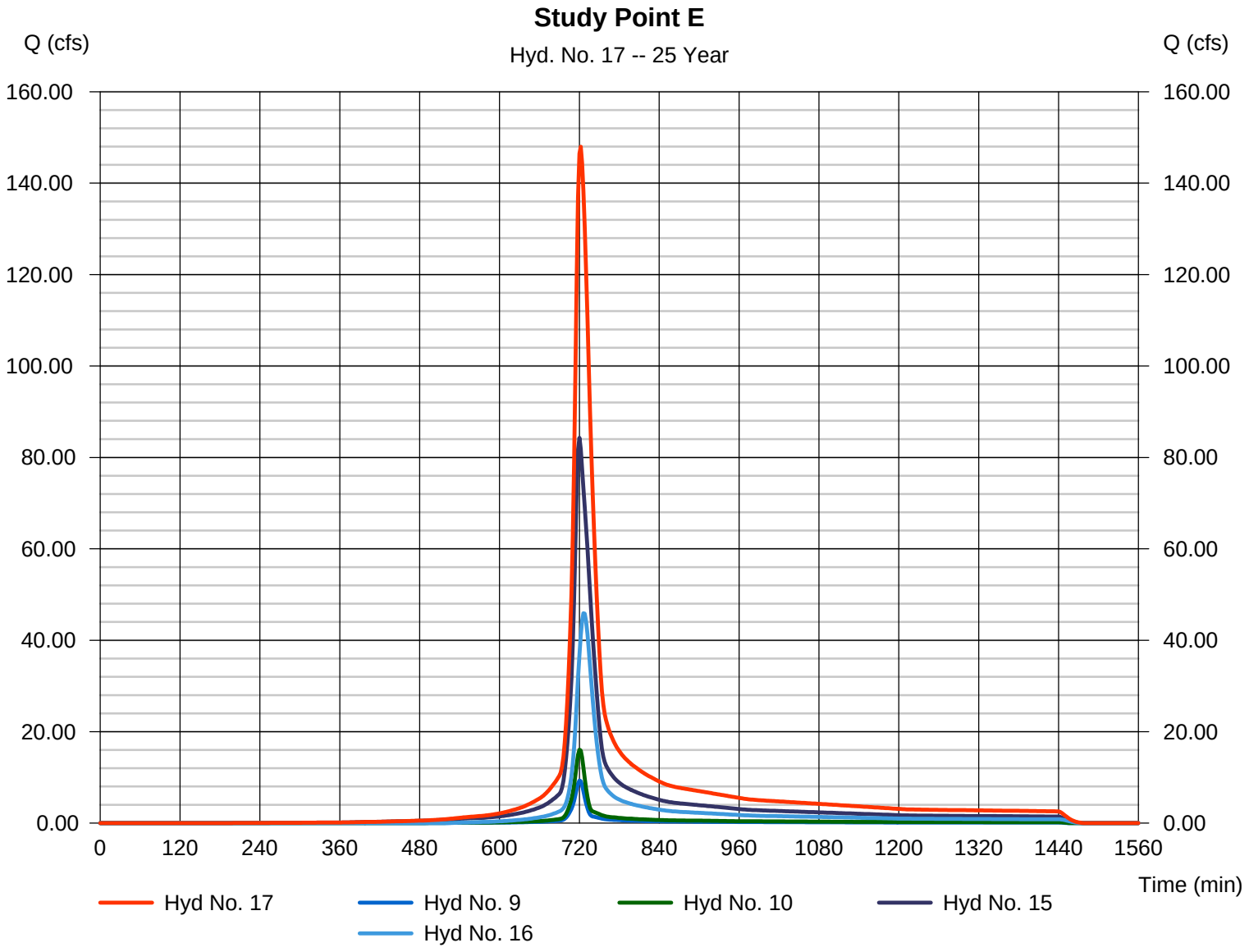
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 Tuesday, Apr 20, 2010

Hyd. No. 17

Study Point E

Hydrograph type	=	Combine	Peak discharge	=	147.97 cfs
Storm frequency	=	25 yrs	Time to peak	=	722 min
Time interval	=	2 min	Hyd. volume	=	542,383 cuft
Inflow hyds.	=	9, 10, 15, 16	Contrib. drain. area	=	4.800 ac



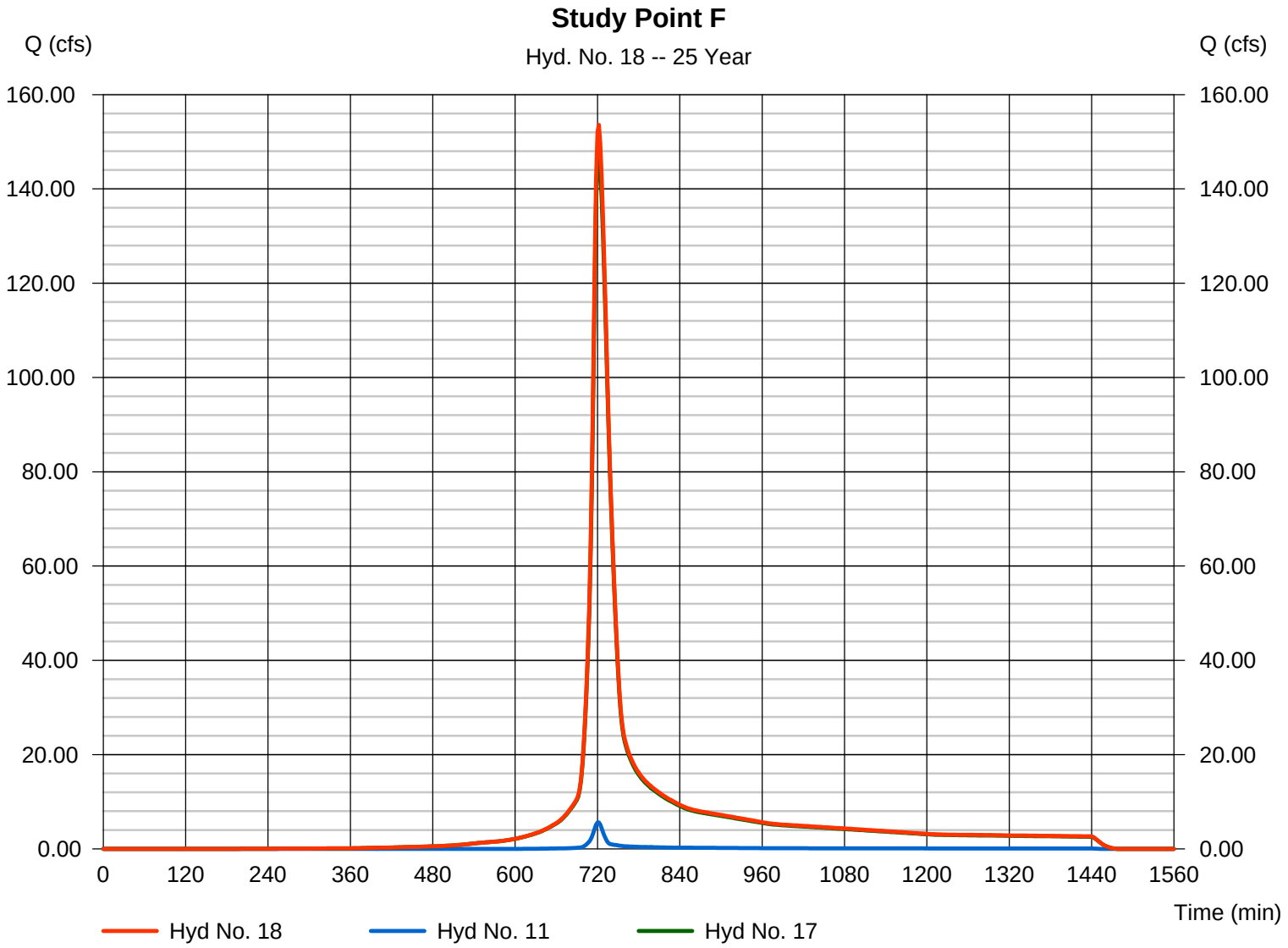
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 Tuesday, Apr 20, 2010

Hyd. No. 18

Study Point F

Hydrograph type	=	Combine	Peak discharge	=	153.58 cfs
Storm frequency	=	25 yrs	Time to peak	=	722 min
Time interval	=	2 min	Hyd. volume	=	557,065 cuft
Inflow hyds.	=	11, 17	Contrib. drain. area	=	1.400 ac



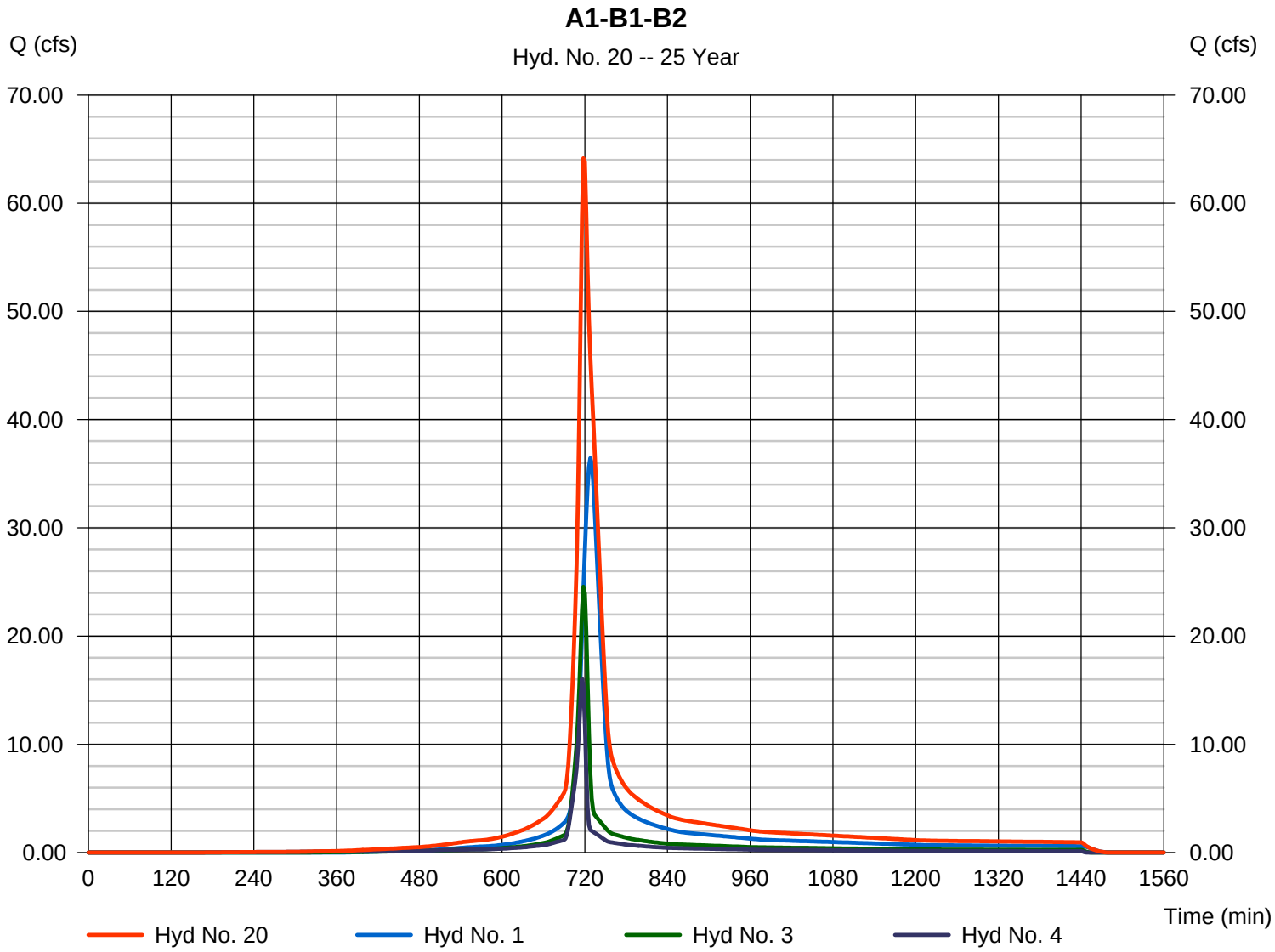
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 Tuesday, Apr 20, 2010

Hyd. No. 20

A1-B1-B2

Hydrograph type	=	Combine	Peak discharge	=	64.15 cfs
Storm frequency	=	25 yrs	Time to peak	=	718 min
Time interval	=	2 min	Hyd. volume	=	227,611 cuft
Inflow hyds.	=	1, 3, 4	Contrib. drain. area	=	14.300 ac



Hydrograph Report

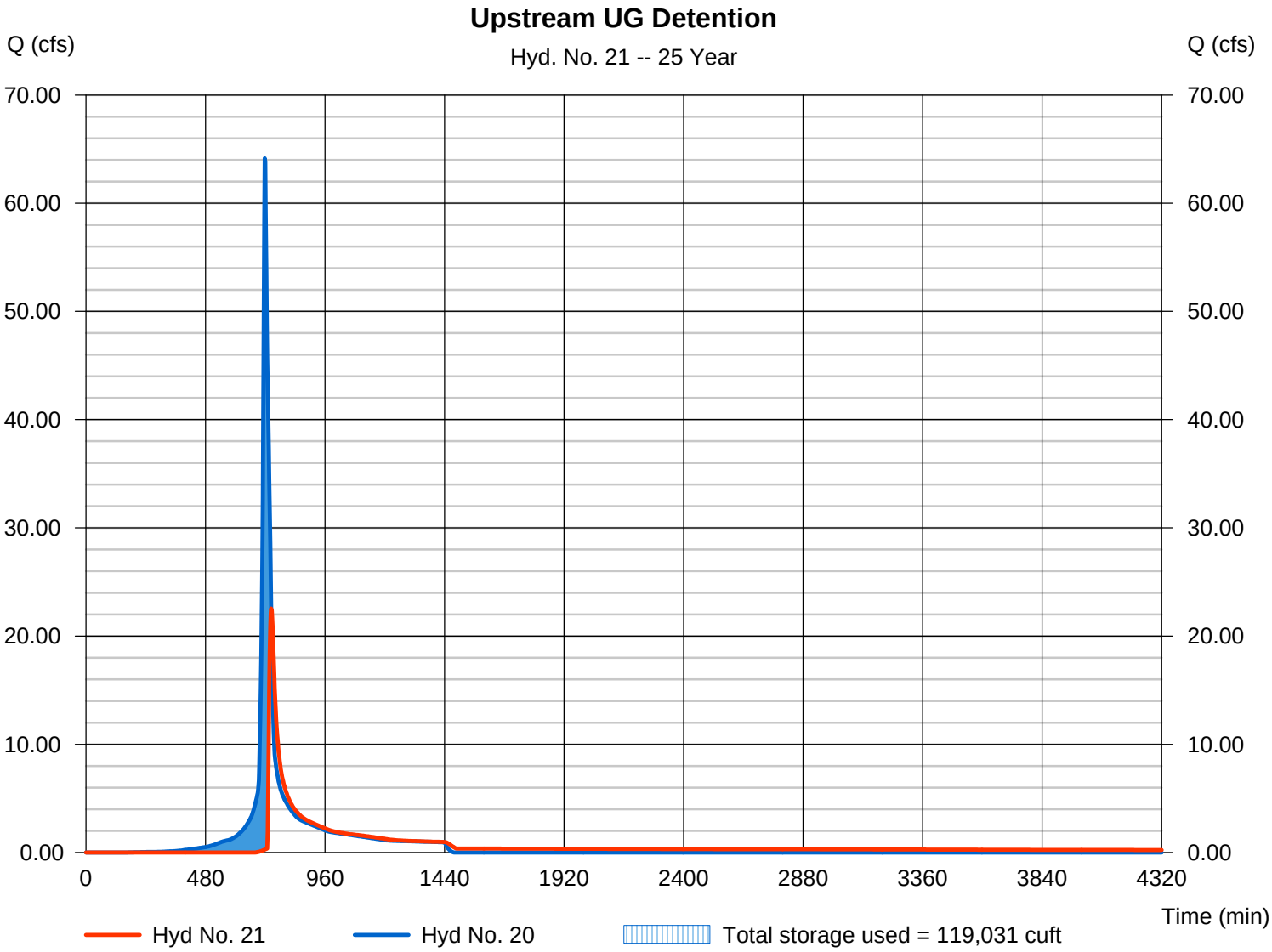
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 Tuesday, Apr 20, 2010

Hyd. No. 21

Upstream UG Detention

Hydrograph type	=	Reservoir	Peak discharge	=	22.56 cfs
Storm frequency	=	25 yrs	Time to peak	=	744 min
Time interval	=	2 min	Hyd. volume	=	192,630 cuft
Inflow hyd. No.	=	20 - A1-B1-B2	Max. Elevation	=	1052.66 ft
Reservoir name	=	UG HDPE	Max. Storage	=	119,031 cuft

Storage Indication method used.



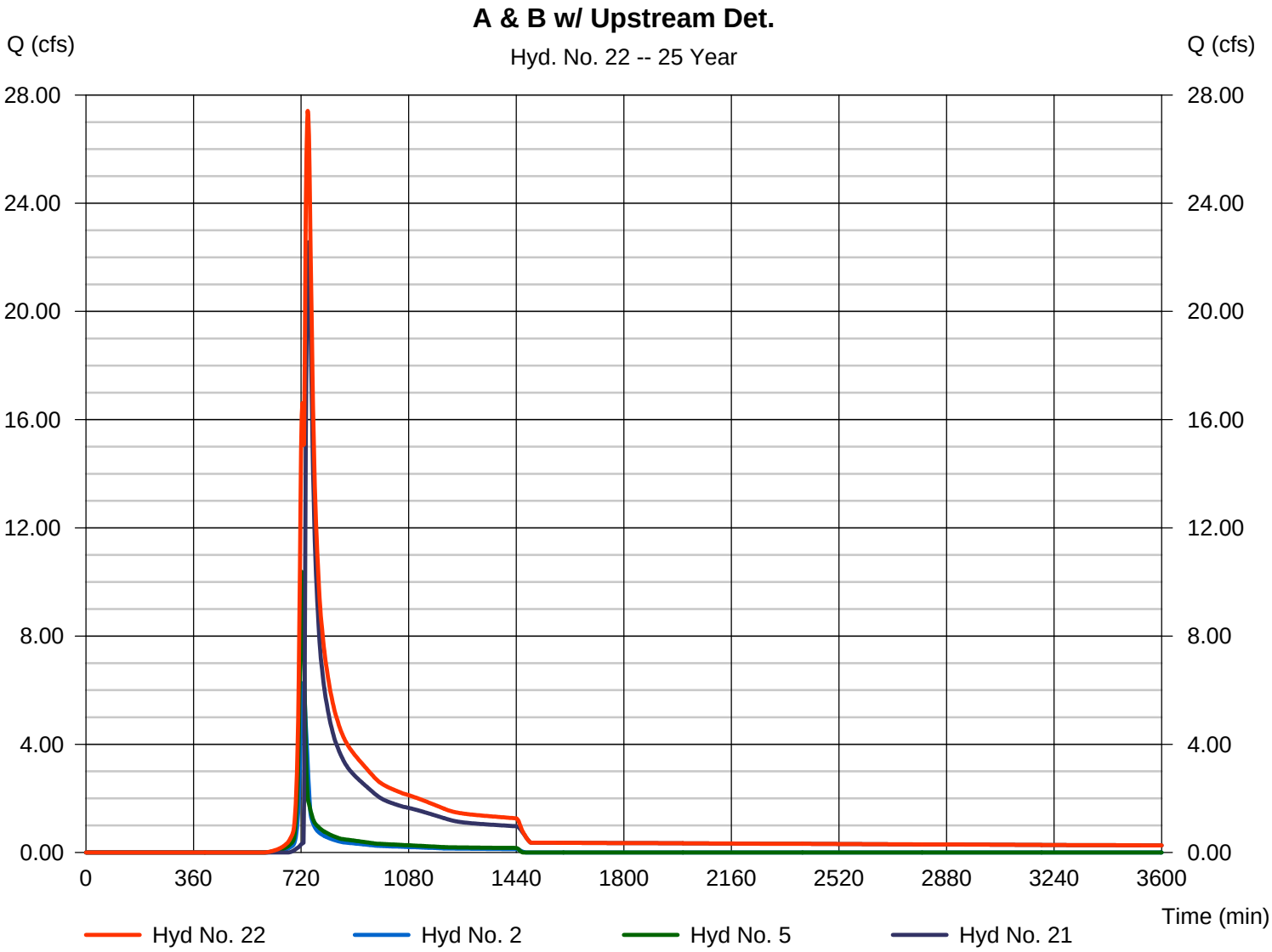
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 Tuesday, Apr 20, 2010

Hyd. No. 22

A & B w/ Upstream Det.

Hydrograph type	=	Combine	Peak discharge	=	27.41 cfs
Storm frequency	=	25 yrs	Time to peak	=	742 min
Time interval	=	2 min	Hyd. volume	=	244,403 cuft
Inflow hyds.	=	2, 5, 21	Contrib. drain. area	=	5.500 ac



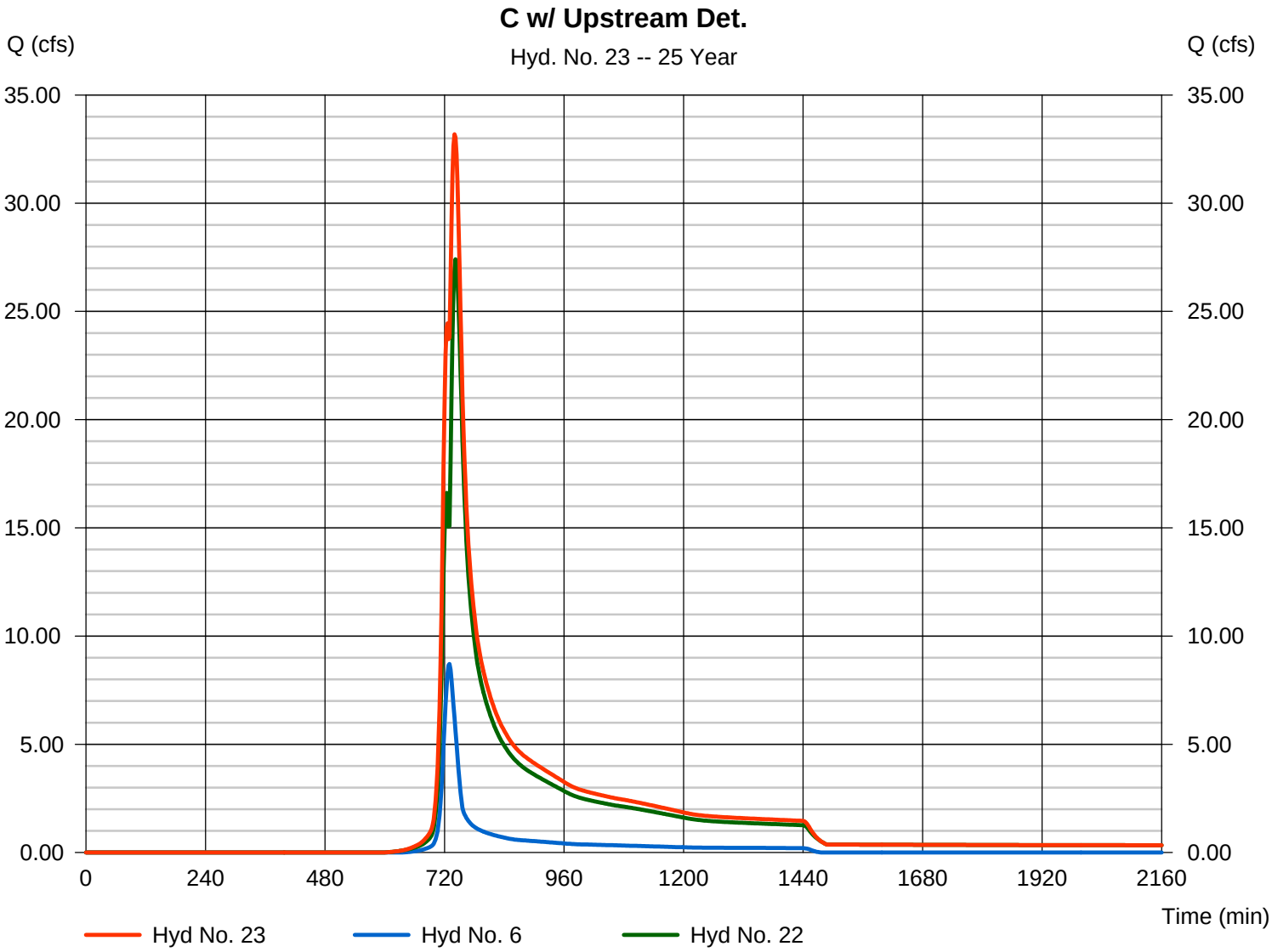
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 Tuesday, Apr 20, 2010

Hyd. No. 23

C w/ Upstream Det.

Hydrograph type	=	Combine	Peak discharge	=	33.19 cfs
Storm frequency	=	25 yrs	Time to peak	=	740 min
Time interval	=	2 min	Hyd. volume	=	277,753 cuft
Inflow hyds.	=	6, 22	Contrib. drain. area	=	4.000 ac



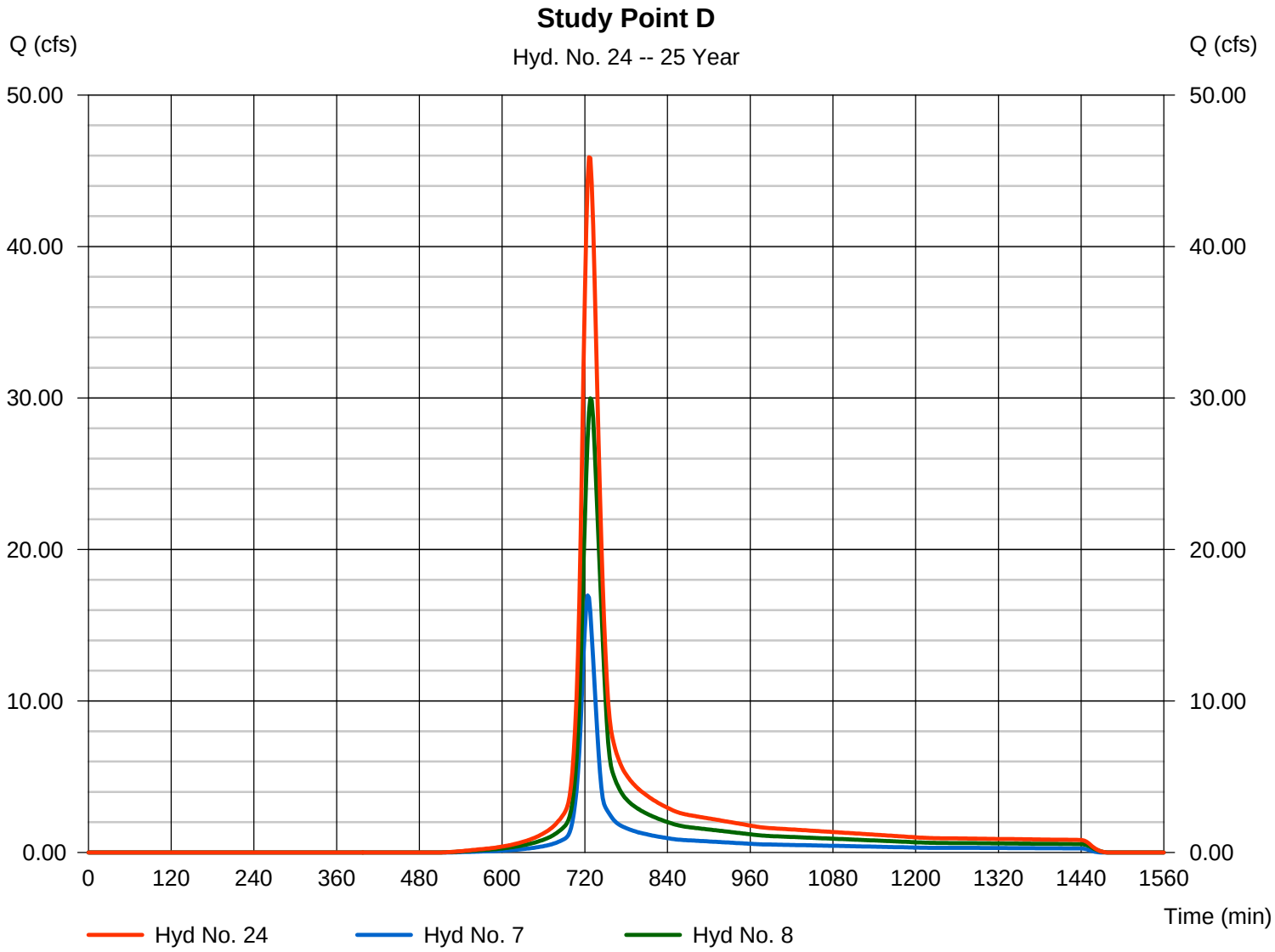
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 Tuesday, Apr 20, 2010

Hyd. No. 24

Study Point D

Hydrograph type	=	Combine	Peak discharge	=	45.89 cfs
Storm frequency	=	25 yrs	Time to peak	=	726 min
Time interval	=	2 min	Hyd. volume	=	163,791 cuft
Inflow hyds.	=	7, 8	Contrib. drain. area	=	14.000 ac



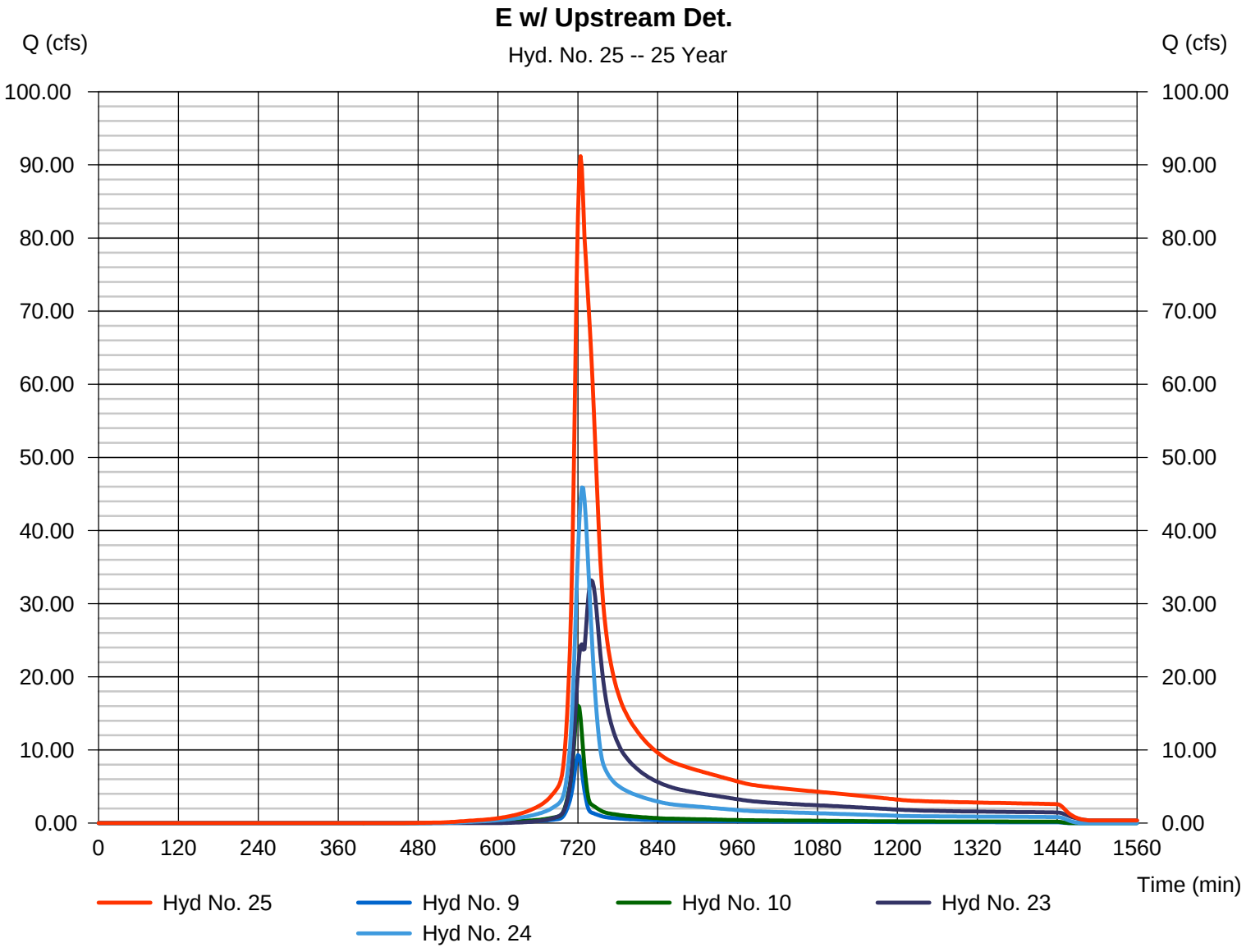
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 Tuesday, Apr 20, 2010

Hyd. No. 25

E w/ Upstream Det.

Hydrograph type	=	Combine	Peak discharge	=	91.20 cfs
Storm frequency	=	25 yrs	Time to peak	=	724 min
Time interval	=	2 min	Hyd. volume	=	507,402 cuft
Inflow hyds.	=	9, 10, 23, 24	Contrib. drain. area	=	4.800 ac



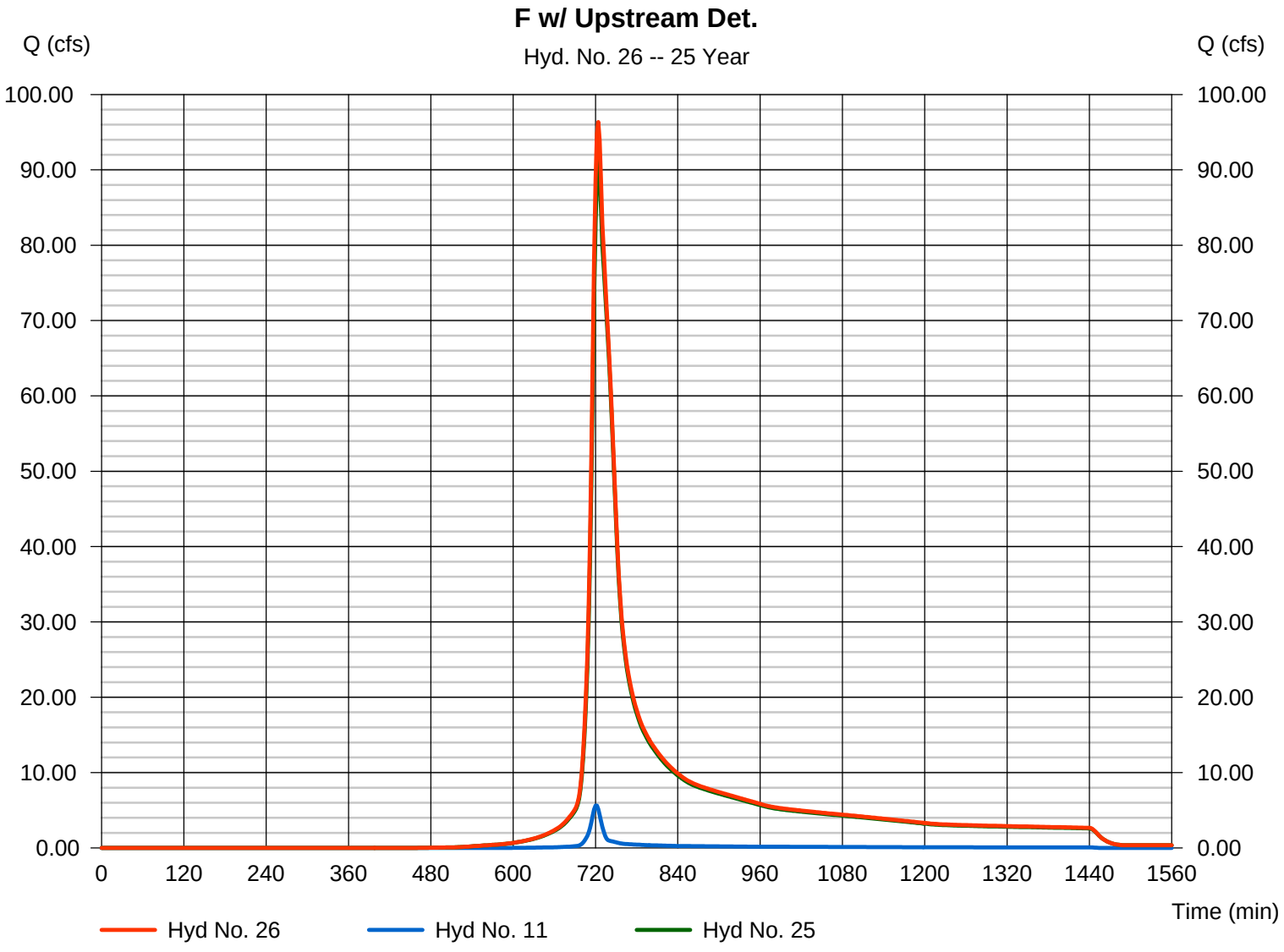
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 Tuesday, Apr 20, 2010

Hyd. No. 26

F w/ Upstream Det.

Hydrograph type	=	Combine	Peak discharge	=	96.34 cfs
Storm frequency	=	25 yrs	Time to peak	=	724 min
Time interval	=	2 min	Hyd. volume	=	522,084 cuft
Inflow hyds.	=	11, 25	Contrib. drain. area	=	1.400 ac



COST ESTIMATES

PRELIMINARY COST ESTIMATE

REPLACE UNDERSIZED PIPES				
Description	**Quantity**	**Units**	**Unit Price**	**Total Price**
Demo/Remove Existing Pipes	641	LF	$ 16	$ 10,256
Install 30" HDPE	159	LF	$ 55	$ 8,745
Install 36" HDPE	445	LF	$ 60	$ 26,700
Remove Existing Structures	8	EA	$ 500	$ 4,000
Pedestal Drop Inlet	2	EA	$ 1,500	$ 3,000
Catch Basin	3	EA	$ 1,500	$ 4,500
Headwall	2	EA	$ 750	$ 1,500
Install Curb & Gutter	292	LF	$ 11	$ 3,212
Excavation/Grading	1	LS	$ 4,000	$ 4,000
Erosion Control	1	LS	$ 5,000	$ 5,000
Permanent Grassing	1342	SY	$ 2.80	$ 3,758
TOTAL				**$ 74,671**

PRELIMINARY COST ESTIMATE

INSTALL CATCH BASINS				
Description	**Quantity**	**Units**	**Unit Price**	**Total Price**
Demo/Remove existing concrete & asphalt	1	LS	$ 2,000.00	$ 2,000
Excavation/Grading	1	LS	$ 6,000.00	$ 6,000
Install 18" RCP	1260	LF	$ 55.00	$ 69,300
Install 24" RCP	440	LF	$ 60.00	$ 26,400
Install Catch Basin	18	EA	$ 1,500.00	$ 27,000
Install Curb & Gutter	2700	LF	$ 11.00	$ 29,700
Install Concrete Driveways	390	SY	$ 22.00	$ 8,580
Erosion Control	1	LS	$ 3,600.00	$ 3,600
Permanent Grassing	893	SY	$ 2.80	$ 2,500
TOTAL				**$ 175,080**

PRELIMINARY COST ESTIMATE

UPSTREAM DETENTION				
Description	**Quantity**	**Units**	**Unit Price**	**Total Price**
Install 24" HDPE	25	LF	$ 50	$ 1,250
Install 30" RCP	370	LF	$ 65	$ 24,050
Remove Existing Structures	2	EA	$ 500	$ 1,000
Grate Inlet	2	EA	$ 1,500	$ 3,000
Junction Box	1	EA	$ 1,500	$ 1,500
Catch Basin	1	EA	$ 1,500	$ 1,500
Underground Detention System	141,000	CF	$ 5	$ 705,000
Demo/Remove Existing Concrete & Asphalt	1	LS	$ 2,000	$ 2,000
Excavation/Grading	1	LS	$ 2,000	$ 2,000
Install Curb & Gutter	900	LF	$ 11	$ 9,900
Install Concrete Driveway	40	SY	$ 22	$ 880
Asphalt Pavement (2")	400.8	TN	$ 200	$ 80,160
Graded Aggregate Base (6")	1200	TN	$ 20	$ 24,000
Erosion Control	1	LS	$ 1,500	$ 1,500
TOTAL				**$ 857,740**