WK DICKSON
community infrastructure consultants

City of Rocky Mount
Maple Creek Tributary #1 Basin Study

August 2009

CITY OF ROCKY MOUNT

MAPLE CREEK TRIBUTARY #1 DRAINAGE BASIN STUDY

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Prepared for

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The City of Rocky Mount has retained WK Dickson to evaluate the Maple Creek Tributary #1 watershed for existing flooding, water quality, and erosion problems and to recommend improvements for addressing the identified issues. The primary goal of this project is to reduce flooding by providing a holistic approach to the entire watershed. This will be done by identifying capital improvements that will maintain and improve the infrastructure for flood control and public safety.

WK Dickson evaluated the hydrologic and hydraulic characteristics of the Maple Creek Tributary #1 watershed. These findings, along with improvement recommendations, are included in this report. Capital costs were estimated for varying levels of service and are included to enable the City to evaluate this information when selecting an alternative.

This report focuses on the flooding identified in the hydrologic and hydraulic evaluation and the alternatives proposed for reducing this flooding. Highlights of this evaluation are:

- The culverts located along Maple Creek Tributary #1 at Winstead Road, Sheffield Drive, and Avondale Avenue are undersized and do not pass the required design storm. In order to meet the City's design standards, the capacity of existing culverts would need to be increased. Upsizing the culverts at these crossings could potentially create flooding problems downstream, therefore no improvements are recommended at these three locations. The recommended alternative to address culvert capacity issues at Winstead Road and Sheffield Drive would be covered by including additional stormwater detention in the upper portions of the study area.

- The culvert located at South Winstead Avenue (SR #1613) along Maple Creek Tributary #1 passes the required design but it is not meeting the minimum freeboard requirement. Since this culvert passes the required design storm without overtopping and it is in good condition, no improvements are recommended.

- The culvert located at the railroad crossing along Maple Creek Tributary #1 is in good condition and is providing a 100-year level of service. Therefore, no improvements are recommended.

- The culvert located at Nottingham Road along the unnamed tributary of Maple Creek Tributary #1 (referred to as Nottingham Tributary) is not passing the required design storm and is in poor condition. It is recommended that this culvert be replaced.

- Storm drainage pipes and swales were evaluated in the neighborhoods along and upstream of Maple Creek Tributary #1 on Mansfield Drive between Newby Road and Hawthorne Road (referred to as Mansfield Area). Many of the piping systems do not pass the required design storm. In order to meet the City's design standards, the pipe sizes would need to be increased throughout. While this would decrease the flooding in the vicinity of the Mansfield Area, it would increase flooding in the areas downstream of Hawthorne Road and cause additional property owner impacts. Therefore, upsizing these undersized piping systems are not recommended. The recommended alternative to help decrease the frequency of flooding in the vicinity of the Mansfield Area would be covered by including additional stormwater detention in the upper portions of the study area.

- Stormwater detention areas were evaluated to lower the peak discharges for the 25-year storm event. The locations identified for detention areas included sites in the upper portion of the study area near Lochinvar Lane and Newby Road. The installation of both of these detention areas would provide decreased flooding in the Mansfield Area without increasing the flooding downstream of Hawthorne Road. In addition, it will help decrease the flooding frequency at other downstream culvert crossings at Winstead Road and Sheffield Drive. This proposed alternative is based off of limited survey and modeling. Therefore, it is recommended that prior to the design of the Lochinvar and Newby detention areas more detailed information would need to be obtained including a detailed survey, soils analysis and detailed hydraulic modeling. This data can be used to supplement the limited survey provided for this study and to complete a more detailed modeling effort.

Table ES-1 lists a brief description of the recommended alternative for Maple Creek Tributary #1 watershed and the associated estimated costs.

Table ES-1 – Summary of Costs for Recommended Alternative

Location	Description of Improvements	Estimated Budgetary Cost[1]
Lochinvar Detention Area	4.1-acre area detention at end of Lochinvar Lane	$630,840
Newby Detention Area	1.3-acre detention near abandoned right-of-way along Newby Road	$535,460
Nottingham Road	Replace culvert	$280,180
	Total	$1,446,480

[1]Estimated Budgetary Cost is for fiscal year 2009-2010

Project Description

The City of Rocky Mount has retained WK Dickson to evaluate the Maple Creek Tributary #1 watershed for existing flooding, water quality, and erosion problems and to recommend improvements for addressing identified issues. This study was prepared for the City of Rocky Mount as part of the Maple Creek Tributary #1 Drainage Basin Study. A vicinity map of the watershed is shown as Figure 1. The areas evaluated as part of this study are as follows:

- Maple Creek Tributary #1 from the confluence with Maple Creek upstream to Hawthorne Road.
- Unnamed tributary from Jeremy Lane downstream to the confluence with Maple Creek Tributary #1; referred to as Nottingham Tributary in this study.
- Selected closed systems in the vicinity of Mansfield Drive; referred to as Mansfield Area in this study.

The simulation of the rainfall-runoff process and recommendations in this report are analyzed with the U.S. Army Corps of Engineers (USACE) HEC-1 and HEC-RAS models based on Natural Resources Conservation Service (NRCS) methodologies. The HEC-RAS program was utilized for the open channel systems (including roadway culverts). The hydraulic capacity of the closed systems was evaluated using Intelisolve's Hydraflow Storm Sewers (Version 2008) computer program and hydraulic grade line computations. A detailed description of the hydrologic and hydraulic analyses can be found in Appendices A and B of this report.

The input data and information used for the models was obtained from the following sources:

- Drainage inventory (i.e., culvert sizes, channel side slopes, pipe inverts and lengths) was provided by the City. It was presumed to be North American Vertical Datum of 1988 (NAVD 1988).
- Two-foot contours from the North Carolina Department of Transportation (NCDOT) GIS database.
- Zoning and parcel data from the City's GIS database.

It should be noted that survey was not completed by WK Dickson personnel except along the railroad crossing. In the area along the railroad, cross sections were surveyed (NAVD 1988). First floor elevations (FFEs) and lowest adjacent grade (LAG) elevations were also surveyed for properties closest to the railroad. Additionally, the size and material of culverts, along with the depth and side slopes of channels in the project area were field verified to confirm data provided by City.

Watershed Characteristics

The Maple Creek Tributary #1 sub-basins are situated in the southwest portion of the City of Rocky Mount. Maple Creek Tributary #1 flows into Maple Creek, which is a tributary of the Tar River. The project area is approximately 741 acres (1.16 square miles). The delineated drainage area (see Appendix C) included some periphery areas in sub-basin #1A that contain minor closed systems which may drain to an adjacent watershed. Based on the assumption that these pipes are undersized and will become backed up during larger storm events, it was

concluded that portions of the periphery area will drain into the Maple Creek Tributary #1 watershed. Therefore to err on the conservative side, it was considered to be part of the project area studied in this report.

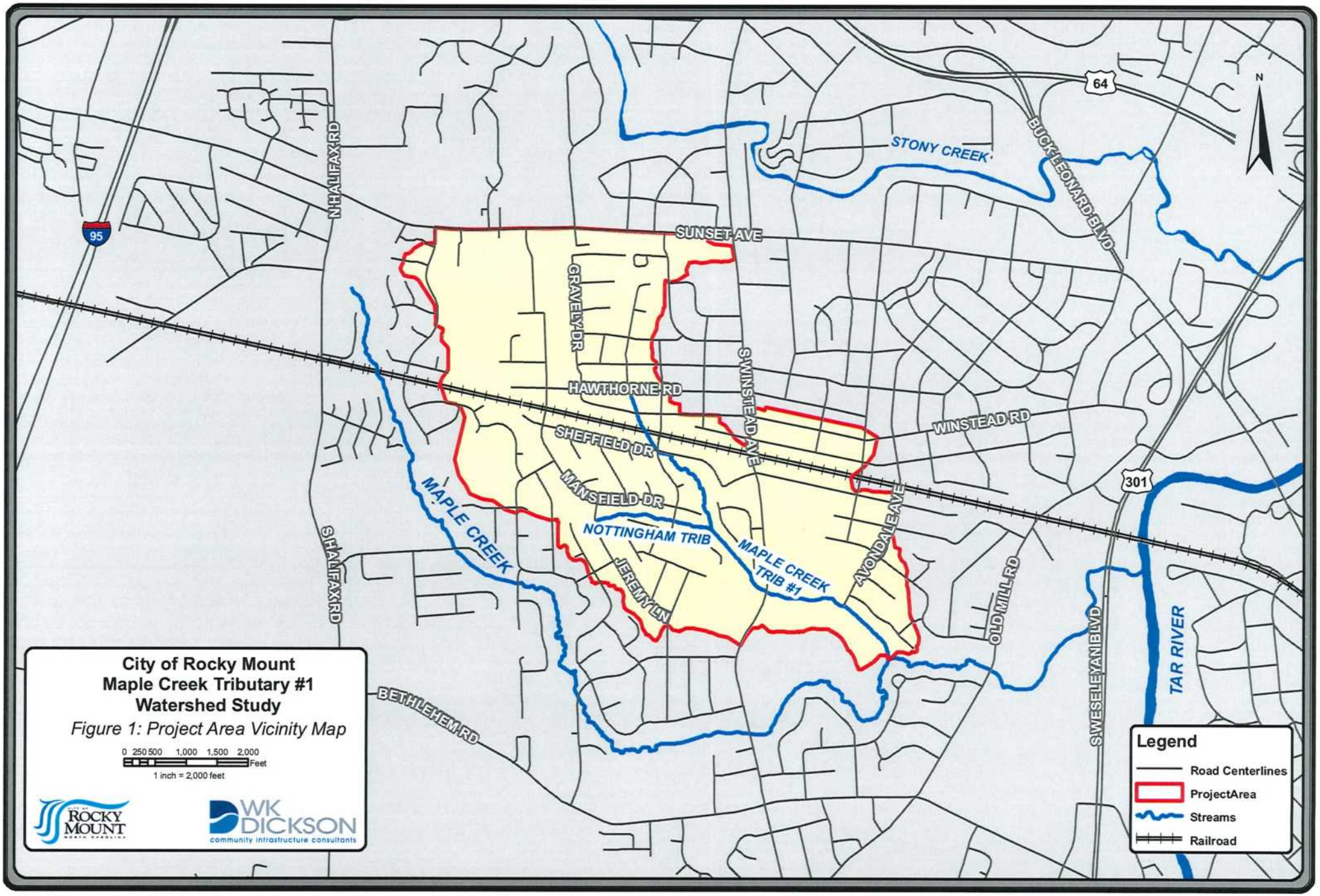
Another periphery area, delineated as sub-basin #1B was also evaluated in greater detail. Based on a review of drainage inventory, it was concluded that a large portion of the flow from this sub-basin would drain to Sunset Avenue and be carried out of the Maple Creek Tributary #1 watershed. Therefore, it was not considered to be part of the project area studied.

Land use in the basin is primarily built-out as shown on the Land Use Map in Appendix C. For this reason, the existing conditions land use was assumed to be the future conditions land use obtained from the City's zoning maps. The curve numbers for the proposed conditions were calculated based on this assumption. Development within the watershed is 85% residential, 10% agricultural and split use (i.e. mixture of churches, businesses, and residential) and 5% commercial. Soils within the watershed are predominately NRCS hydrologic soil groups B and B/D as shown in Appendix C.

Stormwater Guidelines & Design Requirements

Based on guidelines provided in the City of Rocky Mount Stormwater Design Manual, the following standards and criteria were used to evaluate the existing drainage system:

- Residential Local and Collector Roadways – 25-year design storm with 1 foot of freeboard.
- Commercial Local and Collector Roadways – 50-year design storm with 0.5 foot of freeboard.
- Industrial Local and Collector Roadways – 50-year design storm with 0.5 foot of freeboard.
- Minor and Major Arterial Roadways – 50-year design storm with 0.5 foot of freeboard.
- HW/D (the ratio of headwater depth to culvert depth) < 1.2.


City of Rocky Mount
Maple Creek Tributary #1
Watershed Study
Figure 1: Project Area Vicinity Map
0 250 500 1,000 1,500 2,000 Feet
1 inch = 2,000 feet
ROCKY MOUNT
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Legend
Road Centerlines
ProjectArea
Streams
Railroad
N
95
64
301
N HALIFAX RD
S HALIFAX RD
SUNSET AVE
GRAVELY DR
HAWTHORNE RD
SHEFFIELD DR
MANSFIELD DR
NOTTINGHAM TRIB
JEREMY LN
SWINSTEAD AVE
WINSTEAD RD
AVONDALE AVE
OLD MILL RD
S WESELEYAN BLVD
BUCK LEONARD BLVD
STONY CREEK
MAPLE CREEK
MAPLE CREEK TRIB #1
TAR RIVER
BETHLEHEM RD

Culvert Crossings

Peak flows for the Maple Creek Tributary #1 watershed were developed for the 2-, 10-, 25-, 50-, and 100-year storm events. The existing conditions' flows were developed taking into account attenuation and are summarized below in Table 1. The attenuation area (see Figure 2) is located upstream of Maple Creek Tributary #1 and was determined based on field visits and a review of the topographic data.

Detailed descriptions of the model parameters can be found in Appendices A and B. Based on the assumptions and design criteria stated in Section 1, the system was evaluated for the 10-year, 25-year, and 50-year storm events. A description of the existing drainage structure at each roadway crossing analyzed is presented Table 2. The lengths, sizes, and inverts for the culverts were provided by the City of Rocky Mount. WK Dickson personnel confirmed the size and material of the culverts only.

Table 1 – Existing Flows from HEC-1

	HEC-1 Node	Road Name / Location	Storm Event				
			2-year (cfs)	10-year (cfs)	25-year (cfs)	50-year (cfs)	100-year (cfs)
REACH 1 (Maple Creek Tributary #1)	BSN1A	U/S Limit of Maple Creek Tributary #1	111	217	298	351	393
	B1A-RT	Winstead Avenue	49	171	172	172	172
	B1-RT	Railroad Culvert	167	178	202	215	228
	B2-RT	Sheffield Drive	159	178	202	215	228
	RT3	Confluence of Mansfield and Nottingham Tributary	327	535	706	815	895
	B4-RT	South Winstead Avenue	356	566	700	792	861
	B5-RT	Avondale Avenue	415	751	946	1070	1181
	1	D/S Limit of Maple Creek Tributary #1	432	797	1008	1153	1268
REACH 2 (Nottingham Tributary)	NT-RT1	U/S Limit of Nottingham Tributary	97	171	226	263	290
	B3-RT	Nottingham Road	153	245	351	422	470

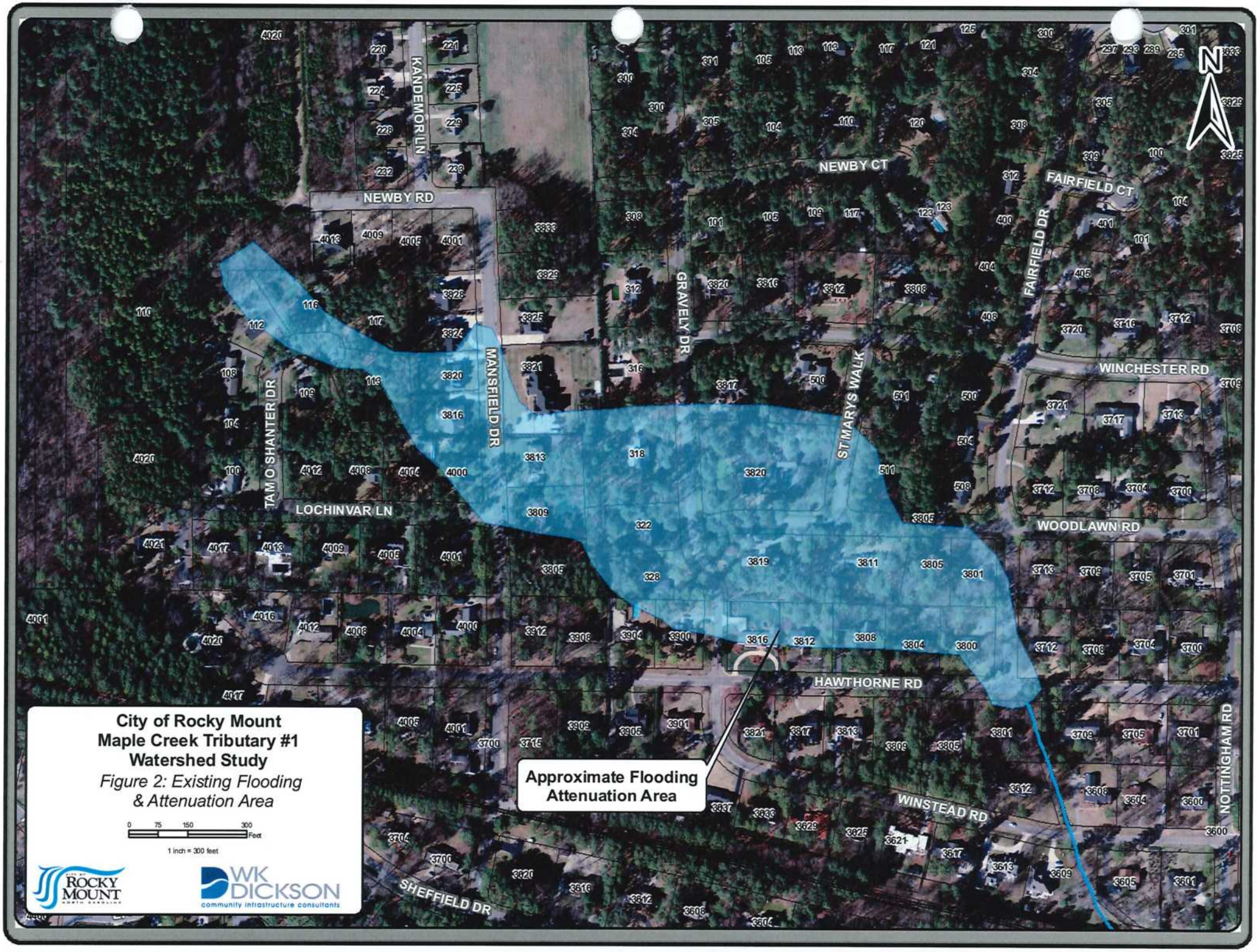

City of Rocky Mount
Maple Creek Tributary #1
Watershed Study
Figure 2: Existing Flooding
& Attenuation Area
0 75 150 300 Feet
1 inch = 300 feet
Approximate Flooding
Attenuation Area
KANDEMOR LN
NEWBY RD
NEWBY CT
FAIRFIELD CT
FAIRFIELD DR
GRAVELY DR
MANSFIELD DR
ST MARYS WALK
WINCHESTER RD
TAM O SHANTER DR
LOCHINVAR LN
WOODLAWN RD
HAWTHORNE RD
WINSTEAD RD
NOTTINGHAM RD
SHEFFIELD DR
N

Table 2 – Existing Structures at Roadway/Railroad Crossings

Location	Structure Size and Material*	Length (feet)	Required Level of Service (years)	Actual Level of Service (years)
Winstead Road	Double 5.5' x 4' Elliptical CMP	62	25	<2
Railroad Crossing	72" Diameter CMP	60	N/A	100
Sheffield Drive	48" Diameter CMP	102	25	<2
South Winstead Avenue	Double 6' x 6' RCBC	106	50	25
Avondale Avenue	9.7' X 6.1' Elliptical CMP	60	25	<2
Nottingham Road (Reach 2)	Double 3' X 4.4' Elliptical CMP	87	25	2

*RCBC–Reinforced Concrete Box Culvert; RCP–Reinforced Concrete Pipe; CMP–Corrugated Metal Pipe

One railroad and five roadway culvert crossings were analyzed for flooding potential in the Maple Creek Tributary #1 drainage basin study. All crossings that were analyzed in this study are listed in Table 3 and include the minimum top-of-road elevations and the 2-, 10-, 25-, 50- and 100-year flood elevations at the crossing for existing conditions.

Table 3 – Hydraulic Performance for Existing Conditions

Location	Minimum Elevation at Top of Road (feet NAVD)	Calculated Water Surface Elevations (feet NAVD)				
		2-year flood	10-year flood	25-year flood	50-year flood	100-year flood
BOLD PRINT INDICATES NOT MEETING CITY'S DESIGN CRITERIA						
Winstead Road	126.17	**125.81**	**126.47**	**126.70**	**126.87**	**127.17**
Railroad Crossing	127.97	125.75	126.01	126.51	126.83	127.16
Sheffield Drive	123.85	**124.30**	**124.41**	**124.50**	**124.58**	**124.60**
South Winstead Avenue	109.37	105.18	106.92	108.10	**109.08**	**109.55**
Avondale Avenue	100.61	**101.02**	**101.58**	**101.78**	**101.95**	**102.04**
Nottingham Road (Reach 2)	115.96	115.94	**118.54**	**119.29**	**119.61**	**119.78**

*All elevations in this report are referenced to the North American Vertical Datum of 1988 (NAVD 1988).

South Winstead Avenue is a major arterial that is required to pass the 50-year storm with 0.5 feet of freeboard. Currently, it is only providing 0.28 feet of freeboard and is just meeting the 25-year level of service. The complete sufficiency evaluation is in Appendix E.

Mansfield Area Closed Systems

The Mansfield Area is located within the Maple Creek Tributary #1 watershed. A map of the area is shown as Figure 3. It was evaluated separately to assess the minor drainage issues that are specific to the area. A detailed survey of the area was not completed for this analysis. Pipe information such as size, material, and invert elevations were provided by the City of Rocky Mount.

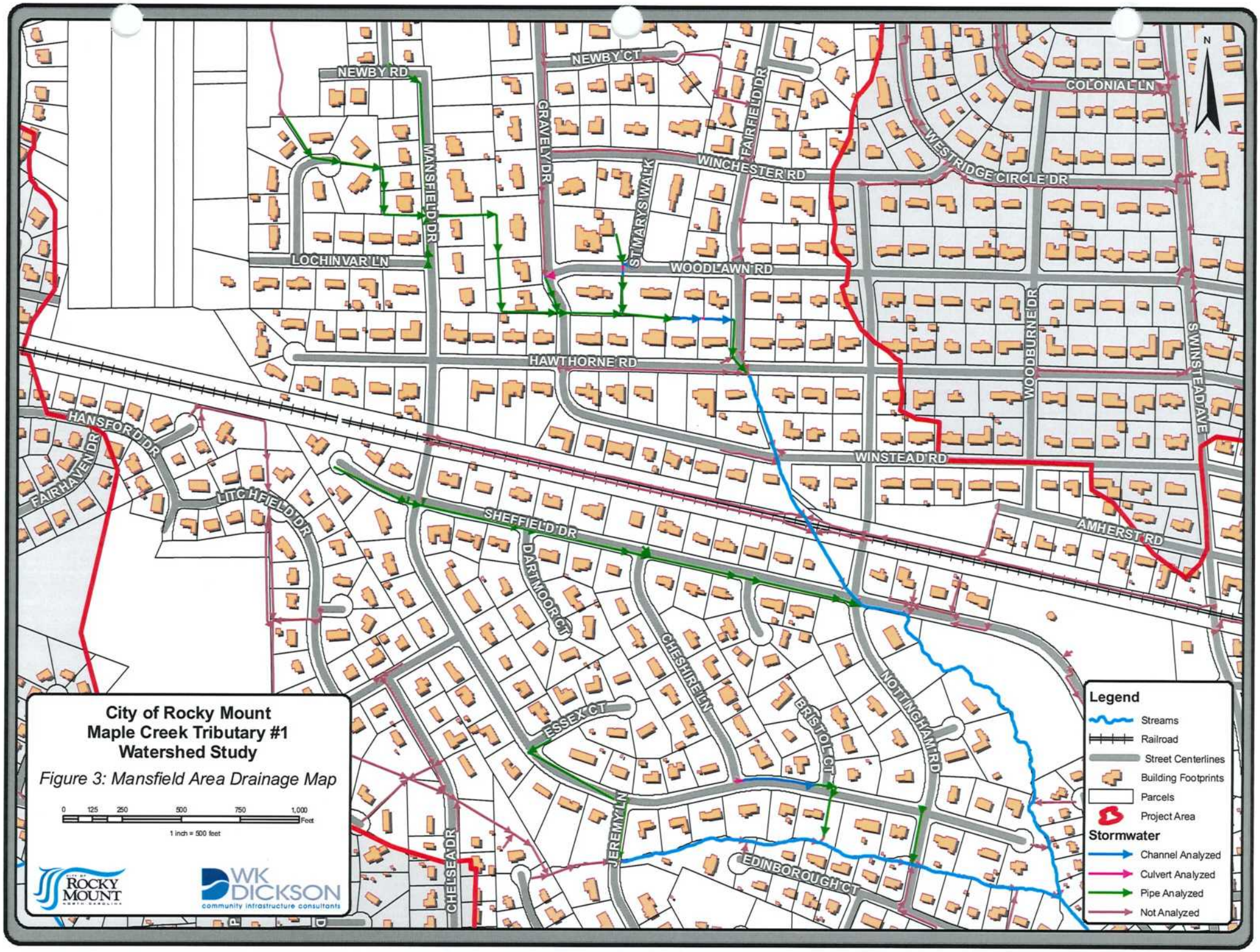
An alternative method was used to analyze the closed, secondary systems. The hydrologic analysis was completed using the rational method. This method is typically used for smaller sub-division closed systems. Input data for the rational method was developed using drainage areas based from topographic maps, runoff coefficients based from land use maps, and mean rainfall intensity for duration equal to the time of concentration.

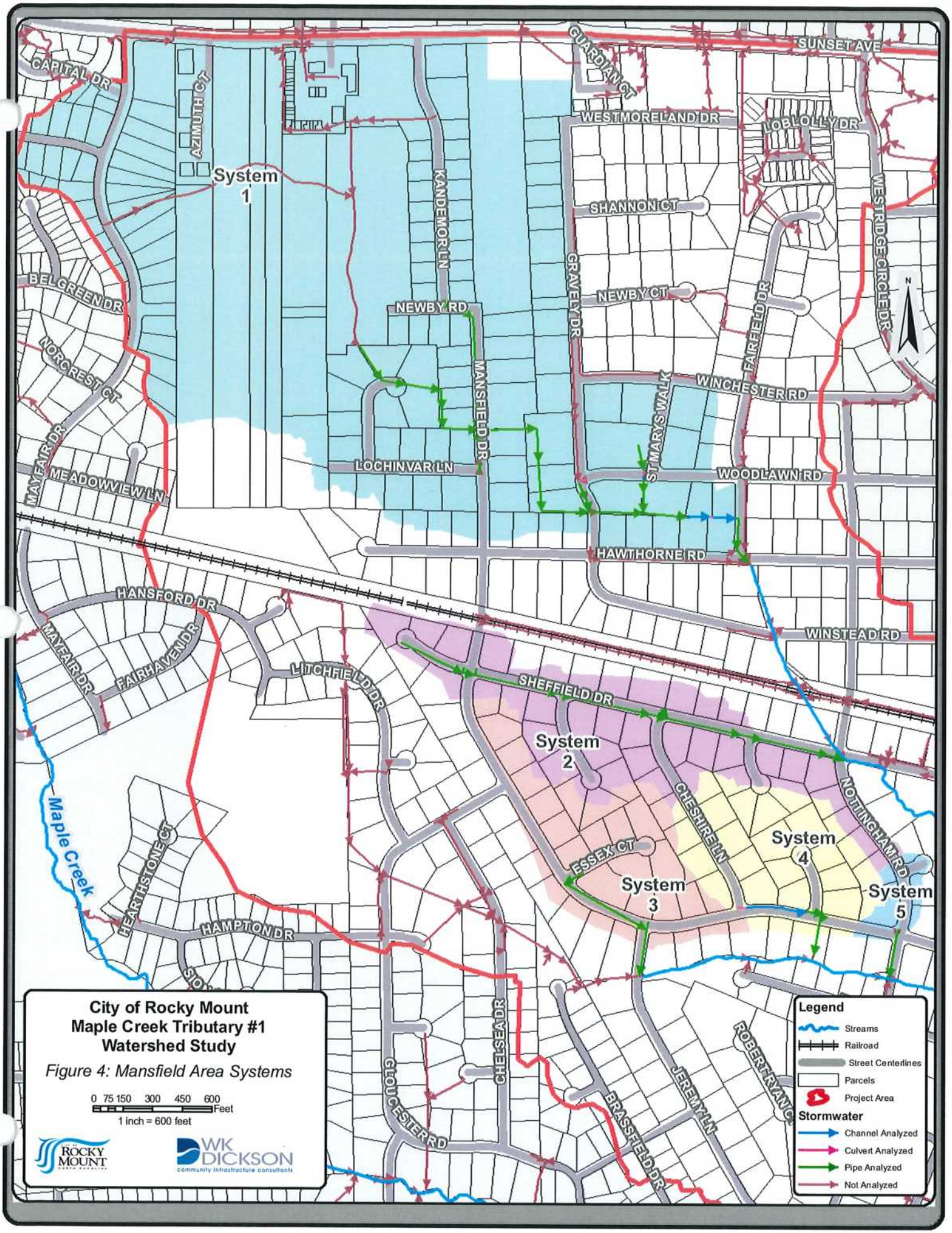
The Mansfield Area was divided into five separate systems (see Figure 4). An initial screening of the five systems was conducted to remove those closed systems that are meeting the City's design standards, as well as those where no drainage deficiencies were identified. The screening was based on feedback from residents obtained through questionnaires and at a public meeting, WK Dickson's field observations and known drainage complaints provided by the City. Additionally, Hydraflow was used to complete the sufficiency evaluations and identify those portions of the system which did not meet current City standards.

Of the five systems evaluated, only System 5 was functioning as intended and meeting the City's design requirements. The system was passing the required 25-year design storm therefore no further analysis was warranted. Systems 1 through 4 were not performing as intended and were not meeting the City's design standards. System 1 is severely undersized and experiencing major flooding. Systems 2 through 4 are undersized as well. These systems are only passing a 2-year design storm. Consequently, a more detailed analysis was completed for Systems 1 through 4. The capacity of the systems was evaluated using Hydraflow along with the rational method for the following storm events:

- 10-year for non-street systems.
- 25-year for street systems.

The Hydraflow input and output for the systems' results are included in Appendix F.


City of Rocky Mount
Maple Creek Tributary #1
Watershed Study
Figure 3: Mansfield Area Drainage Map
0 125 250 500 750 1,000 Feet
1 inch = 500 feet
ROCKY MOUNT
WK DICKSON
community infrastructure consultants
Legend
Streams
Railroad
Street Centerlines
Building Footprints
Parcels
Project Area
Stormwater
Channel Analyzed
Culvert Analyzed
Pipe Analyzed
Not Analyzed
NEWBY RD
NEWBY CT
GRAVELY DR
FAIRFIELD DR
COLONIAL LN
WESTRIDGE CIRCLE DR
WINCHESTER RD
MANSFIELD DR
ST MARYS WALK
LOCHINVAR LN
WOODLAWN RD
HAWTHORNE RD
WOODBURNE DR
S WINSTEAD AVE
HANSFORD DR
FAIRHAVEN DR
LITCHFIELD DR
WINSTEAD RD
SHEFFIELD DR
AMHERST RD
DARTMOOR CT
CHESHIRE LN
ESSEX CT
BRISTOL CT
NOTTINGHAM RD
JEREMY LN
EDINBOROUGH CT
CHELSEA DR
N


City of Rocky Mount
Maple Creek Tributary #1
Watershed Study
Figure 4: Mansfield Area Systems
0 75 150 300 450 600 Feet
1 inch = 600 feet
ROCKY MOUNT
WK DICKSON
community infrastructure consultants
System 1
System 2
System 3
System 4
System 5
Maple Creek
CAPITAL DR
AZIMUTH CT
KANDEMOR LN
GUARDIAN CT
SUNSET AVE
WESTMORELAND DR
LOBLOLLY DR
WESTRIDGE CIRCLE DR
SHANNON CT
BELGREEN DR
NORCREST CT
MAYFAIR DR
MEADOWVIEW LN
NEWBY RD
NEWBY CT
GRAVELY DR
FAIRFIELD DR
WINCHESTER RD
ST MARYS WALK
MANSFIELD DR
LOCHINVAR LN
WOODLAWN RD
HAWTHORNE RD
HANSFORD DR
WINSTEAD RD
FAIRHAVEN DR
LITCHFIELD DR
SHEFFIELD DR
CHESHIRE LN
NOTTINGHAM RD
ESSEX CT
HEARTHSTONE CT
HAMPTON DR
GLOUCESTER RD
CHELSEA DR
BRASSFIELD DR
JEREMY LN
ROBERT RYAN
Legend
Streams
Railroad
Street Centerlines
Parcels
Project Area
Stormwater
Channel Analyzed
Culvert Analyzed
Pipe Analyzed
Not Analyzed

The design objectives for all of the primary systems except South Winstead Avenue are to convey the 25-year peak flow through roadway culverts with a minimum freeboard of 12 inches and an HW/D ratio of 1.2 or less. To meet the Division of Water Quality requirements, culverts were modeled as if the inverts were buried one foot below the existing channel bottom. In addition, it was decided that proposed culverts in this study shall have endwalls, and/or wingwalls to improve the hydraulic efficiency.

The improvements presented in this section were identified through an iterative process of upsizing culverts, adjusting culvert and channel inverts, evaluating potential detention sites and discussions with City staff. The future peak flows used for sizing the proposed culverts are summarized below in Table 4. These culvert improvements were developed to meet the City's design standards and to alleviate flooding in the Maple Creek Tributary #1 watershed.

Table 4 – Future Flows from HEC-1

	HEC-1 Node	Road Name / Location	Storm Event				
			2-year (cfs)	10-year (cfs)	25-year (cfs)	50-year (cfs)	100-year (cfs)
REACH 1 (Maple Creek Tributary #1)	BSN1A	U/S Limit of Maple Creek Tributary #1*	**45**	**89**	**122**	**144**	**162**
	B1A-RT	Winstead Avenue*	**88**	**144**	**189**	**220**	**245**
	B1-RT	Railroad Culvert	204	242	326	400	401
	B2-RT	Sheffield Drive	196	236	326	400	401
	RT3	Confluence of Mansfield and Nottingham Tributary	402	578	742	851	939
	B4-RT	South Winstead Avenue	419	594	721	837	940
	B5-RT	Avondale Avenue	481	769	962	1087	1210
	1	D/S Limit of Maple Creek Tributary #1	501	817	1030	1167	1299
REACH 2 (Nottingham Tributary)	NT-RT1	U/S Limit of Nottingham Tributary	98	176	232	269	299
	B3-RT	Nottingham Road	151	258	358	426	480

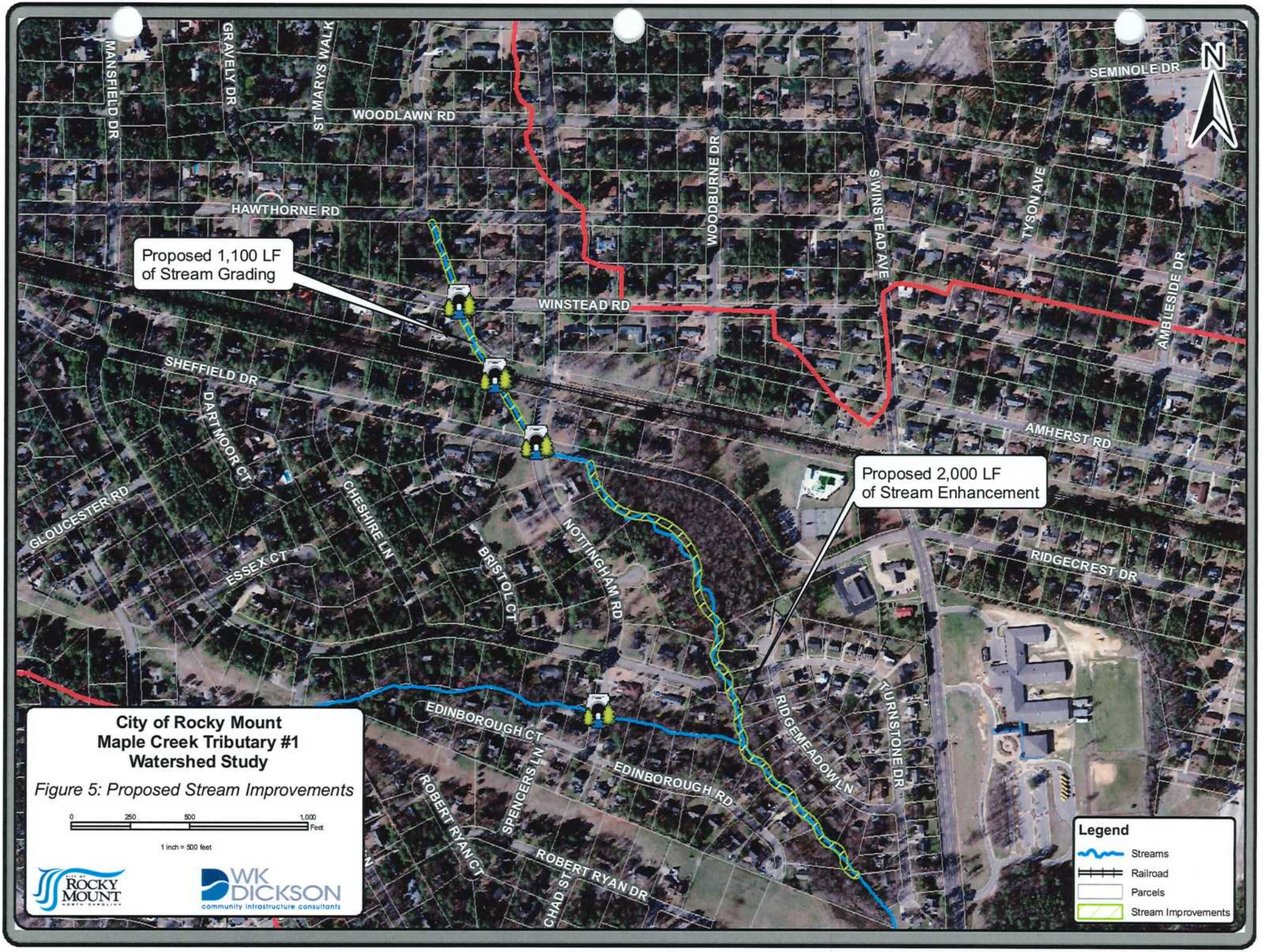
*The flows have been adjusted based on the output from the Hydraflow model.

When the future condition flows identified above in Table 4 are compared to the existing conditions flows (see Table 1), the flows for the 25-year storm event show an increase of approximately 60% downstream of the System 1 upgrades at the Railroad Culvert and at Sheffield Drive. A comparison of the future and existing flows is shown in Table 5.

Table 5 – Comparison of Future to Existing Flows

	HEC-1 Node	Road Name / Location	Storm Event				
			2-year (cfs)	10-year (cfs)	25-year (cfs)	50-year (cfs)	100-year (cfs)
REACH 1 (Maple Creek Tributary #1)	BSN1A	U/S Limit of Maple Creek Tributary #1	-66	-128	-176	-207	-231
	B1A-RT	Winstead Avenue	39	-27	17	48	73
	B1-RT	Railroad Culvert	37	64	124	185	173
	B2-RT	Sheffield Drive	37	58	124	185	173
	RT3	Confluence of Mansfield and Nottingham Tributary	75	43	36	36	44
	B4-RT	South Winstead Avenue	63	28	21	45	79
	B5-RT	Avondale Avenue	66	18	16	17	29
	1	D/S Limit of Maple Creek Tributary #1	69	20	22	14	31
REACH 2 (Nottingham Tributary)	NT-RT1	U/S Limit of Nottingham Tributary	1	5	6	6	9
	B3-RT	Nottingham Road	-2	13	7	4	10

It should be noted that the improvements being presented below for the primary system assume the upgrades proposed in the latter part of this section for System 1 will be made along with extensive stream grading and channel improvements (see Figure 5). It will likely that it will be difficult to complete the stream grading due to the private property impacts and required permitting.



City of Rocky Mount
Maple Creek Tributary #1
Watershed Study

Figure 5: Proposed Stream Improvements

Culvert Crossings

Winstead Road

The culvert at Winstead Road is undersized and does not pass the 2-year existing conditions flood without overtopping. The following summarizes the design improvements proposed at Winstead Road (See Figure 6):

- Remove 62 linear feet of double 5.5' x 4' CMP.
- Install approximately 70 linear feet of double 12' x 5' RCBCs.
- Remove and replace downstream and upstream headwalls and wingwalls.
- Remove and replace downstream and upstream concrete headwalls.
- Perform necessary channel improvements to accommodate installation of larger culverts.

The estimated project costs are approximately $634,840. HEC-RAS results of the proposed conditions have been included in Appendix G.

Railroad Crossing

The culvert at the railroad crossing is currently passing the 100-year existing conditions flood without overtopping. However, in order for the changes at Winstead Road to be effective, improvements must be made at this culvert crossing. The increased flows caused by the upgrades proposed upstream at System 1 will also contribute to the need for improvements at this crossing. The following summarizes the design improvements proposed at the railroad crossing (See Figure 7):

- Install approximately 60 linear feet of 54" RCP.
- Install downstream and upstream headwalls.
- Perform necessary channel improvements.

HEC-RAS results of the proposed conditions for the railroad crossing have been included in Appendix G. The proposed improvements will continue to provide the railroad crossing with a 100-year level of service.

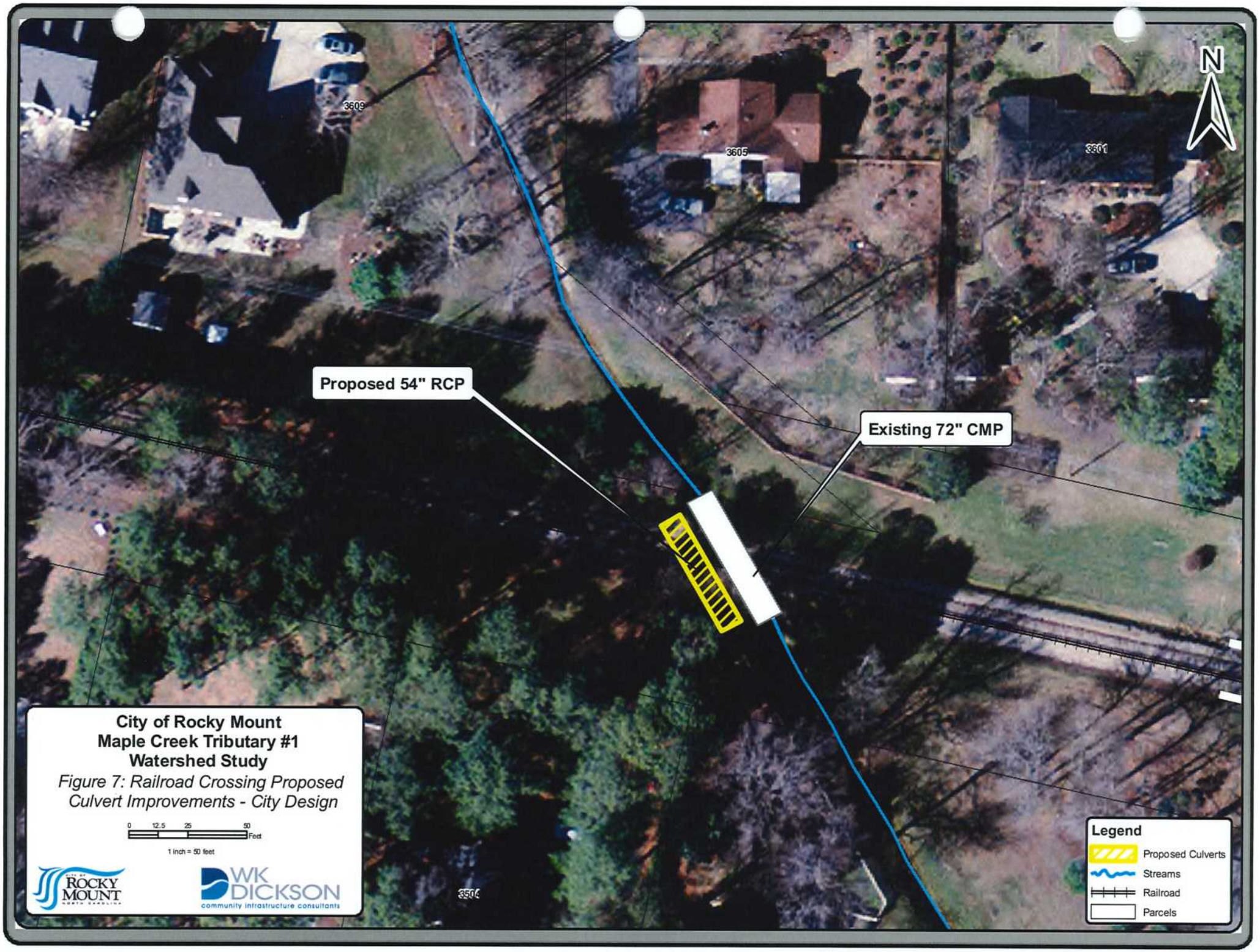
The estimated project costs are approximately $193,690.

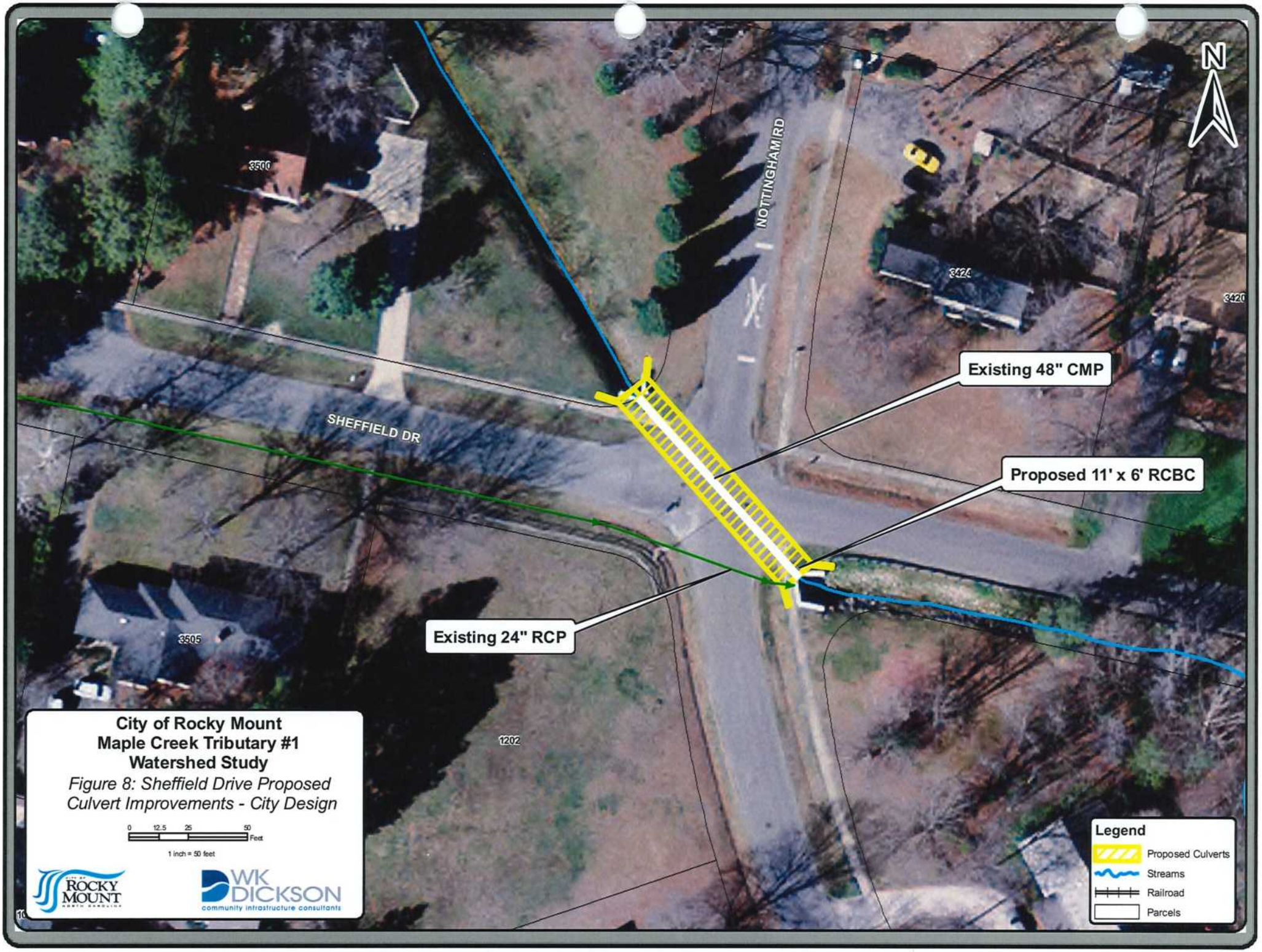
Sheffield Drive

The culvert at Sheffield Drive is undersized and does not pass the 2-year existing conditions flood without overtopping. The increased flows caused by the upgrades proposed upstream at System 1 have also been taken into consideration for the analysis of the improvements at this crossing. The following summarizes the design improvements proposed at Sheffield Drive (See Figure 8):

- Remove 102 linear feet of 48" CMP.
- Install approximately 110 linear feet of 11' x 6' RCBC as the main culvert.
- Remove and replace downstream and upstream wingwalls.
- Remove and replace downstream and upstream concrete headwalls.
- Perform necessary channel improvements to accommodate installation of larger culverts.

N
Remove Existing
Double 5.5' x 4' CMP
Proposed Double
12' x 5' RCBCs
WINSTEAD RD
3612
3609
3604
3617
3609
3605
City of Rocky Mount
Maple Creek Tributary #1
Watershed Study
Figure 6: Winstead Road Proposed
Culvert Improvements - City Design
0 12.5 25 50 Feet
1 inch = 50 feet
ROCKY MOUNT
WK DICKSON
community infrastructure consultants
Legend
Proposed Culverts
Streams
Railroad
Parcels


N
3609
3605
3501
3504
Proposed 54" RCP
Existing 72" CMP
City of Rocky Mount
Maple Creek Tributary #1
Watershed Study
Figure 7: Railroad Crossing Proposed Culvert Improvements - City Design
0 12.5 25 50 Feet
1 inch = 50 feet
ROCKY MOUNT
WK DICKSON
community infrastructure consultants
Legend
Proposed Culverts
Streams
Railroad
Parcels


N
NOTTINGHAM RD
SHEFFIELD DR
3500
3424
3420
3505
1202
Existing 48" CMP
Proposed 11' x 6' RCBC
Existing 24" RCP
Legend
Proposed Culverts
Streams
Railroad
Parcels
City of Rocky Mount
Maple Creek Tributary #1
Watershed Study
Figure 8: Sheffield Drive Proposed
Culvert Improvements - City Design
0 12.5 25 50 Feet
1 inch = 50 feet
ROCKY MOUNT
WK DICKSON
community infrastructure consultants

The estimated project costs are approximately $501,160. HEC-RAS results of the proposed conditions have been included in Appendix G.

South Winstead Avenue

The culverts at South Winstead Avenue are currently passing the 50-year existing conditions flood without overtopping but it is not providing the 0.5 foot of freeboard required by the City's design standards. The upsizing of System 1 and the upstream culverts will cause this crossing to overtop by approximately 0.1 feet.

This is a North Carolina Department of Transportation (NCDOT) maintained road. In order to complete any proposed design recommendations, coordination with and buy-in from NCDOT would be required. Additionally, this a relatively new culvert in good condition therefore, no design improvements are proposed.

Avondale Avenue

The culvert at Avondale Avenue is undersized and does not pass the 2-year existing conditions flood without overtopping. The following summarizes the design improvements proposed at Avondale Avenue (See Figure 9):

- Remove 60 linear feet of 9.7′ x 6.1′ CMP.
- Install approximately 60 linear feet of double 10′ x 7′ RCBCs as the main culvert.
- Install downstream and upstream wingwalls.
- Install downstream and upstream concrete headwalls.
- Perform necessary channel improvements to accommodate installation of larger culverts.

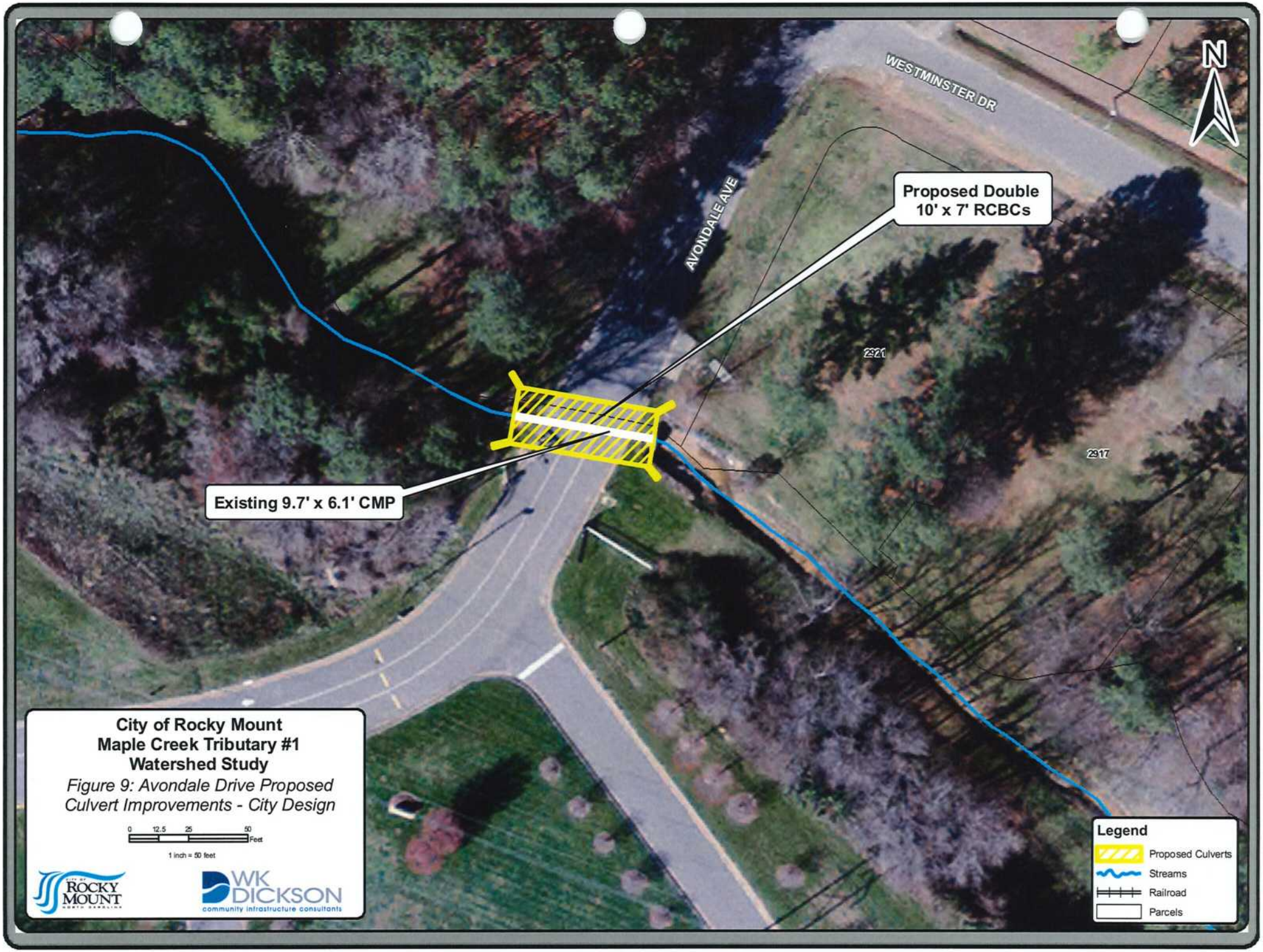
The estimated project costs are approximately $751,690. HEC-RAS results of the proposed conditions have been included in Appendix G.

Nottingham Road

The culvert at Nottingham Road is undersized and does not pass the 10-year existing conditions flood without overtopping. The following summarizes the design improvements proposed at Nottingham Road (See Figure 10):

- Remove 87 linear feet of double 3′ x 4.4′ CMP.
- Install approximately 90 linear feet of 8′ x 6′ RCBC as the main culvert.
- Remove and replace downstream and upstream wingwalls.
- Remove and replace downstream and upstream concrete headwalls.
- Perform necessary channel improvements to accommodate installation of larger culverts.

The estimated project costs are approximately $280,180. HEC-RAS results of the proposed conditions have been included in Appendix G.


WESTMINSTER DR
AVONDALE AVE
N
Proposed Double
10' x 7' RCBCs
2921
2917
Existing 9.7' x 6.1' CMP
City of Rocky Mount
Maple Creek Tributary #1
Watershed Study
Figure 9: Avondale Drive Proposed
Culvert Improvements - City Design
0 12.5 25 50 Feet
1 inch = 50 feet
ROCKY MOUNT
WK DICKSON
community infrastructure consultants
Legend
Proposed Culverts
Streams
Railroad
Parcels

Existing 18" RCP
MANSFIELD DR
N
3505
3501
3429
NOTTINGHAM RD
Existing 3.0' x 4.4' CMP
104
Proposed 8' x 6' RCBC
2140
City of Rocky Mount
Maple Creek Tributary #1
Watershed Study
Figure 10: Nottingham Road Proposed Culvert Improvements - City Design
0 12.5 25 50 Feet
1 inch = 50 feet
ROCKY MOUNT
WK DICKSON
community infrastructure consultants
Legend
Proposed Culverts
Streams
Railroad
Parcels

Table 6 – Summary of Proposed Culvert Improvements

Location	Roadway Classification	Level of Service Provided (years)	Existing Culvert	Proposed Culvert
Winstead Road	Residential	25	Double 5.5' x 4' CMPs	Double 12' x 5' RCBCs
Railroad Crossing	N/A	N/A	72" CMP	Existing 72" CMP with 54" RCP
Sheffield Drive	Residential	25	48" CMP	11' x 6' RCBC
South Winstead Avenue	Residential	50	Double 6' x 6' RCBCs	No Proposed Changes
Avondale Avenue	Residential	25	9.7' x 6.1' CMP	Double 10' x 8' RCBCs
Nottingham Road (Reach 2)	Residential	25	Double 3.0' x 4.4' CMPs	8' x 6' RCBC

The culvert improvements presented will increase the level of service for the crossings at Winstead Road, Sheffield Drive, and Avondale Avenue. However, it will cause the water surface elevations in downstream areas to increase by over one foot between Sheffield Drive and South Winstead Avenue. The upsizing of System 1 will also contribute significantly to the increase in flows and water surface elevations. This will likely cause flooding to residents who have never reported experiencing it before. Additionally, the proposed upstream changes will lead to an increased water surface elevation at the South Winstead Avenue culvert crossing. This increase will cause the culvert to overtop and no longer be able to pass the 50-year storm event.

Based on the negative effects improving the culverts along Maple Creek Tributary #1 will have on the watershed as a whole, it is recommended that none of the proposed improvements for these culverts be implemented. However, it should be noted that the improvements would be required if System 1 upgrades are completed.

The improvements proposed for the Nottingham Road culvert are recommended. This culvert is in poor condition. It has an endwall that is failing as well as an invert that is rusted through. The Nottingham Road culvert is not located along the main stream; therefore its replacement will not have the same negative impacts as the others.

The estimated project costs for the various systems are outlined in the following table.

Table 7 – Summary of Costs for Proposed Primary System Improvements

Location	Estimated Construction Cost	Estimated Design Cost*	Estimated Total Cost
Winstead Road	$488,340	$146,500	$634,840
Railroad Crossing	$148,990	$44,700	$193,690
Sheffield Drive	$385,510	$115,650	$501,160
Avondale Avenue	$578,220	$173,470	$751,690
Nottingham Road (Reach 2)	$215,180	$64,660	$280,180
Stream Grading	$1,125,480	$667,640	$1,463,120

*Design, Survey, Easement Acquisition, Permitting, & Miscellaneous Administrative Costs

Mansfield Area Closed Systems

System 1

System 1 is severely undersized; therefore, it would require substantial design improvements to meet the required City design standards. The design improvements required to provide the 25-year level of service include extending the existing closed system alignment down Mansfield Drive to Hawthorne Road and continuing along Hawthorne until the closed system outlets near Fairfield Drive (see Figure 11). This proposed system includes the following:

- Approximately 1,200 linear feet of 36" reinforced concrete pipe.
- Approximately 4,500 linear feet of 42" reinforced concrete pipe.
- 2,000 linear feet of full road reconstruction along Mansfield Drive and Hawthorne Road.
- 1,100 linear feet of stream grading.
- 15 proposed catch basins.
- 20 proposed drop inlets and/or manholes.

The proposed system would capture runoff upstream of Lochinvar Lane and along Mansfield Drive and convey it through the new pipes. This alternative would keep the existing alignment in place to capture the drainage not collected by the new system.

In order to construct this proposed system with the required pipe sizes, Maple Creek Tributary #1 would need to be lowered by roughly 2 feet between Hawthorne Road and Sheffield Drive. This must be done in order to set the culverts at their necessary invert while also providing adequate cover. An individual permit would be required to perform the stream work.

These proposed improvements would correct the existing nuisance flooding in the vicinity of Mansfield Drive, Gravely Drive, and Hawthorne Road. However, if the improvements were to be constructed, flooding would increase in areas downstream of Hawthorne Road. For example, the resident at 3605 Winstead Road, located upstream of the railroad crossing, has not experienced flooding in the last fifteen years. If the proposed closed systems were installed, the flows reaching the resident would increase by approximately 30% and likely cause flooding. Additionally, this alternative would increase the water surface elevations downstream between Sheffield Drive and South Winstead Avenue.

The estimated project costs are approximately $2,047,830. Hydraflow modeling results of the proposed system have been included in Appendix F.

Systems 2- 4

Systems 2 through 4 are also undersized and currently only pass the 2-year design storm. In order to meet the City's design requirements, these systems would need to be upsized to pass the 25-year design storm. Figures 12 through 14 outline the proposed design improvements required to provide the 25-year level of service and bring the systems into compliance with the City's standards. Hydraflow modeling results for the proposed systems have been included in Appendix F.

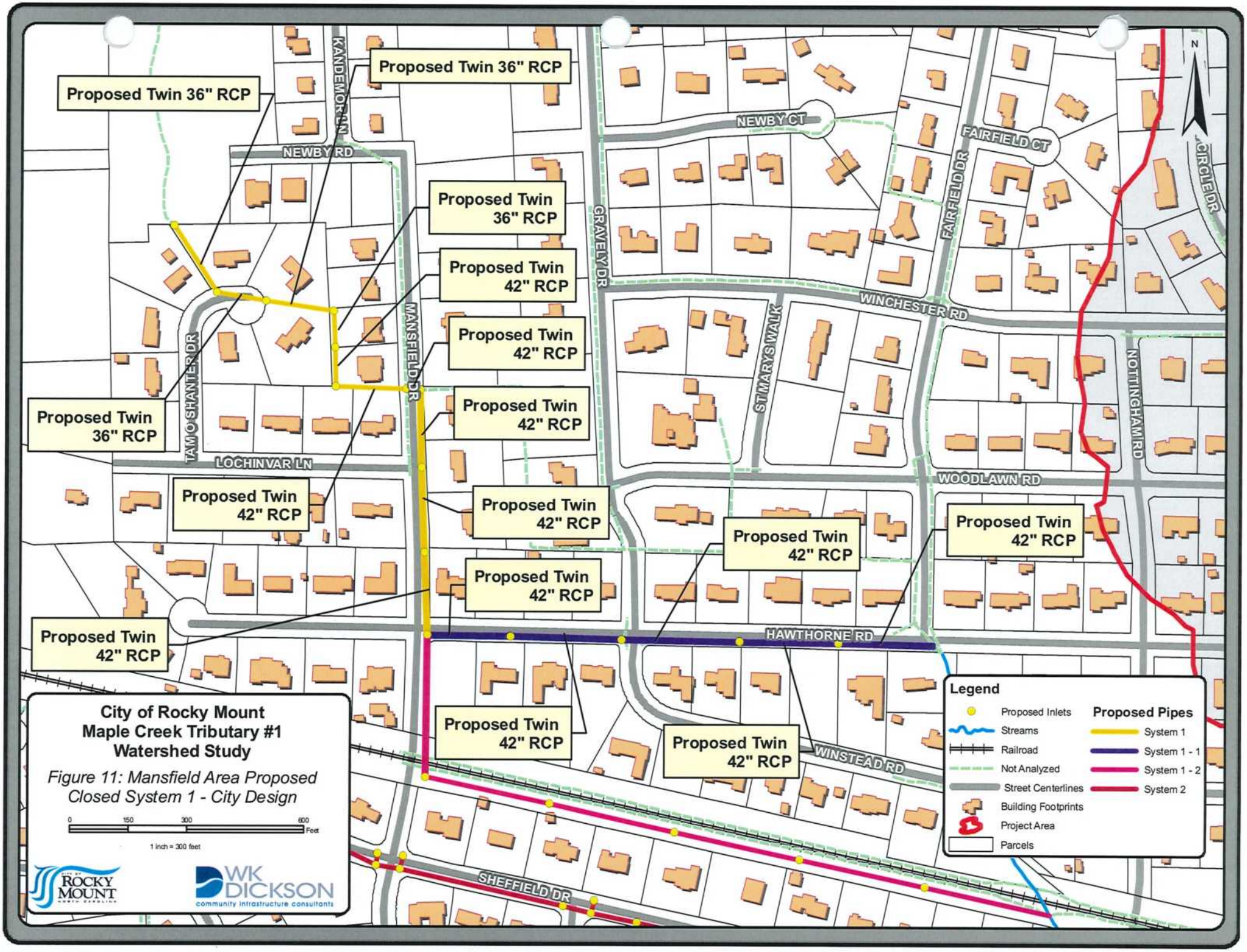
The estimated project costs for the various systems are outlined in the following table.

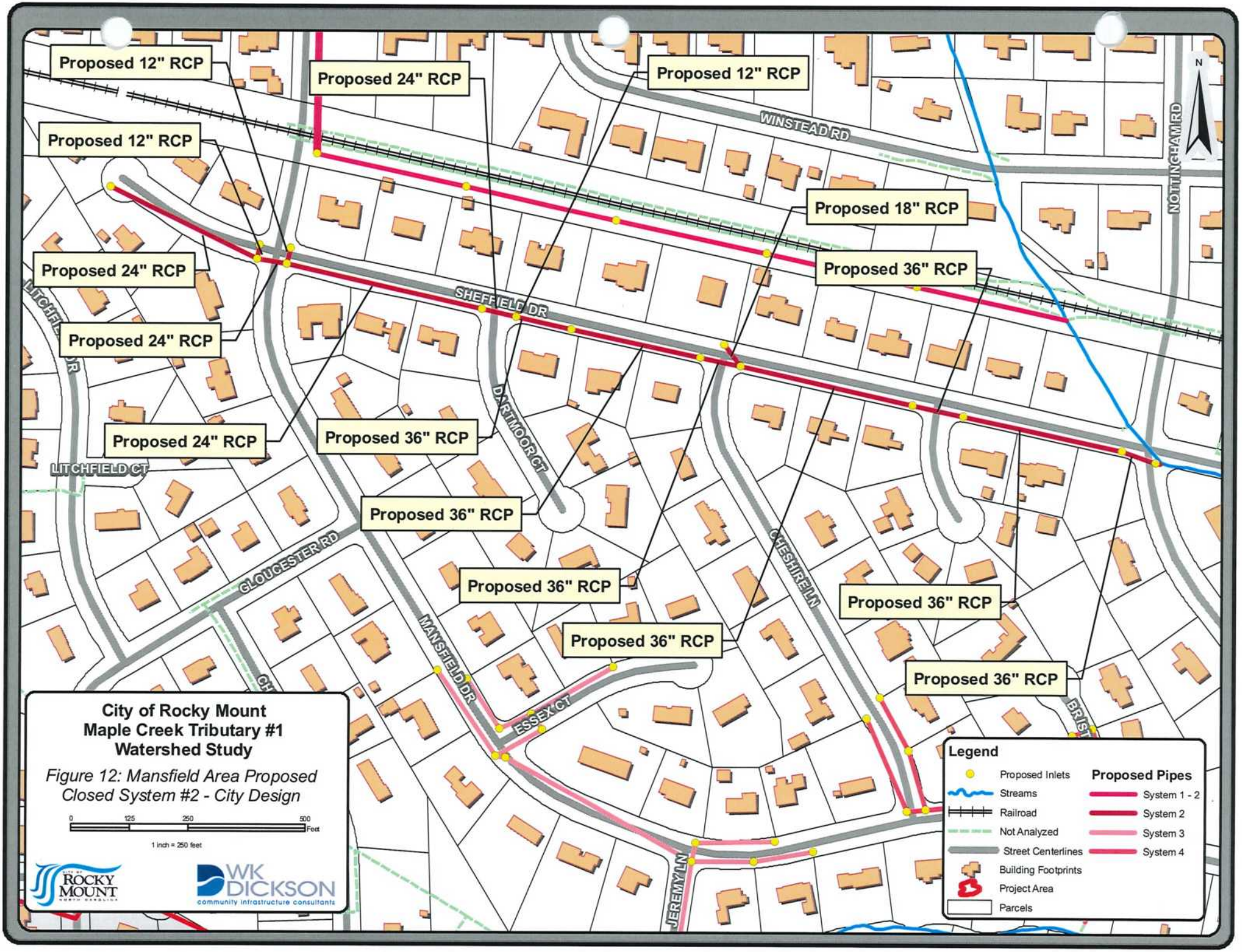
Table 8 – Summary of Costs for Mansfield Area Closed Systems

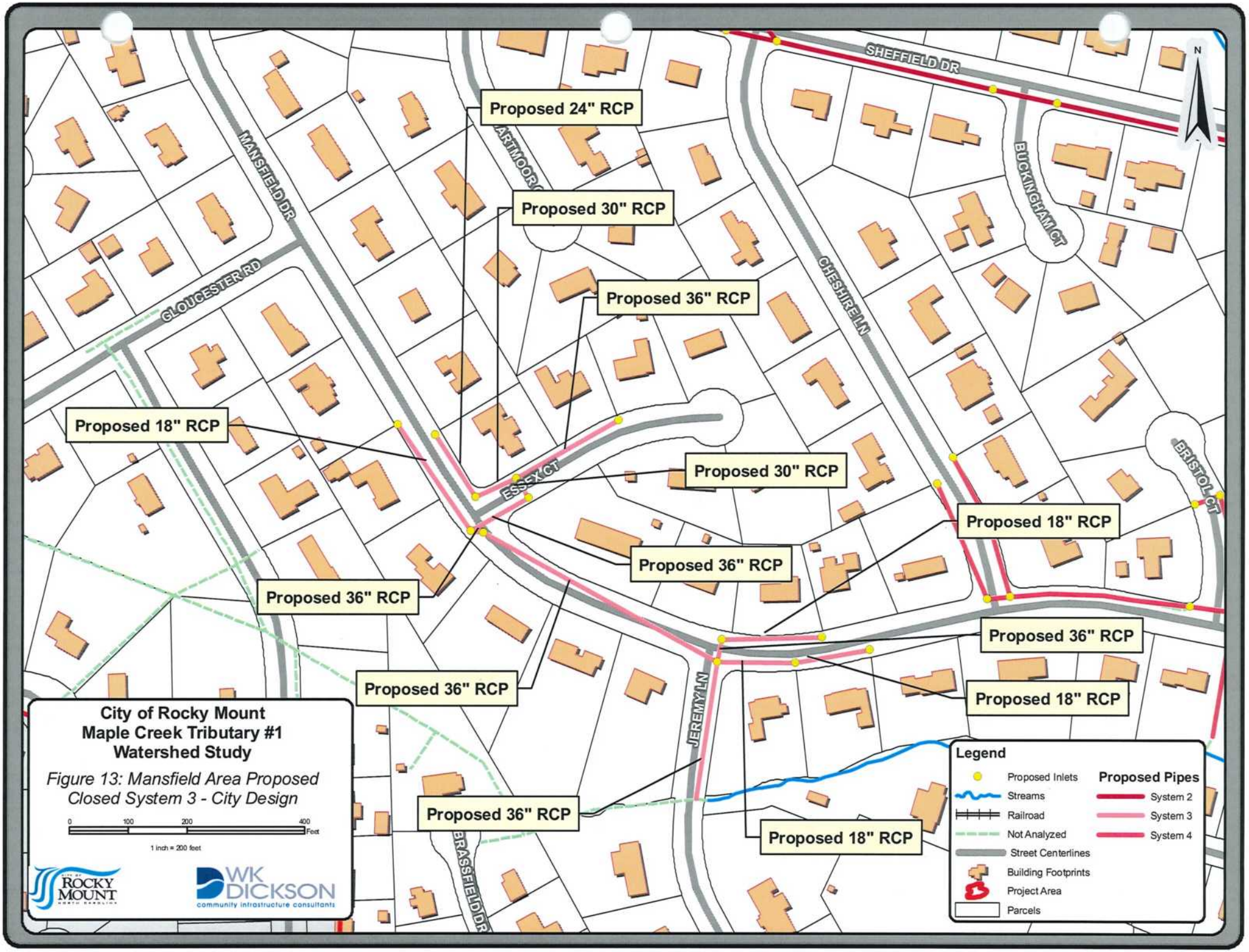
System	Estimated Construction Cost	Estimated Design Cost*	Estimated Total Cost
1	$1,596,020	$478,810	$2,074,830
2	$652,300	$195,960	$847,990
3	$450,610	$135,180	$585,790
4	$300,420	$90,130	$390,550

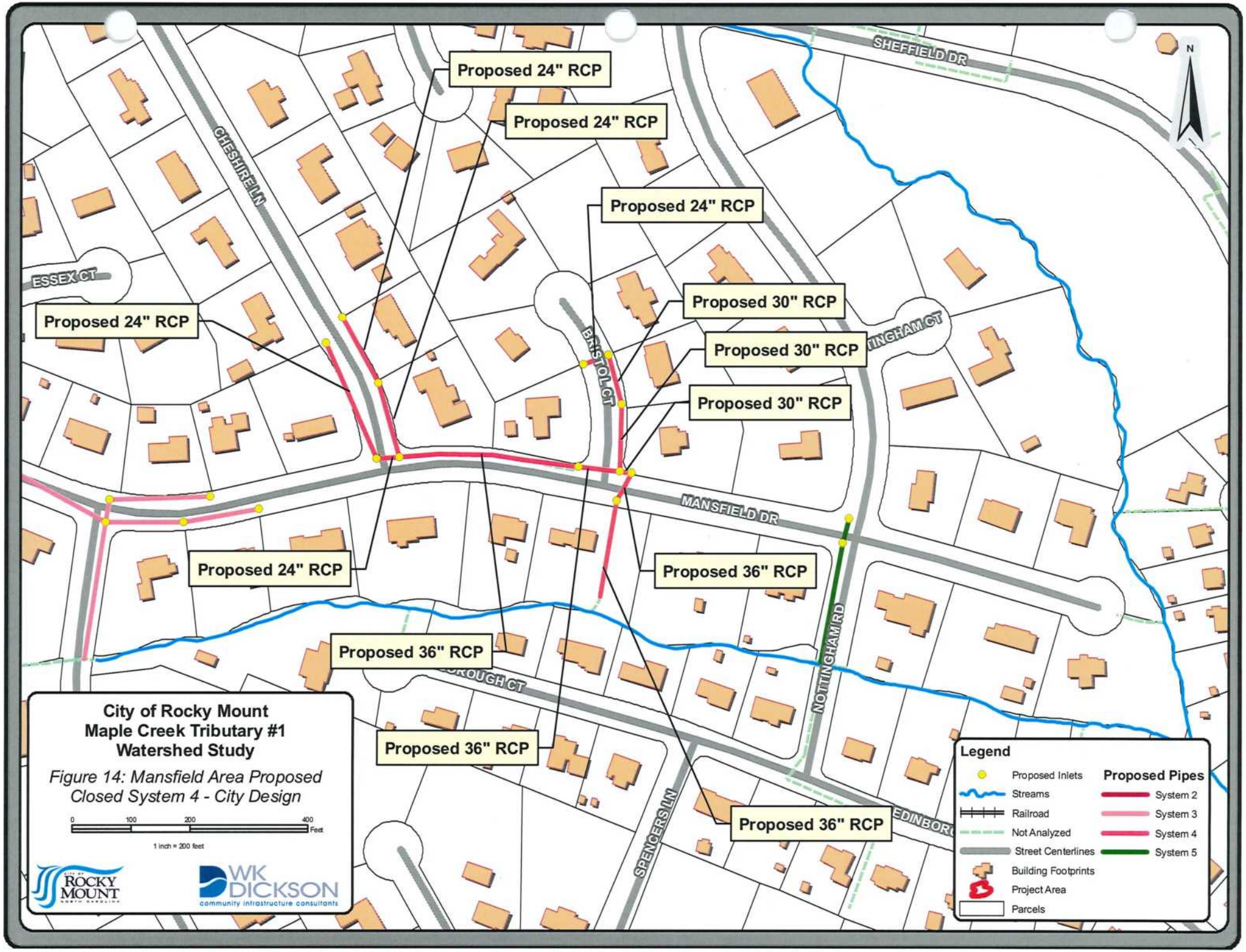
*Design, Survey, Easement Acquisition, Permitting, & Miscellaneous Administrative Costs

Based on evaluating the costs for design and construction of the systems relative to the value gained, Systems 2 through 4 are not recommended for installation.


Proposed Twin 36" RCP
Proposed Twin 36" RCP
Proposed Twin 36" RCP
Proposed Twin 36" RCP
Proposed Twin 42" RCP
Proposed Twin 42" RCP
Proposed Twin 42" RCP
Proposed Twin 42" RCP
Proposed Twin 42" RCP
Proposed Twin 42" RCP
Proposed Twin 42" RCP
Proposed Twin 42" RCP
Proposed Twin 42" RCP
Proposed Twin 42" RCP
Proposed Twin 42" RCP
KANDEMORE LN
NEWBY RD
MANSFIELD DR
TAMOSHANTER DR
LOCHINVAR LN
GRAVELY DR
NEWBY CT
FAIRFIELD CT
FAIRFIELD DR
CIRCLE DR
WINCHESTER RD
ST MARYS WALK
NOTTINGHAM RD
WOODLAWN RD
HAWTHORNE RD
WINSTEAD RD
SHEFFIELD DR
N
Legend
Proposed Inlets
Streams
Railroad
Not Analyzed
Street Centerlines
Building Footprints
Project Area
Parcels
Proposed Pipes
System 1
System 1 - 1
System 1 - 2
System 2
City of Rocky Mount
Maple Creek Tributary #1
Watershed Study
Figure 11: Mansfield Area Proposed Closed System 1 - City Design
0
150
300
600
Feet
1 inch = 300 feet
ROCKY MOUNT
WK DICKSON
community infrastructure consultants


Proposed 12" RCP
Proposed 24" RCP
Proposed 12" RCP
Proposed 12" RCP
Proposed 18" RCP
Proposed 36" RCP
Proposed 24" RCP
Proposed 24" RCP
Proposed 24" RCP
Proposed 36" RCP
Proposed 36" RCP
Proposed 36" RCP
Proposed 36" RCP
Proposed 36" RCP
Proposed 36" RCP
WINSTEAD RD
NOTTINGHAM RD
SHEFFIELD DR
DARTMOOR CT
LITCHFIELD CT
GLOUCESTER RD
MANSFIELD DR
ESSEX CT
CHESHIRE LN
JEREMY LN
N
City of Rocky Mount
Maple Creek Tributary #1
Watershed Study
Figure 12: Mansfield Area Proposed Closed System #2 - City Design
0 125 250 500 Feet
1 inch = 250 feet
ROCKY MOUNT
WK DICKSON
community infrastructure consultants
Legend
Proposed Inlets
Streams
Railroad
Not Analyzed
Street Centerlines
Building Footprints
Project Area
Parcels
Proposed Pipes
System 1 - 2
System 2
System 3
System 4


SHEFFIELD DR
N
Proposed 24" RCP
Proposed 30" RCP
Proposed 36" RCP
Proposed 18" RCP
Proposed 30" RCP
Proposed 36" RCP
Proposed 18" RCP
Proposed 36" RCP
Proposed 36" RCP
Proposed 36" RCP
Proposed 18" RCP
Proposed 36" RCP
Proposed 18" RCP
MANSFIELD DR
GLOUCESTER RD
ESSEX CT
CHESHIRE LN
BUCKINGHAM CT
BRISTOL CT
JEREMY LN
BRASSFIELD DR
City of Rocky Mount
Maple Creek Tributary #1
Watershed Study
Figure 13: Mansfield Area Proposed Closed System 3 - City Design
0
100
200
400
Feet
1 inch = 200 feet
ROCKY MOUNT
WK DICKSON
community infrastructure consultants
Legend
Proposed Inlets
Streams
Railroad
Not Analyzed
Street Centerlines
Building Footprints
Project Area
Parcels
Proposed Pipes
System 2
System 3
System 4



City of Rocky Mount
Maple Creek Tributary #1
Watershed Study

Figure 14: Mansfield Area Proposed Closed System 4 - City Design

The following section presents additional alternatives based on conversations with City staff.

Culvert Crossings

Nottingham Road – Rehabilitation

As previously mentioned the culvert at Nottingham Road is undersized and does not pass the 10-year existing conditions flood without overtopping. It is also in poor condition with a failing endwall and rusted invert. Instead of completely replacing the culverts, rehabilitation can be completed using two possible options.

Option 1 would include sliplining a new pipeline into the existing culvert. The new pipe would be slightly smaller in size and similar in shape to maintain the maximum amount of cross sectional area. The process involves relining by erecting metal plate structures outside and threading into the existing structure. Grout would be placed in the annular space between the old structure and thereby minimize the load on the new lining.

Option 2 would include injecting a liner such as high-density polyethylene or conventional polyethylene which would provide a smooth inner surface. The annular void between the existing pipe and the liner is filled with grout. The grout permeates into the existing surface and provides a direct full-surface bond between the liner and existing pipe. This option would improve the hydraulic performance of the culvert by providing a lower Manning's 'n' value.

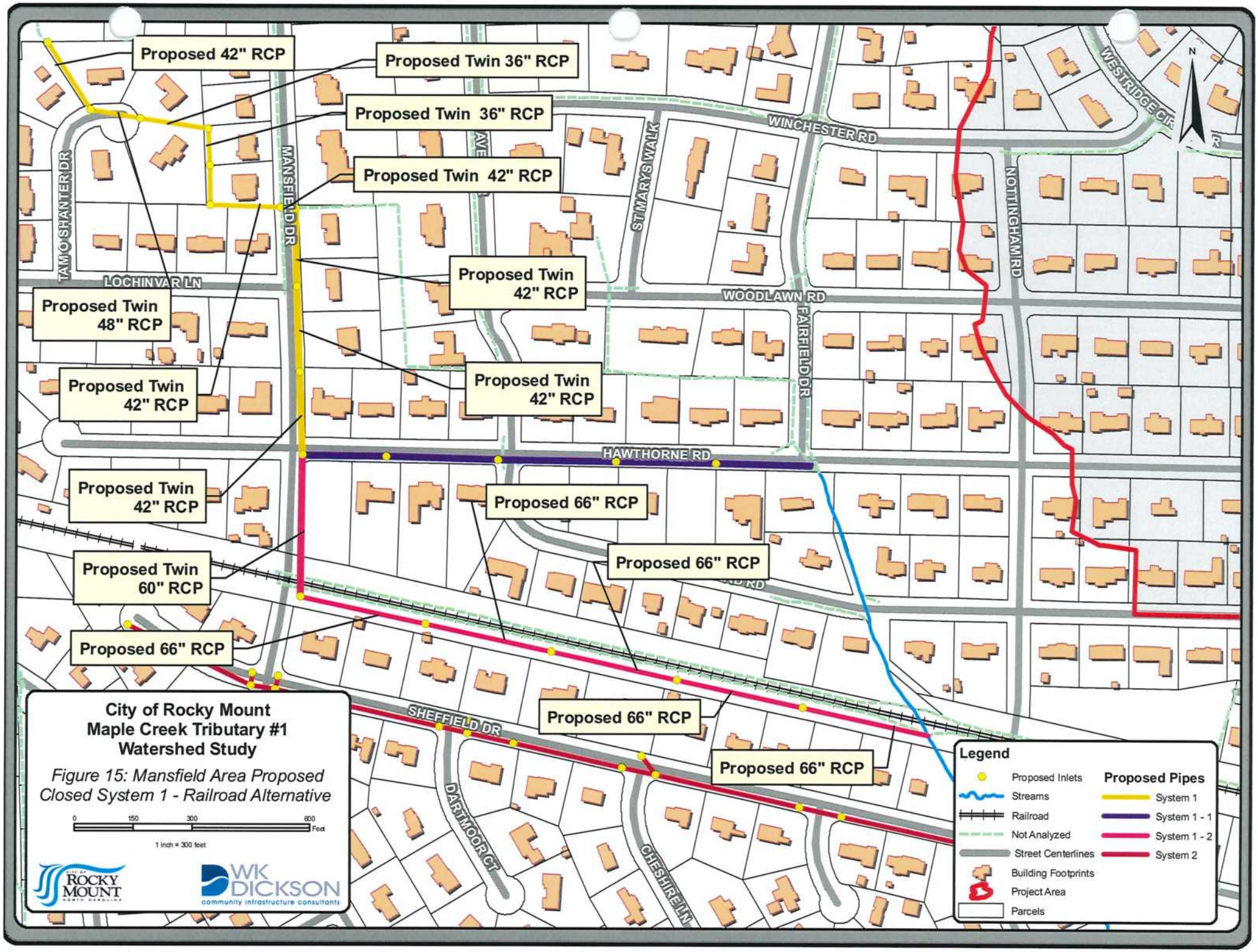
In addition to rehabilitating the existing culvert, the existing brick headwalls would be replaced. The proposed headwalls would lower the inlet loss coefficient to 0.2. This will help the culvert to perform more efficiently by reducing the entrance losses. It should be noted that the 25-year level of service will not be met by completing the rehabilitation. This alternative was considered because it provides a lower cost option that will extend the usable life of the culvert.

Mansfield Area Closed Systems

System 1 – Railroad Alternative

The design improvements proposed for this alternative include extending the existing closed system alignment down Mansfield Drive to the railroad right-of-way and continuing it along the railroad tracks until it outlets on the downstream side of the existing railroad culvert (see Figure 15). The proposed system will capture all runoff upstream of the low point in Mansfield Drive as well as along Mansfield Drive, and convey it through the new system. This alternative will also keep the existing alignment in place to capture the runoff not diverted to the new system. These proposed improvements will correct the existing nuisance flooding in the vicinity of Mansfield Drive, Gravely Drive, and Hawthorne Road and also increase the level of service for the culvert at Winstead Road. However, it will create flooding problems downstream of the railroad tracks because of the increase in flow and heightened water surface elevations.

Additionally, the proposed changes will lead to an increased water surface elevation at the South Winstead Avenue culvert crossing. This increase will cause the culvert to overtop and no longer be able to pass the required 50-year storm event.


Proposed 42" RCP
Proposed Twin 36" RCP
Proposed Twin 36" RCP
Proposed Twin 42" RCP
Proposed Twin 42" RCP
Proposed Twin 48" RCP
Proposed Twin 42" RCP
Proposed Twin 42" RCP
Proposed Twin 42" RCP
Proposed Twin 60" RCP
Proposed 66" RCP
Proposed 66" RCP
Proposed 66" RCP
Proposed 66" RCP
Proposed 66" RCP
TAM O SHANTER DR
MANSFIELD DR
LOCHINVAR LN
ST MARYS WALK
WINCHESTER RD
WESTRIDGE CIR
NOTTINGHAM RD
WOODLAWN RD
FAIRFIELD DR
HAWTHORNE RD
SHEFFIELD DR
DARTMOOR CT
CHESHIRE LN
N
City of Rocky Mount
Maple Creek Tributary #1
Watershed Study
Figure 15: Mansfield Area Proposed Closed System 1 - Railroad Alternative
0 150 300 600 Feet
1 inch = 300 feet
ROCKY MOUNT
WK DICKSON
community infrastructure consultants
Legend
Proposed Inlets
Streams
Railroad
Not Analyzed
Street Centerlines
Building Footprints
Project Area
Parcels
Proposed Pipes
System 1
System 1 - 1
System 1 - 2
System 2

The estimated project costs are approximately $2,695,080. Hydraflow modeling results of the proposed system has been included in Appendix F.

Based on the negative impacts that accompany putting this system in place, it is not recommended for design or implementation.

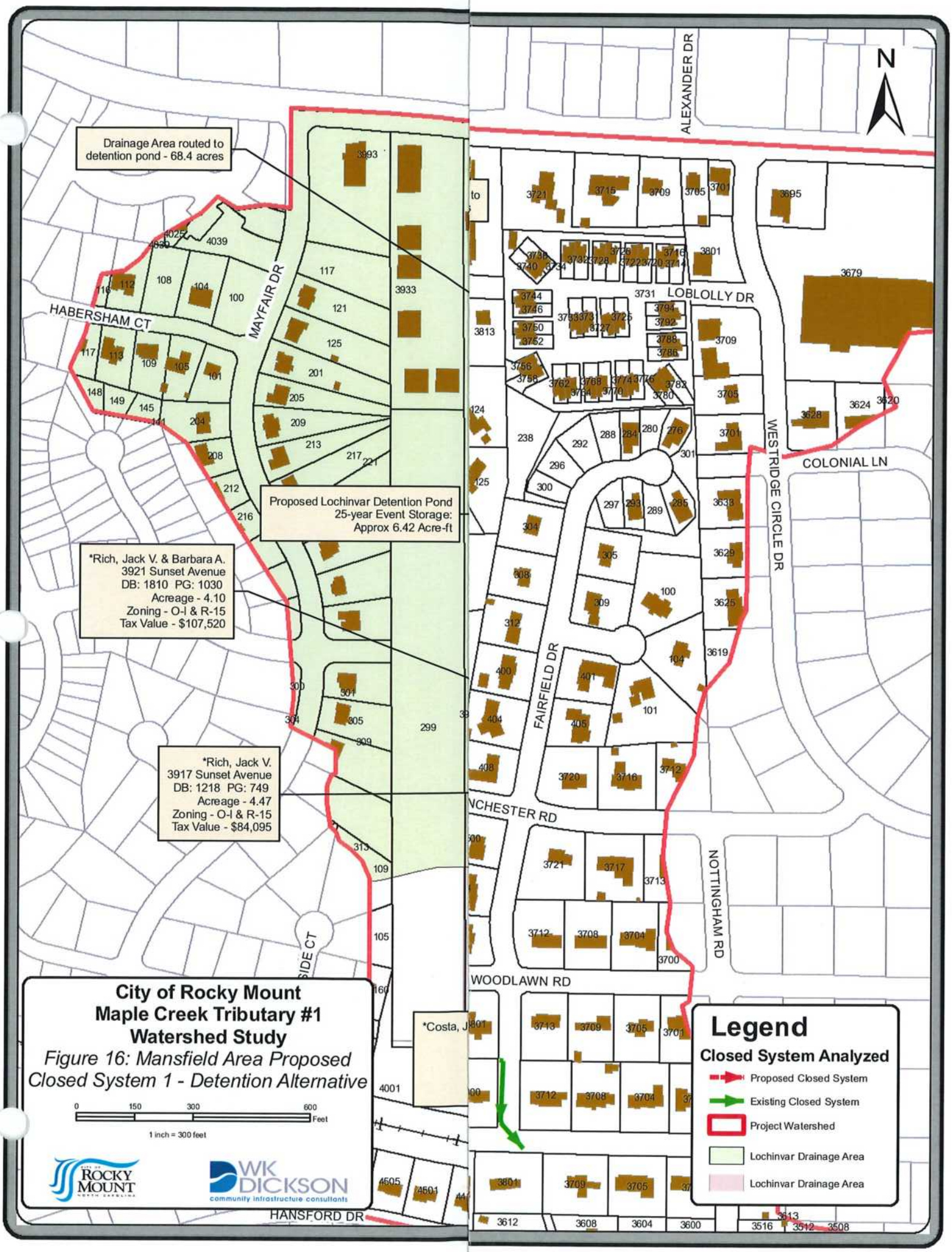
System 1 – Lochinvar and Newby Detention Alternative

This alternative proposes two detention areas. One will provide detention near Lochinvar Lane and the other near Newby Road. The Lochinvar detention area will be used to collect runoff from approximately 68 acres of the uppermost drainage area and slowly discharge it back into the existing system at the upper end of the Mansfield Area closed system (see Figure 16). The Lochinvar detention area will provide a significant peak flow reduction in the existing Mansfield Drive closed system. For the 25-year storm, the peak flow will be reduced from 180 cfs to 60 cfs. This reduction alone will not allow Mansfield Drive to pass the 25-year storm event.

The second detention area, referred to in this report as the Newby detention area will collect runoff from about 47 acres in the uppermost drainage area and release it back into the existing system. The combination of the Lochinvar and Newby detention areas will reduce the peak flows to the existing system from 180 cfs to approximately 15 cfs. This reduction nearly brings the existing system into compliance with the required 25-year level of service. More importantly, these changes do not result in increased peak flows downstream of the closed system outlet.

The estimated project cost for the proposed Lochinvar and Newby detention areas is approximately $1,171,840.

The Lochinvar and Newby detention alternative is the most cost-effective solution to decreasing the flooding in the Mansfield Area without creating flooding problems for the residents downstream of Hawthorne Road. Therefore, it is the recommended alternative for this system.



City of Rocky Mount
Maple Creek Tributary #1
Watershed Study

Figure 16: Mansfield Area Proposed Closed System 1 - Detention Alternative

SECTION 5
PUBLIC EDUCATION AND OUTREACH

The objective of the public education and outreach program is to inform and educate the City's residents, City staff, the development community (i.e. building contractors), and elected officials. An educated public is essential to the success of a stormwater management plan. The best method to accomplish this is to use a multi-pronged approach to reach the diverse demographics and varying levels of knowledge within the City.

Currently, the City of Rocky Mount has a website that provides information about the Stormwater Hotline, along with a general stormwater presentation discussing the development of the City's Stormwater Utility and a yard waste flyer. The website should be updated periodically and information about additional topics should be made available to the public through this and other mediums. For example, providing fact sheets that discuss the effects of stormwater pollution on natural resources and public health. These fact sheets can show how urban runoff contributes to polluting local water bodies and affects aquatic life. Additionally, they can talk about how stormwater pollution creates potential health risks to people swimming or fishing in contaminated waters.

Another idea is to target those City residents that live adjacent to Maple Creek Tributary #1 and Nottingham Tributary. For this select group, quarterly newsletters could be mailed presenting information regarding the importance of not illegally discharging items (i.e. yard waste, car batteries, and other miscellaneous debris) into the stream. The newsletter should encourage the residents to keep the stream clean and report any blockage.

Proposed improvements within the Maple Creek Tributary #1 watershed must adhere to the requirements set forth in Sections 401 and 404 of the Clean Water Act. Required permitting can range from activities that are pre-authorized to those requiring a pre-construction notification (PCN) for a Nationwide Permit (NWP). It is anticipated that NWP #3 (Maintenance), NWP #13 (Bank Stabilization), and NWP #27 (Stream and Wetland Restoration Activities) will be required to support the projects associated with the Maple Creek Tributary #1 Drainage Basin Study. More detailed explanations of the aforementioned NWPs are provided below.

NWP #3 – Maintenance. This permit authorizes the repair, replacement or rehabilitation of any previously permitted or currently serviceable structure. A PCN is not required if minor deviations in the structure's configuration or filled area occur as a result of changes in materials, construction techniques, or safety standards necessary to make repair or replacement, provided that environmental impacts are minimal. A PCN to the United States Army Corp of Engineers (USACE) is required if a significant amount of sediment is excavated/filled within the channel. NC Division of Water Quality (DWQ) does not require a PCN for NWP #3 but usually receives one as a courtesy.

Other provisions imposed by the State of North Carolina require that culvert inverts must be buried a minimum of 1-foot below the streambed for culverts greater than or equal to 48 inches in diameter to allow low flow passage of water and aquatic life. Culverts less than 48 inches in diameter should be buried to a depth of 20% or greater of the diameter of the culvert.

NWP #13 – Bank Stabilization. This permit authorizes the reshaping of channel banks or bank stabilization activities that are necessary for erosion prevention. The placement of material is prohibited in any special aquatic site in a manner that may impede surface water flow into or out of a wetland area, or in a manner that will be eroded during normal or high flows. The activity must be part of a single and complete project and cannot exceed 1 cubic yard per running foot placed below the high water mark line. If stabilization activities exceed 500 linear feet, then a PCN is required for both the USACE and DWQ. DWQ must also be notified should fill be placed within the streambed.

NWP #27 – Stream and Wetland Restoration Activities. This permit authorizes stream enhancement, stream restoration, and channel relocation for restoration purposes that provide gains in aquatic functions. Stream channelization and the conversion of streams to other aquatic uses such as impoundments or waterfowl habitat are not authorized. A PCN to the USACE is required for any restoration activities occurring on private or public lands. DWQ requires a PCN if impacts are proposed for greater than 500 feet of stream bank or if in-stream structures are used.

Impacts proposed to the streams may need evaluation under the State Environmental Policy Act (SEPA). An Environmental Assessment (EA) is required under SEPA if greater than 500 linear feet of perennial stream is disturbed and stream restoration or enhancement is not performed. Channel disturbances are defined as activities that remove or degrade stream uses such as channelization, culvert placement, riprap, and other hard structures.

General Conditions for Permit Issuance
A list of some other conditions that should be followed under regulations provided by the USACE and DWQ are as follows:

- Soil erosion and sediment controls must be used and maintained in effective operating conditions during construction, and all exposed soil and fills should be stabilized at the earliest possible date.
- No activity is authorized under any NWP that is likely to jeopardize the existence of a threatened or endangered species, or which will destroy or adversely modify the habitat of such species.
- No activity is authorized that may affect historic properties listed or eligible for listing in the National Register of Historic Places.
- More than one NWP used for a single and complete project is prohibited (e.g. the Maple Creek Tributary #1 Basin project).
- Mitigation in all its forms will be required to the extent necessary to ensure that the adverse effects to the aquatic environment are minimal.
- Hardening techniques should be avoided and minimized to the greatest practicable extent.

Erosion and Sediment Control
North Carolina Department of Environment and Natural Resources (NCDENR) is another agency that requires notification before proposed activities are constructed. NCDENR requires that an erosion and sedimentation control plan be submitted to the Land Quality Section for approval before the start of construction.

SECTION 7
FUNDING OPPORTUNITIES FOR WATER QUALITY IMPROVEMENTS

As final design of the proposed improvements are evaluated, the City of Rocky Mount is encouraged to investigate the potential funding mechanisms that are available for water quality projects like stormwater BMPs and stream restoration. Identified potential restoration sites should be evaluated for landowners interested in participation. Preliminary project objectives should be developed for each site within the watershed. It should be noted that including multiple objectives such as a greenway trail or stormwater BMPs into the stream restoration project broadens the number of potential funding sources.

Once the City has identified stream reaches and developed objectives for a given area, appropriate grant opportunities can be identified and pursued. There are a wide range of funding mechanisms available to the City. Obvious sources include the Clean Water Act Part 319 funds administered by the US EPA and the North Carolina Cleanwater Management Trust Fund. However, several transportation grants can be applied to restoration projects if greenways or bike paths are included in the design. There are also environmental justice programs to fund projects in economically disadvantaged areas. Finally, there has been an emergence of mitigation bankers within North Carolina that will fund similar projects. They handle all issues through construction and then sell the mitigation credits to public agencies that have impacts in the area. These funding opportunities can be very effective in offsetting project costs.

SECTION 8
RESOLUTION OF CITIZENS COMPLAINTS

Citizen feedback has primarily been provided in the form of resident responses to the City of Rocky Mount generated questionnaires. In addition to the questionnaires, feedback and complaints were also obtained at public meetings, from the City's Citizen Reporting Center, and from WK Dickson phone conversations. The information received from the residents assisted in identifying existing problems and verifying high water data. One of the residents who lives upstream of the railroad culvert crossing at 3605 Winstead Avenue provided pictures and information that was used as a check to confirm that the modeling results were reasonable.

All of the questionnaires received did not contain complaints, but they were included in the tally of responses. Approximately 40% of the responses received were concerning erosion and/or flooding related to the Maple Creek Tributary #1.

Appendix D contains the complete table of residents' responses to the questionnaires. A summary of responses and the corresponding resolution is also included. Of the 97 problems reported, 26 would be resolved by the recommended alternatives while 14 could be resolved by the City maintenance. The majority of the erosion problems reported will not be resolved by this project. However, the reduced flows resulting from the construction of the detention areas will not cause the identified problems to get any worse.

SECTION 9
CONCLUSIONS AND RECOMMENDATIONS

The goal of this project is to reduce flooding by providing a holistic approach to the entire watershed. Currently, several roads do not meet the City's hydraulic design requirements. WK Dickson has presented alternatives that will meet the City's requirements. Additionally, alternatives that help to reduce or eliminate the identified problems have been presented. The following factors were used to compare the various alternatives:

- Desired roadway level of service.
- Anticipated permitting.
- Physical feasibility.
- Anticipated easement needs.
- Cost versus benefits.

All of the culverts, with the exception of the one located at the railroad crossing, are not meeting the required level of service prescribed by the City. The recommendations for these culverts as are follows:

- Winstead Road, Railroad Crossing, Sheffield Drive, and Avondale Avenue – No improvements recommended. The culverts should be replaced on an individual basis as they near the end of their service lives.
- South Winstead Avenue – No improvements recommended.
- Nottingham Road – Replace the existing culvert with an 8' x 6' RCBC.

The recommendations for Systems 1 through 5 located in the Mansfield Area are as follows:

- System 1 – Continue to study the areas including obtaining detailed survey and soils data for the Lochinvar and Newby detention areas. Prior to constructing the detention areas, additional modeling will need to be completed.
- Systems 2, 3, and 5 – Currently, there are no recommended improvements for this system. The City's maintenance staff can replace the system as the pipes near the end of their service lives.
- System 5 – No improvements recommended. This system currently meets City design standards.

The detention areas are the most beneficial alternative because they decrease the flooding in the Mansfield Area without creating additional flooding problems for those located downstream. Although it is beneficial, it is uncertain if these detention areas will be constructed. Their location is on private property and buy-in from the property owners is required. It is recommended that the Lochinvar and Newby detention areas be analyzed more thoroughly after obtaining detailed survey and a soils analysis for the areas of interest. Additionally, property owners should be kept informed and involved throughout the process.

APPENDIX A

Hydrologic Analyses

The purpose of the hydrologic analysis of Maple Creek Tributary #1 is to estimate the magnitude of selected frequency floods for sub-basins within the watershed. The USACE's HEC-1 computer model simulates the surface runoff response to precipitation for an interconnected system of surfaces, channels, and ponds and was selected for the hydrologic analysis of this watershed. Input data for the HEC-1 model was developed using topographic, land use, and soils maps in ArcGIS to delineate and calculate the basin areas and Natural Resources Conservation Service (NRCS) hydrologic parameters.

The HEC-1 model offers a variety of methods for simulating the rainfall-runoff response, hydrograph development, channel and pond routing. The selection of methods for the analyses is based on the study objectives, data availability, and watershed characteristics. The precipitation data for the 6-hour duration, Type 2 storm was used to represent the synthetic rainfall event. The NRCS curve number approach was selected to calculate runoff volumes from the precipitation data, and the sub-basin unit hydrographs for these flood volumes were developed using the NRCS lag times. Where appropriate, the Muskingham-Cunge routing method was selected to account for channel routing.

Sub-basin Delineation and Connectivity

The Maple Creek Tributary #1 basin was manually delineated into 12 sub-basins using digital topographic maps with 2-foot contour intervals obtained from NCDOT GIS database. The sub-basin divisions were selected at hydrologically and hydraulically significant points, such as major roadway crossings, stream convergences, known problem areas, etc. Basin sizes range from 9.8 to 141.5 acres. The watershed map included in Appendix C illustrates the sub-basin and hydrologic connectivity.

Soils

The NRCS curve number method uses basin characteristics, such as soil types and land use, to compute the runoff response. The infiltration rate of a soil influences the volume of surface runoff that results from given storm events. Soils with high infiltration rates produce lower runoff than soils with lower infiltration rates. The Natural Resources Conservation Service has prepared soil maps for Nash County that identify four soil groups. The groups (A, B, C, and D) correspond to decreasing rates of infiltration. A general description of the four soil groups taken from the USDA, SCS, NEH-4 (1972) is presented in Table A-1.

Table A–1 – Hydrologic Soils Groups

Soil Group	Description
A	Group A soils have high infiltration rates even when thoroughly wetted and consist chiefly of deep, well to excessively drained sand or gravels. These soils have a high rate of water transmission. (greater than 0.3 inch per hour)
B	Group B soils have moderate infiltration rates even when thoroughly wetted and consist chiefly of moderately deep to deep, moderately well to well drained soils with moderately fine to moderately coarse texture. These soils have a moderate rate of water transmission. (0.15 to 0.3 inch per hour)
C	Group C soils have slow infiltration rates when thoroughly wetted and consist chiefly of soils with a layer that impedes downward movement of water, or soils with moderately fine to fine texture. These soils have a slow rate of water transmission. (0.5 to 0.15 inch per hour)
D	Group D soils have a very slow infiltration rate when thoroughly wetted and consist chiefly of clay soils with a high swelling potential, soils with a permanent high water table, soils with a clay plan or clay layer at or near the surface, and shallow soils over nearly impervious material. These soils have a very slow rate of water transmission. (0 to 0.05 inch per hour)
B/D	Group B/D soils behave as a Group B soil until the soil becomes saturated. When saturated the soil will behave as a Group D soil.

The NRCS soils map for the Maple Creek Tributary #1 basin was generated based on information provided by the City of Rocky Mount. Soils within the watershed are predominantly NRCS hydrologic soil groups B and B/D (See Appendix C).

Land Use

Land use is the watershed cover condition as it relates to the actual type of development and zoning within the watershed. Land use influences the runoff characteristics of a watershed, and combined with other basin characteristics, is used to determine the NRCS curve number for the basin.

The existing zoned land uses for the Maple Creek Tributary #1 basin were provided by the City of Rocky Mount. These zoning maps were used to develop the future conditions peak flows for the watershed. Seven land use categories were delineated within the Maple Creek Tributary #1 basin based on the information provided and field observation of the current uses (See Appendix C). The following table provides a description of the land use categories in the Maple Creek Tributary #1 basin.

Table A–2 – Land Use Categories

Land Use Category	General Description
Residential – Single Family	Single-Family Residential, typically 1/3 acre – 1/2 acre
Residential – Multi-Family	Multi-Family Residential, typically 1/8 acre
Commercial	Commercial and Business
Office	Commercial and Business
Industrial	Industrial
Agricultural	Agricultural
Split Use	Split Use (i.e. churches, businesses, and residential)

In its entirety, the Maple Creek Tributary #1 basin covers an area of 741 acres (1.16 square miles). More than 90 percent of the basin is developed currently to its zoned land use. It is assumed that several undeveloped lots in the watershed will be developed as they are currently zoned. Percentages of each land use group and the correlating acreage are listed in the table below.

Table A–3 – Land Use/Zoning Groups

Land Use Group Name	Percent of Basin Area of Selected Land Use	
	Existing Conditions	Acreage
Residential – Single Family	82%	23
Residential – Multi-Family	3%	607
Commercial	1%	10
Office	4%	30
Industrial	0%	0
Agricultural	2%	52
Split Use	7%	18
Total	**100%**	**741**

NRCS Curve Numbers

The NRCS curve number approach was used in computing the runoff response in HEC-1. Runoff curve numbers (RCNs) were generated using the hydrologic soil group and land use to assign a runoff curve number as described in the NRCS document entitled Urban Hydrology for Small Watersheds, dated June 1986 and commonly referred to as TR-55. This method relates the drainage characteristics of soil group, land use category, and antecedent moisture conditions to assign a runoff curve number. The runoff curve number and an estimate of the initial surface moisture storage capacity are used to calculate a total runoff depth for a storm in a basin.

The antecedent moisture condition (AMC) refers to the total rainfall in a five-day period preceding a storm and relates to the soil moisture condition at the beginning of the storm event. The AMC value can be used as a calibration tool in the hydrologic computations where AMC-1 represents "dry" conditions and AMC-3 represents "wet" conditions. The average antecedent moisture conditions (AMC-2) are generally considered most representative for the humid southeastern portion of the country and were used for the hydrologic calculations in this study.

Runoff curve numbers were determined for each sub-basin based on the soil group, land use, and average AMC for the area. The curve numbers calculated for this study are listed in Table A-4 below.

Table A–4 – Curve Numbers Based on Land Use and Soil Groups

Land Use Category	Soil Group			
	A	B	C	D
Residential – Single Family	61	75	83	87
Residential – Multi-Family	80	85	90	92
Commercial	98	98	98	98
Office	96	97	98	98
Industrial	98	98	98	98
Agricultural	39	61	74	80
Split Use	25	55	70	77

For each sub-basin, the curve number was determined and weighted by area to calculate the composite curve number for each sub-basin. A summary of the hydrologic input data including the runoff curve numbers is shown in Appendix F.

Table A–5 – Summary of Hydrologic Input Data

Drainage Basin ID	Drainage Area (acre)	RCN	Time of Concentration (minute)
1A	139.9	78	59.6
1B	40.0	89	28.6
1C	39.9	82	37.1
1D	58.5	75	32.5
2A-1	20.0	76	41.6
2A	40.2	79	33.0
2B	55.0	77	24.2
2C	77.8	82	37.3
2D	9.8	79	21.9
2E	78.7	75	36.9
3A	39.2	74	56.1
3B	141.5	77	38.0

Time of Concentrations

The lag time as defined by the NRCS for use in the NRCS dimensionless unit hydrograph method is the time, or lag, between the center of mass of rainfall excess and the peak of the unit hydrograph. The lag time is based on the sub-basin time of concentration, or travel time, and is a function of the sub-basin size, shape, slope, cover, and other basin characteristics. For the NRCS method, the sub-basin lag time is calculated to be 0.6 times the time of concentration for each sub-basin.

The times of concentrations for the sub-basins were calculated from the methodology described in TR-55. A summary of the calculations is shown in Appendix G. The longest flow path is divided into 3 types of flow; overland flow, shallow concentrated flow, and channel flow. A spreadsheet was developed to tabulate the incremental travel times for each type of flow for each sub-basin. The incremental travel times were totaled and multiplied by 0.6 to compute the lag time for each sub-basin. The equation detailing the travel time for sheet flow is as follows:

$$T_t = \frac{.007\,(nL)^{0.8}}{(P_2)^{0.5}\,s^{0.4}}$$

T_t = Travel Time in hours
n = Manning Roughness Coefficient (Paved=0.011, Unpaved=0.24)
L = flow length in feet
P_2 = 2-year, 24 hour rainfall = 3.6 inches
S = slope of hydraulic grade line (land slope in ft/ft)

For shallow concentrated flow, the velocity (V) is calculated for either paved or unpaved sections by using the following equations:

$$\text{Unpaved } V = 16.1345\,(S)^{1/2}$$
$$\text{Paved } V = 20.3282\,(S)^{1/2}$$

The travel time for shallow flow is then calculated by dividing the flow length (L in feet) by velocity as follows:

$$T_t = \text{Travel Time} = L / (3600 * V)$$

The open channel travel times are determined by a modified version of the Manning equation, which is as follows:

$$V = \frac{1.49\, R^{2/3}\, S^{0.5}}{n}$$

V = Average full-flow velocity (ft/s)
R = Hydraulic radius (ft)
S = Slope of hydraulic grade line (ft/ft)
n = Manning roughness coefficient

Rainfall

The HEC-1 model is based on the assumption that a certain frequency rainfall will produce the same frequency runoff or flood event. The 6-hour duration NRCS Type 2 storm for Rocky Mount, North Carolina provides the rainfall data for the Maple Creek Tributary #1 basin study HEC-1 model. During a Type 2 storm, the most intense rainfall occurs at the midpoint of the rainfall period. The rainfall depths for each design storm were developed from the intensity-duration-frequency curves calculated by the US Weather Bureau's Technical Paper No. 40. The rainfall depths for various duration and frequency storms for Rocky Mount, North Carolina are shown in Table A-6.

Table A–6 – Rainfall Depth Duration-Depth Frequency Table for Rocky Mount, NC

Duration	Rainfall Depth (inches) For Selected Storm Frequencies				
	2-year	10-year	25-year	50-year	100-year
5-minute	0.49	0.61	0.69	0.76	0.82
15-minute	1.05	1.34	1.54	1.69	1.84
1-hour	1.80	2.58	3.30	3.65	3.75
2-hour	2.25	3.30	3.85	4.40	4.75
3-hour	2.45	3.65	4.20	4.70	5.20
6-hour	2.90	4.25	5.00	5.60	6.40
24-hour	3.60	5.28	6.48	7.20	8.00

Channel Elements

Flood peaks attenuate, or reduce, as they travel downstream due to the storage characteristic of the stream reach. The Muskingum-Cunge routing method in HEC-1 was selected to define the storage characteristic of selected stream reaches in the Maple Creek Tributary #1 basin. It can be described as a hydrologic routing method based on physical parameters of the channel and floodplain. Input data for this method consists of representative channel/floodplain sections, reach length, Manning's roughness coefficient, and channel bed slope. This method provides advantages over other hydrologic techniques based on three factors. The relative size and slope of the channels and floodplains in the Maple Creek Tributary #1 watershed make the Muskingum-Cunge method an ideal choice for attenuating peak flows.

Structure and Pond Routing

Reservoir storage routing was used for routing hydrographs through the storage areas upstream from undersized structures (culverts). HEC-1 is able to model the effects of an undersized culvert through inputs defining the relationship between water volume or area and elevation and the relationship between outflow and water surface elevations. The relationship between outflow and water surface elevations is developed using an iterative process between HEC-1 and HEC-RAS. A rating curve generated using HEC-RAS defines the outflow of the water leaving this system.

Structures having fill heights greater than or equal to 50 percent of the height of the structure were assumed to provide significant peak flow attenuation and, therefore, were routed in the HEC-1 model. In addition, any structure which exhibited significant upstream floodplain storage or significant backwater from the HEC-RAS model output would be analyzed for providing peak flow attenuation.

For each structure, the cutoff point in the backwater pool was determined where the structure routing ends and upstream channel routing begins. This determination was necessary so that available storage areas calculated for channel and structure routing did not overlap. The following procedure was used for this determination:

- The approximate limit of the 100-year frequency flood backwater pool was delineated in the topographic map;
- The distance from the upstream face of the structure to the upstream limit of the pool was measured;
- From the upstream end of the backwater pool, a distance equal to 20 percent of the total pool length was measured in the downstream direction and the point marked on the topographic map;
- Through this point a line was drawn perpendicular to the contour lines;
- This line was then designated as the cutoff point to be used as the upstream limit of the channel routing.

For each structure, the elevation-storage relation for the Modified Puls method was derived by calculating the surface area of the topographic contours from the upstream face of the structure to the routing cutoff point associated with the structure. A pair of "SA" (storage area) – "SE" (elevation) records, the elevation-storage relation for each structure was input from the planimetered information. To avoid interpolating storage areas for each stage-discharge point, a separate stage-discharge relation was entered into the HEC-1 model on a pair of "SQ"

(discharge) – "SE" (elevation) records based on the HEC-RAS model output. An NSTPS value of 1 was input into the HEC-1 Model on the "RS" record for these routings because the backwater pool behind the structure functions as a reservoir. An NSTPS value of 1 provides for maximum hydrograph attenuation during the routing.

However, the method described in the previous paragraph does not account for the reduction in tailwater on the structure due to the attenuation effects of the upstream storage, which in turn can affect the stage-discharge relation of the structure. Therefore, an iterative process for storage structures was followed with an objective to obtain a set of peak discharge values, runoff volumes, and water surface elevations that are "balanced" between the two models. The process was initiated by inputting a set of discharges into the HEC-RAS model to develop a set of discharge-storage relations for each reach. This initial set of relations was input into the HEC-1 model. These values were supplemented by the depth-storage relation for each structure. The HEC-1 model was run with these values to derive new discharges at downstream locations. These new values were input into the HEC-RAS model and it was recomputed. The new discharges and water surface elevations listed in the HEC-1 summary output were compared with the discharges listed in the previous HEC-RAS run. When the values stabilized, the model was considered "balanced". If not then additional iterations were performed. Typically, three iterations are adequate to derive a balanced model.

Summary of HEC-1 Model Results

The HEC-1 model was used to compute peak runoff for the 2-, 10-, 25-, 50- and 100- year design storms for the existing developed conditions. The curve numbers for the Maple Creek Tributary #1 basin range from 74 to 92 with the majority being in the mid to upper 70s. The time of concentrations were found to range from 22 minutes to 60 minutes. These results are characteristic of urbanized residential watersheds with areas of high imperviousness.

The results of the hydrologic model are summarized in Table A-7. The HEC-1 input and output are included in Appendix I. Additionally, a CD is included in Appendix L and contains the digital files for the HEC-1 model.

Table A–7 – Existing Flows with Storage Routing from HEC-1

	HEC-1 Node	Road Name / Location	Storm Event				
			2-year (cfs)	10-year (cfs)	25-year (cfs)	50-year (cfs)	100-year (cfs)
REACH 1 (Maple Creek Tributary #1)	BSN1A	U/S Limit of Maple Creek Tributary #1	111	217	298	351	393
	B1A-RT	Winstead Avenue	49	171	172	172	172
	B1-RT	Railroad Culvert	167	178	202	215	228
	B2-RT	Sheffield Drive	159	178	202	215	228
	RT3	Confluence of Mansfield and Nottingham Tributary	327	535	706	815	895
	B4-RT	South Winstead Avenue	356	566	700	792	861
	B5-RT	Avondale Avenue	415	751	946	1070	1181
	1	D/S Limit of Maple Creek Tributary #1	432	797	1008	1153	1268

REACH 2 (Nottingham Tributary)	NT-RT1	U/S Limit of Nottingham Tributary	97	171	226	263	290
	B3-RT	Nottingham Road	153	245	351	422	470

Comparison of Peak Flows

For comparison purposes, flood peaks were estimated using the U.S. Geological Survey (USGS) publication entitled "The National Flood-Frequency Program – Methods for Estimating Flood Magnitude and Frequency in Rural and Urban Areas in North Carolina –USGS Fact Sheet 007-00" (2001) at two key locations within the watershed. The following table compares the peak flows determined from the USGS regional regression equations for the Coastal-Plain region versus the peak flows from HEC-1 and FEMA.

Table A–8 – Comparison of Existing Conditions Peak Flows

Methodology	Location	2-year (cfs)	10-year (cfs)	25-year (cfs)	50-year (cfs)
HEC-1	Basin 1A	252	341	397	442
	D/S Limit of Maple Creek Tributary #1	816	1029	1164	1294
USGS NC Piedmont (2001)	Basin 1A	269	412	477	536
	D/S Limit of Maple Creek Tributary #1	773	1104	1257	1392

Review of the above table shows that the HEC-1 flows in the Maple Creek Tributary #1 watershed are slightly lower than the USGS Regression equation flows calculated by WK Dickson for all the design storms with the exception of the 10-year. The HEC-1 flows were on average 10% lower than those calculated using the USGS Regression equations. This is not untypical for comparisons between HEC-1 and USGS regression equations in North Carolina.

Finally, a comparison was made to a historical study prepared by WK Dickson in the Rocky Mount area. Since the Long Branch Drainage Basin Study had similar land use, the results arrived at in that study provided a good comparison to the current basin study. The Maple Creek Tributary #1 25-year existing conditions peak flow/acre ranged from 1.39 to 2.45 cfs per acre which is in line with results from the Long Branch Study. Based on these comparisons, the peak flows generated using HEC-1 are reasonable and should be used to be evaluate culvert capacity in the watershed.

APPENDIX B

Hydraulic Analyses

The HEC-RAS model calculates water surface profiles for steady, gradually varied flow, both sub-critical and supercritical, for user-specified discharges. The standard step backwater analysis for sub-critical flow was modeled for Maple Creek Tributary #1. The model calculates the effect of obstructions, such as culverts, and building structures in the channel and floodplain on the water surface profile. The hydraulic computations are based on the solution of a one-dimensional energy equation with energy loss due to friction evaluated by Manning's equation.

Input data for the HEC-RAS computer model include the following:

- Cross-section geometry of the channel and floodplain,
- Roughness coefficients to describe the characteristics of the channel and floodplain,
- Size, shape, and characteristics of culverts and roadways along the stream reach, and
- Energy loss coefficients for flow in the channel and at roadway crossings.

Study Limits

As discussed with City of Rocky Mount stormwater staff, study limits for the hydraulic evaluation included those reaches of Maple Creek Tributary #1 from the confluence with Maple Creek upstream to Hawthorne Road. The reach of the Nottingham Tributary from the confluence with Maple Creek Tributary #1 to Jeremy Lane was also included in the hydraulic evaluation.

Field Surveys and Cross Sections

The topographic data for the Maple Creek Tributary #1 Basin Study is 2-feet contour interval mapping provided by the City of Rocky Mount. This data was supplemented by existing survey data for roadways, culverts and channels provided by the City. The two sources of topographic data were combined into a single workmap for the delineation of existing conditions floodplains. Consistent with the FEMA mapping for the City, the horizontal datum is NAD 83/95 and the vertical datum is NAVD 88.

Cross sections were located perpendicular to the flow and at intervals along the stream to characterize the flow capacity of the channel and floodplain for the selected reach. Along stream reaches where the shape, size, and geometry of the cross-section are varying, cross sections were cut at closer intervals than for reaches having little change in channel characteristic. Additional sections were cut as required by the HEC-RAS program to sufficiently model structures such as culverts.

Once the locations of the cross sections were determined, automated procedures were used to extract ground profiles (station-elevation data) along the cross sections. The data was entered into a HEC-RAS compatible format by utilizing an extension in ArcMap called GeoRAS. The file imported from GeoRAS was created from data sets (ArcMap Layers) containing the cross-sections, streams, top of banks, and a Digital Terrain Model represented as a triangulated irregular network (TIN).

Surveyed and template cross sections are identified by station number, which for the Maple Creek Tributary #1 basin model, refers to the approximate linear distance upstream from a reference point on the main channel or tributary reach. The cross sections depict the locations of cut sections from field topographic surveys. Similarly, the cross section at each road crossing represents the top-of-road cross section. The cross sections just upstream and just downstream

of highest point of roadway (commonly referred to as the weir) represent the locations of the upstream and downstream faces, respectively, of the bridge or culvert in an area not impacted by roadway fill. All elevations in this report are referenced to the North American Vertical Datum of 1988 (NAVD 1988).

Roughness Coefficients

Manning's roughness coefficients, or 'n' values, represent the resistance to flow and influence the flow capacity of channels and floodplains. The HEC-RAS model uses these coefficients to compute friction loss longitudinally in the channel and floodplain. The roughness value is a function of the type and density of the vegetation, channel bottom and stream bank material, degree of channel meandering, and depth of flow.

Roughness coefficients were determined for all stream reaches for which hydraulic analyses were performed. Three 'n' values were sufficient to represent the roughness of the floodplain and channel in the study area, one for the channel section, one for the right overbank floodplain, and one for the left overbank floodplain. The right or left bank of the stream is referenced facing downstream. Roughness coefficients used in this study are listed in Table B-1.

Table B–1 – Roughness Coefficients

Stream	Range of 'n' values for:		
	Left Overbank	Channel	Right Overbank
Maple Creek Tributary #1	0.015-0.1	0.035-0.05	0.03-0.1
Nottingham Tributary	0.035-0.1	0.045-0.055	0.035-0.1

All roughness coefficients were estimated through field observation and by referencing standard engineering manuals.

Bridge, Culvert, and Roadway Data

Based on guidelines provided in the City of Rocky Mount Stormwater Design Manual, the following standards and criteria were used to evaluate the drainage system:

Table B–2 – City's Design Standards and Criteria

Roadway Type	Design Storm (years)	Freeboard (feet)
Residential (Local and Collector)	25	1.0
Commercial (Local and Collector)	50	0.5
Industrial (Local and Collector)	50	0.5
Minor and Major Arterial	50	0.5

*HW/D (the ratio of headwater depth to culvert depth) <1.2.

Culverts generally have different characteristics than the channel and floodplains away from roadway crossings. Often culverts constrict flood flows in the channel and floodplain, which may create backwater effects upstream of the structure. The constriction can produce increased velocities and result in localized scour.

For culvert analysis, the HEC-RAS model utilizes the concepts of "Inlet" control and "Outlet" control to simplify complicated culvert hydraulics. Inlet control flow occurs when the flow carrying capacity of the culvert entrance is less than the flow capacity of the culvert barrel.

Outlet control flow occurs when the culvert carrying capacity is limited by downstream conditions or by the flow capacity of the culvert barrel.

During inlet control computations, the culvert inlet acts as either a weir or an orifice, and the resulting headwater is computed. The equations used by HEC-RAS are the same as those developed by the Federal Highway Administration during extensive laboratory testing, which describe the inlet control headwater under various conditions.

For outlet control flow conditions, the required headwater is computed considering various conditions. For culverts flowing full, a form of the Bernoulli Equation, which considers friction losses, entrance losses and exit losses is utilized. Friction losses are based on Manning's equation. Entrance losses are computed as a coefficient times the velocity head in the culvert at the upstream end. Exit losses are computed as a coefficient times the change in velocity head from just inside the culvert (at the downstream end) to outside the culvert.

When the culvert is not flowing full, the direct step backwater procedure is used to calculate the profile through the culvert up to the culvert inlet. An entrance loss is then computed and added to the energy inside the culvert to obtain the upstream headwater. Culvert input data for the HEC-RAS model include:

- Shape and dimensions of the structure openings,
- Culvert length,
- Entrance loss coefficient, exit loss coefficient and coefficient of discharge for weir flow during roadway overtopping,
- Upstream and downstream invert elevations,
- Federal Highway Administration chart number for the culvert type,
- Top-of-road elevations to describe the weir during roadway overtopping and the weir crest length, and
- Four cross sections are required; one cross section sufficiently downstream of the culvert that flow is not affected by the culvert, one at the downstream end of the culvert, one at the upstream end of the culvert, and one located far enough upstream that the culvert has no effect on flow.

Energy Loss Coefficients

Contraction and expansion of flow produces energy losses caused by the transition. The magnitude of these losses is related to the velocity and the estimated loss coefficient. Where the transitions are gradual, the losses are small. At abrupt changes in cross-sectional area, the losses are higher. Energy losses resulting from expansion are greater than losses associated with contraction. Energy loss coefficients used for the Maple Creek Tributary #1 hydraulic models are presented in Table B-2 below:

Table B–3 – Energy Loss Coefficients

Type of Transition	Expansion	Contraction
None	0	0
Gradual	0.3	0.1
Culvert sections	0.5	0.3

Starting Water Surface Elevation

The starting water surface elevations for all the HEC-RAS models were calculated using the slope-area method found in HEC-RAS using the following slopes:

- 0.002 feet/feet for Maple Creek Tributary #1 Reach
- 0.0024 feet/feet for Nottingham Tributary Reach

Model Run Descriptions and Assumptions

The HEC-RAS model was used to compute flood elevations at each cross-section for Maple Creek Tributary #1 and Nottingham Tributary for the 2-, 10-, 25-, 50- and 100-year floods (based on the existing developed conditions). A digital copy of the HEC-RAS input and output is included on the CD in Appendix L.

The hydraulic analysis for this study is based only on the condition of unobstructed flow. Therefore, flood elevations shown on the profiles are considered valid only if hydraulic structures remain unobstructed and do not fail. Flood elevations may be raised by debris blockage of the channel or floodplain.

Model Verification

Efforts were made to verify the model for the large storm events such as Hurricane Floyd and also for smaller storms that occur more frequently. Attempts were made to contact residents living adjacent to the stream near the culverts to obtain high water marks. Only a small number of residents were successfully reached. Most were not able to provide significant information for verifying the model. However, the resident located upstream of the railroad at 3605 Winstead Avenue provided useful for information for verifying the model. The resident stated that he did not experience any flooding during Hurricane Floyd. The property was surveyed and first floor elevations (FFEs) were collected. They were compared to the water surface elevations obtained from the model.

The initial existing conditions model was showing the 10-year water surface elevations (WSELs) exceeding the FFEs by approximately 0.75 feet. In order to lower the WSEL and get the model in line with information provided by the resident, the following adjustments were made:

- Storage Routing for Basin 1A, upstream of Maple Creek Tributary #1 was accounted for.
- The depth of the storage was adjusted until the WSEL for the 50-year design storm was lower than the FFE by at 0.1 feet.

As a result of these modifications the flows were reduced by 20% (2- year storm event) to 46% (25-year storm event). Consequently, the water surface declined to an elevation that was lower than the FFEs in the 50-year design storm by 0.15 feet.

Feedback obtained from the questionnaires was also reviewed for relevant information that could be used to verify the model. The comments and responses received were not specific enough to verify the model. Likewise, the information received during the public meetings was not useful for the purposes of verifying the model.

Open Channel System

Roadway Flooding

Six roadway crossings were analyzed for flooding potential in the Maple Creek Tributary #1 basin study. All roadway crossings that were analyzed in this study are listed in Table B-4 including the minimum top-of-road elevations and the 2-, 10-, 25-, 50- and 100-year flood elevations at the crossing for existing and proposed conditions. The proposed conditions assume that improvements will be made at all of the culvert crossings except South Winstead Avenue. The results for upgrading all of the culverts along Maple Creek Tributary #1 (except the double 6' x 6' RCBCs at South Winstead Avenue) and Nottingham Tributary are included in Appendix J.

Table B–4 – Overtopping Analysis of Roadway Crossings

EXISTING CONDITIONS (WITH ROUTING)						
Location	Minimum Elevation at Top of Road (feet NAVD)	Calculated Water Surface Elevations (feet NAVD)				
		2-year flood	10-year flood	25-year flood	50-year flood	100-year flood
BOLD PRINT INDICATES OVERTOPPING						
Winstead Road	126.17	125.81	**126.47**	**126.70**	**126.87**	**127.17**
Railroad Crossing	127.97	125.75	126.01	126.51	126.83	127.16
Sheffield Drive	123.85	**124.30**	**124.41**	**124.50**	**124.58**	**124.60**
South Winstead Avenue	109.37	105.18	106.92	108.10	109.08	**109.55**
Avondale Avenue	100.61	**101.02**	**101.58**	**101.78**	**101.95**	**102.04**
Nottingham Road (Reach 2)	115.96	115.94	**118.54**	**119.29**	**119.61**	**119.78**
CITY DESIGN CONDITIONS						
BOLD PRINT INDICATES OVERTOPPING						
Winstead Road	126.17	124.61	125.01	125.80	**126.43**	**126.46**
Railroad Crossing	127.97	124.56	124.95	125.70	126.32	126.33
Sheffield Drive	123.85	121.21	121.55	122.32	122.92	122.93
South Winstead Avenue	109.37	105.74	107.06	108.35	**109.47**	**109.65**
Avondale Avenue	100.61	99.28	99.75	100.37	**100.81**	**101.03**
Nottingham Road (Reach 2)	115.96	114.32	115.64	**116.75**	**117.44**	**117.93**

As shown above Winstead Road, Sheffield Drive, Avondale Avenue, and Nottingham Road are not meeting the City design standards for overtopping. The culvert improvements necessary to bring these roads up to City standards have been described in Section 3 of this report. It should be noted that although these improvements will bring the culverts up to City standard due to the negative impacts caused by their installation, it is not recommended that they be installed.

Secondary System

The purpose of the hydrologic analysis for the secondary systems, or closed systems, was to estimate the peak runoff that would flow to the catch basins and into the closed system. The rational method was used for the closed system hydrologic analysis. The rational method can be expressed as follows:

$$Q = CiA$$

Q = maximum rate of runoff (cfs)
C = runoff coefficient representing a ration of runoff to rainfall
i = average rainfall intensity for a duration equal to the time of concentration (in/hr)
A = drainage area contributing to the design location (acres)

Sub-basin Delineation

The closed system basins were delineated using digital topographic maps with 2-foot contours. The sub-basin divisions were selected at hydrologically and hydraulically significant points, such as catch basins, yard inlets and headwalls.

Time of Concentration

The time of concentration can be described as the longest flow path from any point in the sub-basin to the outlet of the sub-basin. The times of concentration for the sub-basins were calculated using the Kirpich equation, which differs from the methodology described in TR-55. The rational method can be expressed as follows:

$$T_c = (K/128)(L^3/H)^{0.385}$$

Tc = Time of concentration (min)
L = Hydraulic length of sub-basin (ft), measured along the circuitous watercourse
H = Height (ft) of the most remote point on the ridge above the sub-basin outlet
K = Multiplier (dimensionless) associated with the nature of the flow path

The K value used was 1.0, which represents a mixed urban setting. Due to the small size of the sub-basins, all times of concentration were calculated to be less than five (5) minutes. Since the time of concentration cannot be less than five (5) minutes all values were rounded up to a value of five.

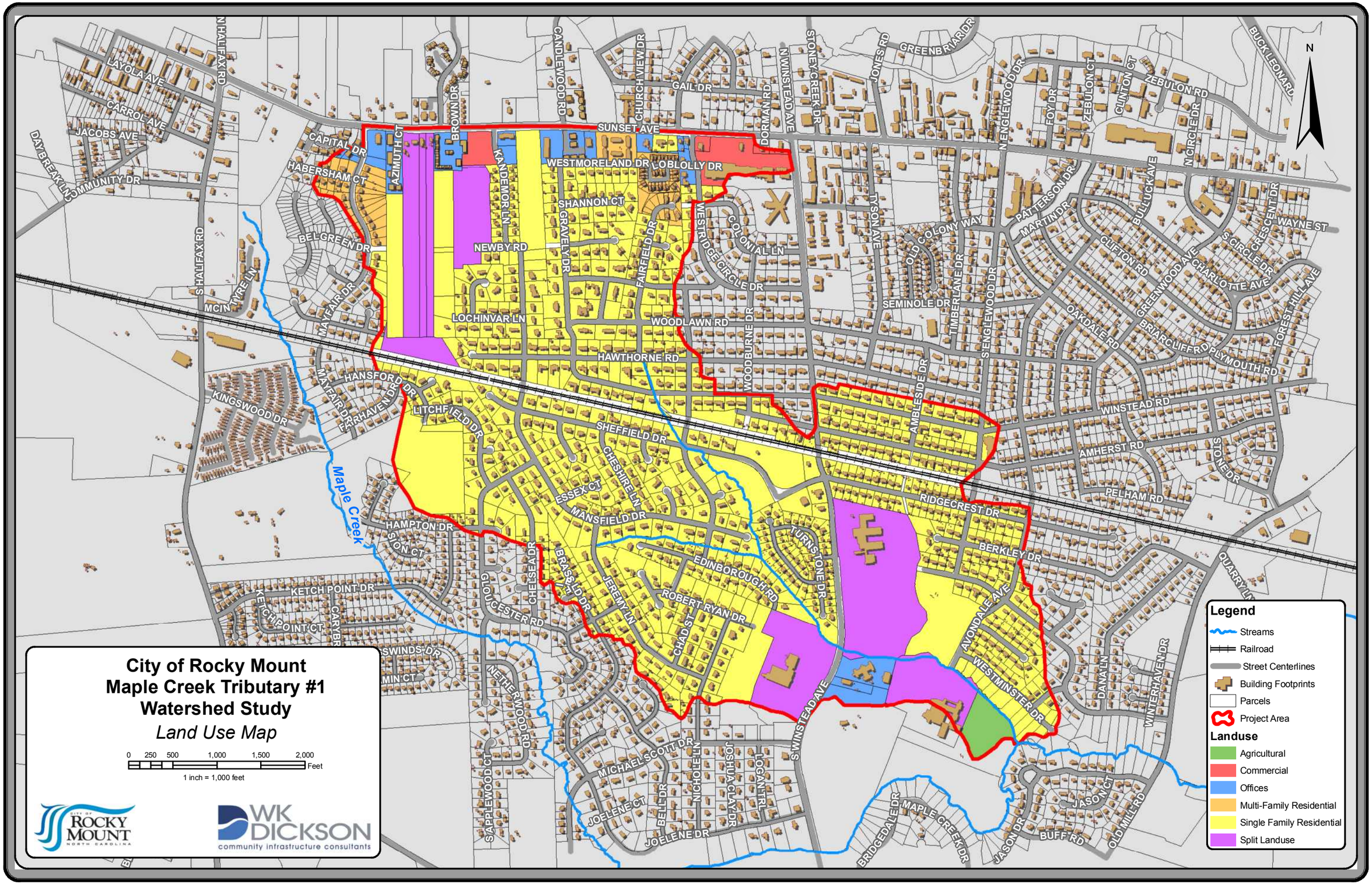
Rainfall Intensity

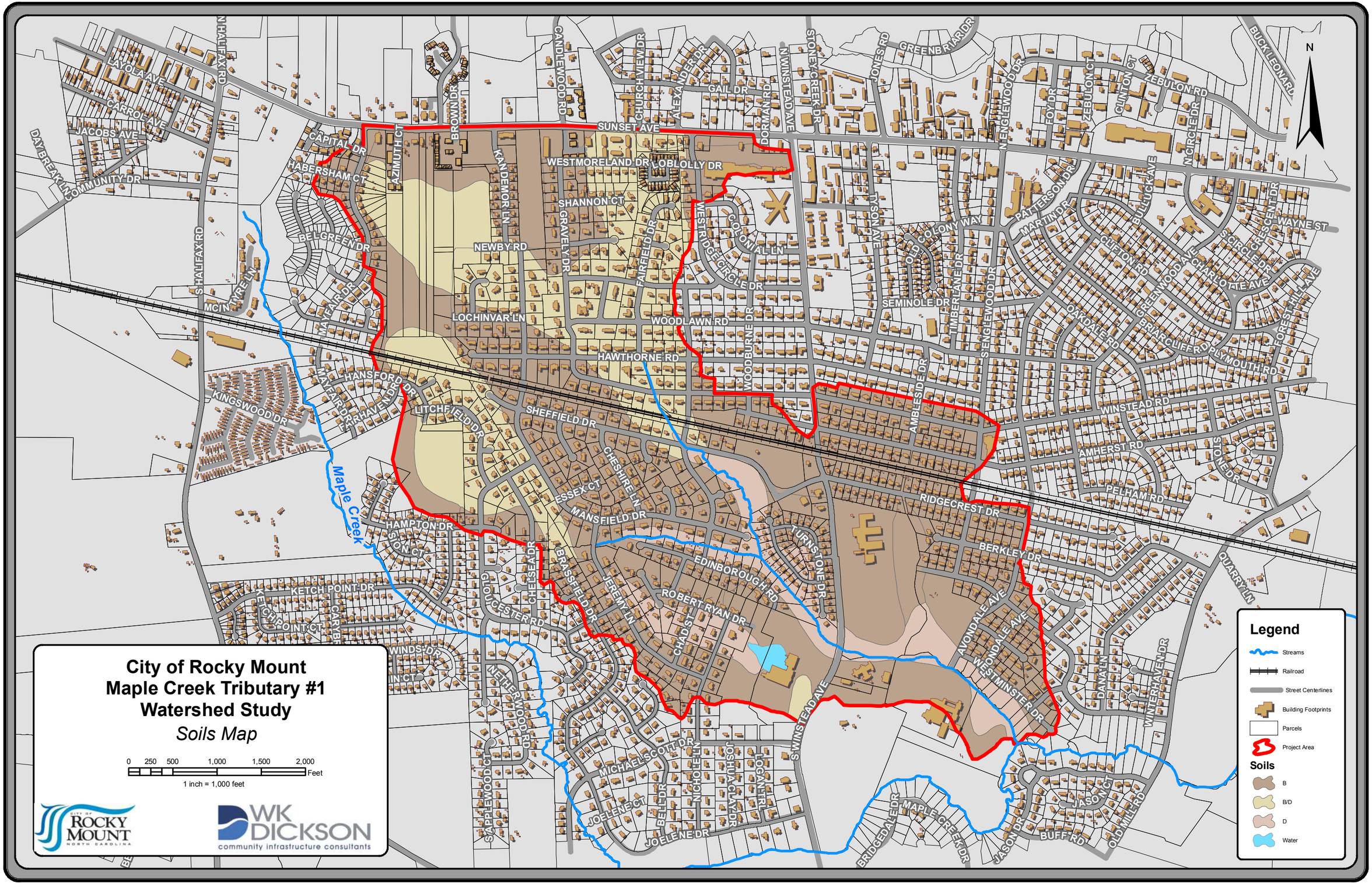
Intelisolve's Hydraflow Storm Sewers 2008 computer program (Hydraflow) computes rainfall intensity values based on the methods presented in FHWA Hydraulic Engineering Circular No. 12, Drainage of Highway Pavements. Precipitation values for the 2- and 100-year storm frequencies for 5, 15, and 60 minute durations are required for input. These input values were taken directly from Table 3-2, Intensity –Duration-Frequency Table – Rocky Mount, NC, from the City's Stormwater Manual.

Runoff Coefficients

Land use is the watershed cover and relates to the activities that occur in an area, that is, the zoned land uses, and to the kind of vegetation or surface cover associated with that use. Land use influences the runoff characteristics of a watershed, and combined with other basin characteristics are used to determine rational runoff coefficient. The predominant landuse surrounding the evaluated closed systems are ¼ to ⅓-acre residential. Since some of the sub-basins were comprised of a high percentage of street area, a composite coefficient was developed to obtain a more accurate value that represented the runoff characteristics for each basin. The two coefficients used were 0.55 for residential and 0.95 for asphalt. These values were obtained from the City of Rocky Mount Stormwater Design Manual.

APPENDIX C


City of Rocky Mount
Maple Creek Tributary #1
Watershed Study
Land Use Map
0 250 500 1,000 1,500 2,000 Feet
1 inch = 1,000 feet
Legend
Streams
Railroad
Street Centerlines
Building Footprints
Parcels
Project Area
Landuse
Agricultural
Commercial
Offices
Multi-Family Residential
Single Family Residential
Split Landuse
N
Maple Creek
SUNSET AVE
WESTMORELAND DR
LOBLOLLY DR
SHANNON CT
NEWBY RD
LOCHINVAR LN
WOODLAWN RD
HAWTHORNE RD
SHEFFIELD DR
MANSFIELD DR
EDINBOROUGH RD
ROBERT RYAN DR
RIDGECREST DR
BERKLEY DR
WESTMINSTER DR
AVONDALE AVE
WINSTEAD RD
AMHERST RD
PELHAM RD
PLYMOUTH RD
BRIARCLIFF RD
OAKDALE RD
CLIFTON RD
GREENWOOD AVE
CHARLOTTE AVE
WAYNE ST
ZEBULON RD
GREENBRIAR DR
GAIL DR
CHURCH VIEW DR
CANDLEWOOD RD
BROWN DR
AZIMUTH CT
KANDEMOR LN
GRAVELY DR
FAIRFIELD DR
WESTRIDGE CIRCLE DR
COLONIAL LN
WOODBURNE DR
AMBLESIDE DR
TIMBERLANE DR
S ENGLEWOOD DR
N ENGLEWOOD DR
TYSON AVE
OLD COLONY WAY
SEMINOLE DR
PATTERSON DR
MARTIN DR
BULLUCK AVE
CRESCENT DR
S CIRCLE DR
FOREST HILL AVE
STONE DR
QUARRY LN
DANA LN
WINTERHAVEN DR
JASON CT
JASON DR
BUFF RD
OLD MILL RD
MAPLE CREEK DR
BRIDGEDALE DR
S WINSTEAD AVE
JOELENE DR
JOELENE CT
MICHAEL SCOTT DR
NICHOLE LN
JOSHUA CLAY DR
LOGAN TRL
BELL DR
NETHERWOOD RD
S APPLEWOOD CT
GLOUCESTER RD
CHELSEA DR
BRASSELD DR
JEREMY LN
CHAD ST
HAMPTON DR
SION CT
KETCH POINT DR
KETCH POINT CT
CARYBR
SWINDS DR
MIN CT
ESSEX CT
CHESHIRE LN
LITCHFIELD DR
HANSFORD DR
MAYFAIR DR
FAIRHAVEN DR
KINGSWOOD DR
MCINTYRE LN
S HALIFAX RD
N HALIFAX RD
LAYOLA AVE
CARROL AVE
JACOBS AVE
DAY BREAK LN
COMMUNITY DR
CAPITAL DR
HABERSHAM CT
BELGREEN DR
MAYFAIR DR
DORMAN RD
N WINSTEAD AVE
STONEY CREEK DR
JONES RD
FOY DR
ZEBULON CT
CLINTON CT
N CIRCLE DR
BUCK LEONARD
TURNSTONE DR
BRIDGEDALE DR
MAPLE CREEK DR
JASON DR
BUFF RD
OLD MILL RD
CITY OF ROCKY MOUNT NORTH CAROLINA
WK DICKSON
community infrastructure consultants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Maple Creek Tributary #1
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EDINBOROUGH RD
ROBERT RYAN DR
RIDGECREST DR
BERKLEY DR
WINSTEAD RD
AMHERST RD
PELHAM RD
PLYMOUTH RD
WAYNE ST
KINGSWOOD DR
HAMPTON DR
KETCH POINT DR
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BRIDGEDALE DR
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S ENGLEWOOD DR
WOODBURNE DR
AMBLESIDE DR
TIMBERLANE DR
SEMINOLE DR
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LAYOLA AVE
CARROL AVE
JACOBS AVE
DAY BREAK LN
COMMUNITY DR
AZIMUTH CT
HANSFORD DR
LITCHFIELD DR
ESSEX CT
CHESHIRE LN
BRASSFIELD DR
JEREMY LN
CHAD ST
TURNSTONE DR
NETHERWOOD RD
SAPPLEWOOD CT
JOELENE CT
BELL DR
NICHOLE LN
JOSHUA CLAY DR
LOGAN TRL
N

APPENDIX D

ALL RESIDENT RESPONSES TO QUESTIONNAIRES

Tabulated responses are to the following questions:

[1] How long have you owned or lived at this location?
[2] Are there any soil erosion problems from a storm drainage system (i.e. pipes, drains, streams or ditches) on your property or in your neighborhood?
[2a] If there are soil erosion problems, please indicate the location and severity of problem.
[3] Have you ever experienced flooding on your property during a (non-Hurricane)storm?
[3a] If yes, check all situations that apply and appropriate letter from legend.
A = Never experienced D = 2-3 times per year
B = Less than once per year E = More than 3 times per year
C = Once per year F = Every time it rains
[4] If flooding occurred, please list the approximate date(s), location, and indicate depth of flooding.
[5] Have you ever noticed flooded streets in your neighborhood?
[6] If you noticed flooded streets, please provide the approximate date(s), location and depth of flooding.
[7] Are there any other problems with the storm drainage system (i.e. pipes, drains, streams or ditches) on your property or in your neighborhood?
[7a] If yes, check all situations that apply: corroded pipes, sink holes, pipe blockage, stream or ditch blockage, drains in need of repair, other.
1 = Corroded Pipes 4= Stream or ditch blockage
2 = Sink holes 5 = Drains in need of repair
3 = Pipe blockage 6 = Other
[8] Do you have an photographs, videotape, or other records of flooding problems that occurred on your property or in your neighborhood (no, photos, video, written, other)?
[9] Has flooding increased on your property due to the filling of lots adjacent to, or near your property?

N/R = No response
N/A = Not applicable

Name	Address	Residency[1]	Erosion[2]	Erosion Notes[2a]	Flooding[3]	Flooding Notes[3a]	Flooding Events[4]	Flooded Streets[5]	Flooded Streets Notes[6]	Other Storm Drainage Problems[7]	Type of Storm Drainage Problems[7a]	Flood Records[8]	Increased Flooding[9]	Other Comments
Randy Adams	318 Gravely Dr.	12 years	Yes	ditch at street (Moderate)	Yes	N/R	N/R	Yes	N/R	Yes	2,3	No	N/R	Sink holes in my backyard, and poor drainage in front of house on Gravely Drive.
John J Allsbrook	3513 Sheffield Drive	28 years	No	N/A	No	N/A	N/A	No	N/R	No	N/A	No	No	
Austin A Anderson	293 Fairfield Drive	3 years	No	N/A	No	N/A	N/A	No	N/R	No	N/A	No	N/R	
Robert W. & Judith K. Anderson	3124 Ridgecrest Dr	40 years	No	N/A	No	N/A	N/A	No	N/R	No	N/A	N/R	No	
Alfred T. Ayscne	5031 Brassfield Dr	10 years	No	N/A	No	N/A	N/A	No	N/R	No	N/A	N/R	No	
George Bailey	2121 Edinborough Rd	17 years	No	N/A	No	N/A	N/A	Yes	6" at corner of Edinborough & Nottingham few times annually	No	N/A	No	No	
John Barrett	3133 Berkley Dr	33 years	Yes	along the back property line (Severe) side ditch at property line (Moderate)	Yes	N/R	when there is heavy rainfall	No	N/R	N/R	N/R	No	No	For most of the years we have lived here, during heavy rainfall water will rush down Berkley Dr down my driveway and pour into our carport. It then exits and goes across our yard to the ditch, but is a terrible nuisance. Last year the city lowered the shoulders on Berkley. This has helped but will need to be done regularyly as grass grows back again. It used to flood our crawl space but we had a very expensive drainage and pump system in 2002 that corrected this problem.
JB Berry	3817 Howthere Road	47 years	No	N/A	No	N/A	N/A	No	N/R	N/R	N/R	N/R	N/R	
Lionel L & Ann C Bishop	3801 Woodlawn Road	28 years	No	N/A	No	N/A	N/A	Yes	end of Woodlawn Road (West End) Hurricane Floyd	No	N/A	No	No	
Stephen F Bishop	221 Timerlane Road	8 years	Yes	front yard (Moderate) side yard (Moderate)	Yes	N/R	heavy rain	No	N/R	Yes	2,3	No	No	
Andy Blanton	501 St Mary's	3 years	No	N/A	No	N/A	N/A	Yes	4" at Winchester Rd every time it rains	No	N/A	No	No	
Paul Blount	100 Hampton Court	20 years	No	N/A	No	N/A	N/A	No	N/R	N/R	N/R	N/R	No	I think our court is the high end of the drainage that runs along the power line easement and becomes the big ditch parralelling Mansfield. In any big rain the swales around the court collect water and in a brief time it runs off into the storm drains. On the other side Gloucester drains away toward the river branch.
Mike Boddie	3613 Hawthorne	12 years	No	N/A	No	N/A	N/A	N/R	N/R	No	N/A	No	No	
Kevin Bondream	117 Shannon Ct	16 years	No	N/A	No	N/A	N/A	N/R	N/R	No	N/A	No	No	
Paul Bondy	601 Nichole Lane	3.5 years	Yes	right rear (Moderate)	Yes	N/R	any heavy rain	No	N/R	Yes	2,4	No	No	there appear to be inadequate number of street drains and very distant spacing between which delays water runoff from streeets in our genenal area. there is frequently water in the street with heavy rain, though minimal flooding. a street drain at right of our property runs to an open ditch at the back of our property. water runoff through this open ditch is inadequate and slow due to poor design and blockage. the dead end of Michael Scott at our property has no street drain and therefore drains onto the property and across the back of my property with heavy rains.
Judy Bradshaw	3616 Sheffield Drive.	15 years	No	N/A	No	N/A	N/A	No	N/R	No	N/A	No	No	
Jane Bragg	3709 Hawthone Road	15 years	Yes	in the streams and ditchs (Minor)	No	N/A	N/A	Yes	Between Harris Teeter and the housing project between Sunset and Westridge Circle	N/R	N/R	N/R	N/R	
Joe Brewer	3819 Woodlawn Road	14 years	No	N/A	Yes	N/R	heavy rains	Yes	2-3 inches at Winschester Rd @ St. Mary's after medium rain	No	N/A	No	No	
Jerry Briggs	3216 Ridgecrest Dr.	21 years	No	N/A	No	N/A	N/A	No	N/R	No	N/A	No	No	
James T Britt	401 Fairfield Drive	28 years	No	N/A	No	N/A	N/A	Yes	8 inches near intersection of Winchester & West Ridge Circle	No	N/A	No	No	
Richard H Bryant	104 Hampton Court	21 years	No	N/A	No	N/A	2008	Yes	few inches Mansfield Drive	No	N/A	No	No	
Rod Buckner	117 Avondale Ct	27 years	No	N/A	Yes	N/R	any very heavy rain	No	N/R	Yes	4	No	No	
Linda Bulluck	3620 Sheffield Drive	31 years	No	N/A	No	N/A	N/A	N/R	N/R	N/R	N/R	No	No	I wish people wouldn't pile straw and trash in the edge of the street and block the flow of water when it does rain.
Glenn Bunn	5021 Brassfield Drive	9 years	No	N/A	No	N/A	N/A	No	N/R	No	N/A	No	No	Seen no problems. Our city government needs not to waste money with you sir. So our fees and taxes will not increase to pay you. Our city government should be able to figure this out themselves.
CE Butler	2900 Westminster Drive	20 years	No	N/A	No	N/A	N/A	No	N/R	Yes	4	No	No	the creek that runs between my house will come out of its bank when a long hard rain.
John Cappiello	3900 Hawthorne	22 years	No	N/A	No	N/A	N/A	Yes	6+ " at corner of Fairfield and Winchester every heavy rain	No	N/A	No	No	
BJ Carter	2105 Edinborough Road	18 years	No	N/A	No	N/A	N/A	No	N/R	No	N/A	N/R	No	
Ronald L Carter	2901 Wellington Drive	38 Years	No	N/A	No	N/A	N/A	No	N/R	No	N/A	No	No	
Dr WC Cooper	3533 Manfield Dr	36 years	Yes	back yard (Moderate)	No	N/A	N/A	No	N/R	Yes	6	No	No	The main problem on our lot concern with the terrible looking drainage ditch that borders our backyard. This ditch is deep, unsightly and very offensive in appearance. Over the past few years we have loast several feet off our back yard due to soil erosion caused by this ditch. We hope that the city could come up with a plan to cover this ditch and make the area more pleasing to the eyes.
Phoebe Crouch	3104 Berkley Drive		No	N/A	No	N/A	N/A	No	N/R	No	N/A	No	No	
Philip Curtis	3721 Winchester Road	2 years	Yes	there is a hole a few feet from the stop sign (Moderate)	No	N/A	N/A	Yes	maybe 6 inches on Westridge circle	Yes	2	No	No	The hole goes down into the drainage system that goes under Fairfield road. It is right on the corner of my property a few feet from the stop sign/street sign.
E.L. & Peggy Daughtridge	1404 Jeremy Lane	2 years	Yes	ditch on Jeremy near Mansfield (Moderate)	No	N/A	N/A	No	N/R	N/R	N/R	No	N/R	
Barbara J. Davis	3620 Woodlawn Road	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	I have a chronic problem with standing water at the end of my driveway, which is on Nottingham. The city dug drainage a
Diane Dettman	3321 Winstead Road	38 years	No	N/A	No	N/A	N/A	No	N/R	No	N/A	No	No	The word 'neighborhood' is vague - I feel fortunate because my property has NEVER FLOODED - even during 'Floyd'.
John A Dinan	105 Essex Court	26 years	No	N/A	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	To my knowledge there are no flooding problems in this area. This sounds like much to do about nothing. This is not the time for expenditures on projects that are not a big problem.
Max Dixon	129 Wellington Court	28 Years	No	N/A	No	N/A	N/A	No	N/R	Yes	4	No	No	ditch in front of my house doesn't drain completely
Cebor Warren & Ruby M. Earp	3609 Mansfield Dr	33 years	Yes	Chelsea Dr (Moderate) 2nd block of Glouchester Rd (Moderate)	No	Street Runoff - D	N/R	Yes	N/R	Yes	3,4	No	Yes	Note on #5: Below my propertyNote on #9: Standing water, but generally drains 1 or 2 days.
Spencer S Edmondson	117 Edinborough St	29 years	Yes	ditch parallel to Edinborough from Jeremy Lane to Nottingham (Severe)	No	N/A	N/A	No	N/R	Yes	6	No	No	city has right of way along ditch. A ditch that I could step across when I moved here, it has eroded to the witdth that the city's right of way is inside the ditch. The depth of the ditch has moved from less than a foot to 7 or 8 feet.
Edward English	3609 Winstead Road	3 Years	Yes	drainage ditch next to house (Moderate)	N/R	Storage Building - A AC units - A Crawl Space - A Living Space - A Stream/Ditch - A Street Runoff - A Adjacent Property - A	N/R	Yes	3 inches front of house in driveway several times after heavy rains	Yes	4	No	No	

Name	Address	Residency[1]	Erosion[2]	Erosion Notes[2a]	Flooding[3]	Flooding Notes[3a]	Flooding Events[4]	Flooded Streets[5]	Flooded Streets Notes[6]	Other Storm Drainage Problems[7]	Type of Storm Drainage Problems[7a]	Flood Records[8]	Increased Flooding[9]	Other Comments
Nick Falk	1500 Jeremy Ln	19 years	No	N/A	No	Storage Building - A AC units - A Crawl Space - A Living Space - A Stream/Ditch - A Street Runoff - A Adjacent Property - A	N/R	Yes	2 feet at Leighton Dr during hurricanes & heavy rains	No	N/A	No	No	
M.G. Feetors	3859 Hawthorne Road	42 years	No	N/A	No	N/A	N/A	No	N/R	No	N/A	No	No	
Robert H Ferguson III	60 Nichole Lane	20 years	No	N/A	Yes	Crawl Space - F	everytime it rains	No	N/R	No	N/A	No	No	
Millard Ferrell	3812 Gloucester Road	30 years	No	N/A	No	Storage Building - A AC units - A Crawl Space - A Living Space - A Stream/Ditch - A Street Runoff - A Adjacent Property - A	N/R	No	N/R	No	N/A	No	No	None of these issues described above pose any problems for my property. I do not know of any improvements that need to be made regarding my property!! Everything is fine as is!
Kenneth V. Finney	3312 Amherst Rd	33 years	No	N/A	No	N/A	N/A	No	N/R	No	N/A	No	No	None.
Julian H. Fisher	3212 Ridgecrest Drive	45 years	Yes	Gail road ditch (Moderate)	No	N/A	N/A	No	N/R	No	N/A	No	No	
Charles W Fisher	4017 Hawthorne Rd	30.5 years	No	N/A	No	N/A	N/A	No	N/R	Yes	4	No	No	
Cynthia S. Fleming	1004 Leighton Dr	15 years	No	N/A	No	N/A	N/A	N/R	N/R	No	N/A	No	No	
Histan Ford	3612 Shuffield Drive	25 years	No	N/A	No	N/A	N/A	No	N/R	No	N/A	N/R	No	I'm glad it is being evaluated as the area is pretty low.
Richard T. Fountain, Jr.	3517 Mansfield Drive	43 years	Yes	Behind my property (Severe)	No	N/A	N/A	N/R	N/R	N/R	N/R	N/R	N/R	
Jim Fries	105 Litchfield Court	10 years	Yes	yard (Moderate)	No	N/A	N/A	No	N/R	Yes	2,3	No	No	
Kimberly Gales	116 Edinborough Ct	3.5 years	Yes	12 feet from house (Severe) utility shed 4 - 5 feet (Severe)	No	N/A	N/A	Yes	not sure of date, but has occured	Yes	4,5,6	No	Yes	excessive erosion has cuased danger to my home because of deteriation of soil around trees. A large portion of my back yard is not safe for my child to play. It is a shame it has gotten this bad with the high texes we pay with the property value decreasing. Its dangerous! #7 Other: standing water and musk rats!
Julian B Gassaway	2805 Wellington Drive	35 years	No	front, back and side of yard (Minor)	Yes	Storage Building - D AC units - D Crawl Space - D Living Space - D Stream/Ditch - A Street Runoff - A Adjacent Property - F	1999 (Hurrican Floyd)	No	N/R	No	N/A	No	No	
John and Susan Gibbs	3612 Winstead Road	14 years	Yes	ditch on east side of house (Moderate)	No	N/A	N/A	Yes	3608 Winstead Road any hard rain	Yes	2,3,4,5	No	No	Water stands on streets. Ditch has changed over years, it has gotten wider and more curvier. My neighbor had his small ditch with pipe under driveway burned. This seemed to help his drainage problem. Could the city do that to our property?
Peggy Gilmne	3424 Mansfield Drive	40 years	No	N/A	No	N/A	N/A	No	N/R	No	N/A	No	No	
Clifton Glover	1208 Cheshire Lane	12 years	No	N/A	No	N/A	N/A	No	N/R	No	N/A	N/R	No	
Joeseph Green	3013 Berkley Drive	3 years	No	N/A	No	N/A	N/A	No	N/R	Yes	3	No	No	there is a ditch in the front of the houses on my block. The pipes under the driveways need cleaning, but the ditch has never filled up with water yet.
Elton Grady Griffin	3412 Sheffield Drive	38 years	Yes	3416 Sheffield Drive (Minor)	No	Storage Building - A AC units - A Crawl Space - A Living Space - A Stream/Ditch - A Street Runoff - A Adjacent Property - A	N/R	No	N/R	Yes	3	No	No	My property is bordered is the north side by the Nash County railroad. Drainage on the south side of the RR ponded and ran across my property when I first moved here in 1971. In 1975 I installed a 12" concrete pipe and filled the open ditch that previously ran from the RR southernly to Sheffield Dr. This works well except when heavy rains wash debris into the mouth of the drain pipe, backing up water which floods my yard.
John Haggerty	124 Shannon Court	31 years	Yes	ditch behind home (Moderate)	Yes	N/R	more than 3 times per year	Yes	Every time it rains	Yes	4	Photos	Yes	Water in crawl space, Water up to or in the living space, and Yard flooding from street runoff all checked but no letter.
Frank Hamrick	3808 Gloucester Road	4 Years	Yes	water drains from street at mailbox (Minor)	N/R	Storage Building - A AC units - A Crawl Space - A Living Space - A Stream/Ditch - A Street Runoff - A Adjacent Property - A	N/R	Yes	N/R	Yes	4	No	No	drain ditch under driveway; water drains from road into ditch; water stands; ditches need cleaning
Jesse Harrington	3705 Sheffield Dr	35 years	No	N/R	No	N/A	N/A	Yes	has water, not a major problem end of cul-de-sac when there is a lot of rain	No	N/A	No	No	
Lawrence E Harris	108 Edinborough Court	22 years	No	N/A	No	N/A	N/A	No	N/R	No	N/A	No	No	You dont want me at a public hearing and you dont want to start talking about charging me more $ for tiling & containing ditch water run off. If i must be contacted, please send someone with an IQ over 60.
Ann T. Hartley	3201 Amherst Road	41 years	Yes	large drainage (Moderate)	No	N/A	N/A	N/R	N/R	Yes	2	No	No	Improvement and better maintenance of entire large drainage ditch that connects to the drainage pipe under the railroad tracks that is adjacent to my south-east property line.
Allen Hayes	221 Kandemor Lane	20 years	No	N/A	No	N/A	N/A	Yes	1 foot 1 block away	No	N/A	No	No	
Howard Haynes	117 Newby Ct	19 years	No	N/A	No	N/A	N/A	N/R	N/R	N/R	N/R	No	No	Comment on #5: How do you define flooding?Other comment: water standing on street or pavement Gravely-Winchester-West Ridge Circle after any shower.
Mark Heilman	229 Mayfair Drive	4 years	No	N/A	No	N/A	N/A	No	N/R	No	N/A	No	No	We are fine with our drainage system and hope nothing happens to make us all of a sudden have problems!
Robert Hendrix	105 Shannon Court	9.5 years	No	N/A	No	N/A	N/A	No	N/R	No	N/A	No	No	
Al and Cherye Hoag	3708 Glouesten	16 years	No	N/A	No	N/A	N/A	No	N/R	No	N/A	No	No	Water Quality is great! Did not have any flooding issues even after hurrican Fran when most of Rocky Mount was flooded.
Elizabeth Hodges	304 Gravely Drive	26 years	No	N/A	Yes	Stream/Ditch - E	2 feet or more at ditch in front of house every heavy rain	Yes	2" on Winchester Rd every heavy rain	Yes	3,4,5	No	No	I have contacted the city about uneven levels of ditches in front of houses on Gravely Drive, specifically that mine is deeper than the neighbors' thus causing my ditch to fill with debris and flood displacing my bridge. I have asked to have the problem corrected and was assured that something would be done after Christmas. I voiced the same concern 2 years ago and was ignored.
Holland	3420 Sheffield Drive	3 years	Yes	front yard, sinkhole near drain (Minor)	No	N/A	N/A	Yes	N/R	No	N/A	No	No	
Ed Holloman	3717 Winchester Rd	25 years	No	N/A	No	N/A	N/A	Yes	2-8" half block west each time get big rain	No	N/A	No	No	
LR Holoman Jr	3521 Sheffield Drive	32.5 years	Yes	fire hydrant on Cheshire (Moderate)	N/R	N/R	N/R		N/R	Yes	2	No	No	
Hugh Horton	2116 Edinborough	15 years	Yes	Ditch Behind house (Minor) Drive on Sheffield (Moderate)	No	N/A	N/A	N/R	N/R	No	N/A	No	No	In Floyd water rose out of ditch to within 50 feet of my deck, but it receded quickly after storm. For Non-hurricane storms the ditch will fill to ground level but seldom overflows.
Christopher Howell	2929 Berkley Drive	10 years	No	N/A	No	N/A	N/A	No	N/R	Yes	4	No	No	
William S. Hoyle	210 Gravely Drive	24 years	No	N/A	Yes	Storage Building - A AC units - A Crawl Space - A Living Space - A Stream/Ditch - C Street Runoff - C Adjacent Property - D	N/R	No	N/R	Yes	4	No	No	Since I had a drainage system installed on my property several years ago, I have had no erosion problems. I have underground pipes that take any excess water to the drainage ditch located in front of our property adjacent to the street.
Junlian E Jeffreys	220 Mayfair Drive	10 years	No	N/A	Yes	Adjacent Property - B	3" in backyard due to berm built by developer	N/R	N/R	No	N/A	No	Yes	our area on Mayfair Drive off sunset is OK
Kathleen Jenkins	1033 Turnshore Dr	5 years	N/R	N/R	No	Storage Building - A AC units - A Crawl Space - C Living Space - A Stream/Ditch - A Street Runoff - A Adjacent Property - A	N/R	No	N/R	No	N/A	N/R	N/R	

Name	Address	Residency[1]	Erosion[2]	Erosion Notes[2a]	Flooding[3]	Flooding Notes[3a]	Flooding Events[4]	Flooded Streets[5]	Flooded Streets Notes[6]	Other Storm Drainage Problems[7]	Type of Storm Drainage Problems[7a]	Flood Records[8]	Increased Flooding[9]	Other Comments
Benny & Joyce Johnson	3505 Mansfield Drive	20 years	No	N/A	No	N/A	N/A	No	N/R	No	N/A	N/R	No	
Craig Johnson	906 S Winstead	11 years	No	N/A	No	N/A	N/A	No	N/R	No	N/A	N/R	No	
Robert C. Jones	105 Buckingham Court	20 years	No	N/A	No	N/A	N/A	No	N/R	No	N/A	N/R	No	
Shephen A Jones	3620 Colonial Lane	11 years	No	N/A	No	N/A	N/A	No	N/R	Yes	3	No	No	
Clarence L. Joyner	3401 Winstead Road	45 years	No	N/A	No	N/A	N/A	N/R	N/R	No	N/A	No	No	
Paul Kinnaird	304 Fairfield Drive	26 years	No	N/A	No	N/A	N/A	Yes	1 foot on Winchester Road	No	N/A	N/R	N/R	
Nancy Kolehma	109 Buckingham Ct	41 years	No	N/A	No	Storage Building - A AC units - A Crawl Space - A Living Space - A Stream/Ditch - A Street Runoff - A Adjacent Property - A	N/R	No	N/R	No	N/A	No	No	
William Kron	3801 Hawthorne Road	21 years	Yes	drainage stream bank (Moderate)	No	N/A	N/A	No	N/R	Yes	4	No	N/R	Trash in drainage stream is not copmletely removed. Trash, bottles, branches from trees, bricks, rocks that have collapsed from rock fill on banks of stream.
CJ LaBau	3904 Woodstock Road	22 years	Yes	Moderate	Yes	Storage Building - A AC units - A Crawl Space - C Living Space - A Stream/Ditch - E Street Runoff - A Adjacent Property - A	anytime over 1.5 inches of rain	Yes	3" on Woodstock Road Hurricane Floyd & other times	Yes	4,6	No	Yes	#7 other: underpass acts as a dam and blocks water
Richard/Deborah Ladd	3320 Winstead Road	17 years	No	N/A	No	N/A	N/A	Yes	several inches; Winstead Ave at Winstead Road during hard/fast rains	No	N/A	No	No	
Richard/Deborah Ladd	3320 Winstead Road	17 years	No	N/A	No	N/A	N/A	Yes	several inches; Winstead Ave at Winstead Road during hard/fast rains	No	N/A	No	No	
Richard Laney	709 Nichole Lane	21 years	No	N/A	No	N/A	N/A	Yes	standing water at 704 Nichole from a sump pump	No	N/A	No	No	
Evelyn H. Lee	617 Chad Street	23 years	Yes	N/R	No	N/A	N/A	No	N/R	No	N/A	No	No	I am not aware of any problems.
Nelson Leggette	3233 Amerst	36 years	No	N/A	No	N/A	N/A	No	N/R	No	N/A	No	No	
Robert and Donna Levijoki	3125 Ridgecrest Dr	10 years	No	N/A	No	Storage Building - A AC units - A Crawl Space - A Living Space - A Stream/Ditch - A Street Runoff - A Adjacent Property - A	N/R	No	N/R	No	N/A	No	No	None.
Rita H Levijoki	3224 Ridgecrest	37 Years	No	N/A	Yes	Stream/Ditch - F	1 - 3 inches in backyard when he have heavy rain	No	N/R	Yes	4	No	No	
Linda Lewis	3537 Mansfield Dr	33 years	Yes	starting with 3531(Severe)	Yes	Crawl Space - D Street Runoff - B Adjacent Property - D	N/R	Yes	N/R	Yes	2	No	No	water stands on lot. Reason - poor landscaping yard caving in on property across side street.
Marsha & Roger Lower	1108 Westminster Lane	27 years	Yes	N/R	No	N/A	N/A	No	N/R	Yes	4	No	No	the ditches running in front of houses on Wellington Dr and Westerminster Dr fill with water when it rains. Maple Creek runs over in heavy rain and goes over its banks
Billy D Luther	2137 Edinborough Road	23 years	No	N/A	No	N/A	N/A	No	N/R	No	N/A	No	No	
Doug and Kimberly Marsiger	3517 Sheffield Dr	3 years	Yes	sinkhole in front yard (Minor)	No	N/A	N/A	No	N/R	Yes	3	No	No	#7 pipe is in front of driveway
MASH Properties	3993 Sunset Avenue	7 years	No	N/A	No	N/A	N/A	No	N/R	No	N/A	No	No	
Troy & Kim Matthews	3701 Woodlawn Rd	7 years	Yes	our house (Moderate)	N/R	Stream/Ditch - F Street Runoff - F	N/R	Yes	Winchester, Hawthorne, Woodlawn, Winstead	No	N/A	No	No	ours was horrible on Nottingham where our driveway is. We called the city and they corrected it for us.
Paul Matthews	100 Bristol Court	10 years	Yes	100 Bristol Court (Minor)	No	Storage Building - A AC units - A Crawl Space - A Living Space - A Stream/Ditch -B Street Runoff - D Adjacent Property - A	3" along property line of 100 Bristol Court on parking pad	No	N/R	Yes	2,6	No	No	
Thomas Maude	3541 Chelsea Dr	30 years	No	N/A	Yes	Adjacent Property - D	2-3" in backyard Spring & Fall	Yes	2-3" Street Spring '08	Yes	3,4	No	No	
Bob and Pat Mauldin	109 Dartmoor Ct	8 years	No	N/A	No	N/A	N/A	N/R	N/R	No	N/A	No	No	
David McDaniel	3513 Chelsea Drive	11 years	No	N/A	No	N/A	N/A	No	N/R	No	N/A	No	No	
William McDonald	3021 Ridgecrest Drive	37 years	No	N/A	No	Storage Building - A AC units - A Crawl Space - A Living Space - A Stream/Ditch - A Street Runoff - A Adjacent Property - A	N/R	No	N/R	No	N/A	No	No	My house is on top of a hill, there is no drainage problems.
M.J. McSorley	3425 Mansfield Drive	34 years	No	N/A	No	Storage Building - A AC units - A Crawl Space - A Living Space - A Stream/Ditch - A Street Runoff - A Adjacent Property - A	N/R	No	N/R	No	N/A	No	No	No Flooding during Hurricane Floyd.
John B. Medley	3821 Mansfield Drive	4 Years	No	N/A	Yes	Street Runoff - D	knee high at curb in front yard several times from January 2005	Yes	knee high Mansfield from Lochinvar from January 2005	Yes	6	Video	No	the street often floods and washed away the mulch and plants in my front yard. Wake is created in my yard as SUVs pass by (I have video of this) from Lochinvar to the end of Mansfield at Kirby. #7 Other: the system is undersized.
Carolyn Moessen	3625 Westridge Circle Drive	4 years	No	N/A	No	N/A	N/A	No	N/R	No	N/A	No	No	
Paul Montgomery	112 Tam O'Shanter Dr	3.5 years	No	N/A	Yes	N/R	4inches	Yes	8" Tam O'Shanter	No	N/A	Video	No	Water on air condition units, Yard flooding from stream/ditch, Yard flooding from street runoff, and Yard flooding from adjacent property all checked but no letter
J. Edgar Moore	3600 Sheffield Dr	35 years	No	N/A	No	N/A	N/A	No	N/R	No	N/A	No	No	
W.E. Morehart	3429 Mansfield Dr.	28 years	Yes	Severe	No	N/A	N/A	No	N/R	No	N/A	No	No	
Danny Morgan	3209 Hawthorne Rd	9 years	No	N/A	No	N/A	N/A	No	N/R	No	N/A	No	No	
Ann Munden	1505 Jeremy Lane	16 years	No	N/A	No	N/A	N/A	No	N/R	No	N/A	No	No	We have no problems with water drainage on this street.
Steven E. Noel	104 Shannon Ct		No	N/A	No	N/A	N/A	No	N/R	No	N/A	N/R	No	Do not live in theseLive in MdRental
Jimmy Parker	208 Kandemer Lane	20 Years	No	N/A	No	Storage Building - A AC units - A Crawl Space - A Living Space - A Stream/Ditch - A Street Runoff - A Adjacent Property - A	N/R	Yes	3900 block of Mansfield Heavy Rains	No	N/A	No	No	
Phil Parrish	2901 Berkley Dr	24.5 years	No	N/A	No	N/A	N/A	No	N/R	Yes	N/A	No	No	ditch of Northeast corner of Road was small at one time untill the city dug a deep V. It is too steep to mow without hurting my bad left knee, it is also slippery when wet.
Mark Pearsall	109 Hillside Ct.	9.5 years	No	N/A	No	N/A	N/A	No	N/R	No	N/A	No	No	I know of no flooding problems in my neighborhood.
Taylor & Sydney Phillips	3508 Sheffield Dr	11 Months	No	N/A	No	N/A	N/A	No	N/R	No	N/A	No	No	
Betty L. Plummer	3001 Winstead Rd.	16 years	No	N/A	No	N/A	N/A	No	N/R	No	N/A	No	No	

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Marie L. Price	3786 Loblolly Dr	3 years	No	N/A	No	N/A	N/A	No	N/R	No	N/A	No	No	
Jean S. Proctor	5005 Brassfield Dr	10 years	No	N/A	No	N/A	N/A	No	N/R	No	N/A	No	No	This was originally swamp land. When it rains the ground does not obsorb water rapidly.
Phillip A Pullen	3713 Winchester Road	30 years	No	N/A	No	N/A	N/A	No	N/R	No	N/A	No	No	
Dr and Mrs. GR Ratchford	3521 Mansfield Drive	40 Years	Yes	ditch in backyard (Moderate)	No	Storage Building - A AC units - A Crawl Space - A Living Space - A Stream/Ditch - A Street Runoff - A Adjacent Property - A	N/R	No	N/R	Yes	2	No	No	sinkhole is near ditch
Jim and Julia Rayborn	3833 & 3829 Mansfield Rd			N/R	N/R	N/R	N/A	N/R	N/R	N/R	N/R	N/R	N/R	I have two vacant lots which I have just recently inherited. I live out of town so I can not comment since I don't know.
Gerald Richards	322 Gravey Dr	30 years	Yes	backyard comm area (Moderate)	Yes	Storage Building - D AC units - B Crawl Space - B Living Space - A Stream/Ditch - D Street Runoff - D Adjacent Property - D	2/3" on property	Yes	3 to 4 ft at Woodlawn & Gravely intersection 06/14/06 (Last MAJOR flood)	Yes	3	No	Yes	Comment on #3: MANY TIMES, but is has become a much bigger issue in recent years.Comment on #5: Water to my front steps - heavy storms Gravely floods in front of my home on most heavy rain storms.Comment on #7: Pipes, drains, ditches not adequate to handle waterflow. Pipes replaced by city that run through back of my & neighbors property, but could not handle 6/14/06 rainstorm.Comment on #9: 2 new homes built on Mansfield, topsoil added, so all flow is channeled to my property.Other comments: Johnson Boone (Stormwater Mgt), Ed White Street Dept. Reason for my flooding problem: 1)Mansfields water drainage is not adequate, so water flows from Mansfield to Gravely, through my property and 318 Gravely. Water flow was 30 yards wide like a small river. One storm drain in my back area was not designed to handle Mansfield run off. Would be adequate if Mansfield corrected.
Mary Richardson	216 Mayfair Drive	8 years	Yes	in my backyard (Minor) Fairfield village II	Yes	Storage Building - C Living Space - C Adjacent Property - C	1 to 1.5 feet at 216 & 220 Mayfair	No	N/R	No	N/A	Photos	Yes	I am concerned about the hedgerow or bunker that has been placed in between my backyard and the condo complex. I believe that its causing water to back up into my property and adjacent properties.
George E Robertson Jr	117 Tam O'Shanter Drive	22 months	No	N/R	No	N/A	N/A	No	N/R	No	N/A	No	No	My lawn stays moist most of the time, no matter the season. There is dampness under my house occasionally.
Dane & Kelly Rock	309 Mayfair Drive	6 years	No	N/R	No	N/A	N/A	No	N/R	No	N/A	No	No	
Richard P. Rogers	708 Dana Lane		No	N/R	No	N/A	N/A	No	4' to 5' on Wellington Drive, Maple Creek September, 1999	No	N/A	No	No	
Don Roper	3617 Mansfield Drive	5 Years	No	N/R	No	Storage Building - A AC units - A Crawl Space - D Living Space - A Stream/Ditch - A Street Runoff - A Adjacent Property - A	N/R	No	N/R	No	N/A	No	No	
Ronald P Ross	4012 Lochinvar Lane	19 years	No	N/R	No	N/A	N/A	Yes	1 foot at Mansfield & Lochinvar	No	N/A	No	No	
Darin & Elizabeth Scott	100 Tam O'Shanter	10 Years	No	N/R	Yes	N/R	N/R	Yes	2-3 feet Mansfield at Lochinvar 6/2006 cul-de-sac at Tom O'Shanter	Yes	6	No	No	#7 other: drainage planning
Jane Seeger	4165 Meadowview Ln	8.5 years	Yes	N/R	No	N/A	N/A	No	N/R	No	N/A	No	No	
Mary B Shannon	3608 Mansfield Drive	34 years	No	N/R	No	N/A	N/A	No	N/R	No	N/A	No	No	
Boyd Shaw	220 Robert Ryan Rd	22 years	No	N/R	Yes	Storage Building - D Crawl Space - D Stream/Ditch - D Street Runoff - D Adjacent Property - D	1-2"	Yes	summer-winter	No	N/A	No	No	
W.N. Shepherd	4000 Hawthorne Rd	6 years		N/R	No	N/A	N/A	Yes	8" Mansfield at Lochinvar	N/R	N/R	No		
Harold A Smith	113 Avondale Ct	38 years	No	N/R	No	N/A	N/A	Yes	4" or less various times at Wellington Drive	No	N/A	No	No	
Cyndi & Robert Steele	1217 Turnstone Rive	1.5 years	Yes	front yard (Minor)	No	Crawl Space - E	N/R	No	N/R	No	N/A	No	No	
Warren Stephenson	101 Newby Ct	20 years	No	N/R	No	N/A	N/A	Yes	Sep-99	Yes	3,4,6	No	No	original "fall" designed into system does not work due to shifting remain. Problems with website prevented my use of online selection.
Milton Stroud	125 Avondale Ct.	5 years	No	N/R	No	N/A	N/A	N/R	N/R	Yes	5	No	No	
Kathleen Sullivan	1021 Turnstone Drive	21 years	No	N/R	No	N/A	N/A	No	N/R	No	N/A	N/R	No	
Kent Taylor	3701 Hawthorne	14 years	No	N/R	No	N/A	N/A	Yes	6-8 inches on Westridge Circle Drive every time it rains heavy	No	N/A	No	No	
Blake W Tharin	4016 Hawthorne Road	30 years	No	N/R	N/R	N/R	N/R	Yes	6-24 inches on Mansfield Drive between Hawthorne and Kandemar	No	N/A	No	No	there is a shallow ditch along the front of my property. 3-5 times per year ditch overflows the slides but runs off after the heavy rains subside, sometimes 3-4 hours. Any overflow is minor.
George T. Thorne III	405 Fairfield Dr	7 years	No	N/R	No	N/A	N/A	N/R	N/R	No	N/A	No	No	
John M Thorp	1224 Nottingham Road	42 years	No	N/R	No	N/A	N/A	No	N/R	No	N/A	No	No	
Wihkoyd Thrower	3909 Sunset Ave.	80 years	No	N/R	No	N/A	N/A	No	N/R	No	N/A	No	No	
Mac Tilley	4037 Brassfield Drive	4 years	No	N/R	No	N/A	N/A	No	N/R	No	N/A	No	No	
David H. Todd	3201 Hawthorned Road	40 Years	No	N/R	No	N/A	N/A	No	N/R	No	N/A	No	No	No Problems
Stuart Todd	1508 Jeremy lane	20 years	No	N/R	Yes	N/R	N/R	No	N/R	No	N/A	No	No	#3: flooding in our back yard
Peter Vainey	112 Avondale Ct.	34 years	No	N/R	No	N/A	N/A	No	N/R	No	N/A	No	No	

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Carl Van Horn	3804 Hawthorne Rd	14 years	Yes	backyard and ditch (Severe)	Yes	Storage Building - B AC units - B Crawl Space - F Living Space - B Stream/Ditch - D Street Runoff - A Adjacent Property - A	8 -12 inches in yard 1999 Hurricane Floyd	Yes	inches on Hawthorne/Winchester during hard rains	No	N/A	No	No	
Jackie Walters	3900 Hampton Drive	10 years	No	N/R	No	N/A	N/A	Yes	1" on Mansfield any sudden heavy rain	No	N/A	No	No	
Jackie Walters	3900 Hampton Drive	10 years	No	N/R	No	N/A	N/A	Yes	1" on Mansfield any sudden heavy rain	No	N/A	No	No	
Betshy Waters	3624 Colonial Lane	43 years	Yes	front yard (Minor)	Yes	Stream/Ditch - E	heavy rains	No	N/R	Yes	4	No	No	
Steve A. Webb	3108 RidgeCrest Dr	6.5 years	No	N/R	No	N/A	N/A	No	N/R	No	N/A	No	No	
Jimmy Weeks	1209 Cheshire Lane	16.5 years	No	N/R	No	N/A	N/A	No	N/R	No	N/A	No	No	
Charlie Wells	3617 Hawthorne Rd	3 years	No	N/R	N/R	N/R	N/R	Yes	several inches (covers street from curb to curb) Westridge Circle Dr & Loblolly Dr (Harris Teeter entrance) heavy rains	No	N/A	No	No	
Fred D. West	5032 Brassfield Drive	14 years	No	N/R	Yes	Storage Building - A AC units - A Crawl Space - A Living Space - A Stream/Ditch - A Street Runoff - A Adjacent Property - E	4-6 inches backyard everytime there is a severe rain storm	No	N/R	Yes	5	No	Yes	
George G Whitaker	3604 Sheffield Drive	15 years	No	N/R	No	N/A	N/A	Yes	unknown 9/15/1999	No	N/A	No	No	
Hazelbell P White	105 Nottingham Court	42 Years	Yes	2517 Mansfield Drive 3521 Mansfield Drive	No	Storage Building - A AC units - A Crawl Space - A Living Space - A Stream/Ditch - A Street Runoff - A Adjacent Property - A	N/R	No	N/R	Yes	6	No	No	The water in this ditch may be very dangerous for young children. #7 Other: erosion of land (neighborhood)
Beverly Whitehurst	3629 Winstead Road	23 years	No	N/R	No	N/R	N/R	No	N/R	No	N/A	No	No	
Beverly Whitehurst	3716 Winchester Road	1 year	No	N/R	No	N/R	N/R	No	N/R	No	N/A	No	No	
Charles & Carolyn Whitener	3229 Amherst	26 years		N/R	N/R	N/R	N/R	Yes	N/R	No	N/A	No	No	Comment on #5: during Floyd, 1999, flooding came within 8 blocks or so.Other comment: Shortly after the city added curb and gutter, a pine tree beside the driveway fell over. The water may be washing out the ground underneath the driveway.
Donnie Herbert Whitley	3309 Amherst Road	41 years	No	N/R	No	Storage Building - A AC units - A Crawl Space - A Living Space - A Stream/Ditch - A Street Runoff - A Adjacent Property - A	N/R	No	N/R	No	N/A	No	No	
Richard & Virginia Whitley	3706 Gail Dr	4 years	Yes	3706 Gail Drive; repairs made Summer, 2007 (Minor)	No	N/A	N/A	No	N/R	No	N/A	No	No	
AB Whitley	3401 Amherst Road	10 years	Yes	railroad ditch slope (Moderate)	Yes	Stream/Ditch - D Street Runoff - D Adjacent Property - D	N/R	Yes	N/R	Yes	3,5	Photos	Yes	
Rachel B William	3617 Sheffield Drive	35 years	No	N/R	No	N/A	N/A	No	N/R	No	N/A	No	No	No flooding ever
J.T. Williams	104 Essex Ct	22 years	No	N/R	No	N/A	N/A		N/R	Yes	3	No	No	Shoulders are not maintained (wet)Need to consider curb and gutter b/c of trafficCannot park on shoulder, people park in street blocking traffic
Williams Living Trust	3912 Hawthorne Rd	42 years	No	N/R	No	N/A	N/A	Yes	2-3 feet Mansfield Drive and Lochinvar 9/1999	No	N/A	No	No	the drain pipes are not adeuate.
Mary Winders	3782 Loblolly Drive	4 years	No	N/R	No	Storage Building - A AC units - A Crawl Space - A Living Space - A Stream/Ditch - A Street Runoff - A Adjacent Property - A	N/R	No	N/R	No	N/A	No	No	
David and Kim Winnett	3629 Litchfield Drive	12 years	No	N/R	No	N/A	N/A	No	N/R	Yes	3	Written	No	Had to contact the City of Rocky Mount approx. 6 years ago (?)on several occasions due to the street drain pipes blocking and causing water to recede back onto my property at 3629 Litchfield. Seemed that the City had difficulties contacting a landowner (who I don't believe lived in the neighborhood) to get permission to clean out the blockage that was stemming from his property (based on the investigation by the City). I received a memo from the City stating that the problem had been resolved. Currently, I still monitor that same street drain beside my property as there is a tendency for it to get blocked and hold water but not to the extent of several years ago.
Kenneth Woerly	1221 Turnstone Drive	24 years	No	N/R	No	N/A	N/A	No	N/R	No	N/A	No	No	
William & Jill Wood	3833 West Moreland Drive	27 years	No	N/R	Yes	Adjacent Property - F	4-6 inches everytime it rains hard	Yes	2 ditches across Gravely Drive fill up and water stands across Gravely Drive everytime it rains hard	Yes	4	No	No	
Bobby Woodard	5009 Brassfield Dr	21 years	Yes	drainage on Jeremy Lane (Moderate)	Yes	AC units - B Crawl Space - D Street Runoff - C Adjacent Property - C	N/R	Yes	N/R	N/R	N/R	N/R		
AL Woodley Jr	3608 Litchfield Drive	5 years	Yes	Mansfield drive near Lochinvar (Severe)	No	N/A	N/A	Yes	Mansfield drive near Lochinvar	No	N/A	No	No	
Thomas G. Woolard	3100 Berkley Dr	30 years	No	N/R	No	N/A	N/A	No	N/R	No	N/A	No	No	
Jody & Deborah Wright	3616 Litchfield Dr	10 years	No	N/R	No	N/A	N/A	Yes	1-2 FT Litchfield Drive September 1999 (Hurricane Floyd)	Yes	4	No	No	
Ben Yelverton	601 Chad Street	25 years		N/R	No	N/A	N/A	Yes	Floyd 1999	N/R	N/R	No	N/R	Our area has poor drainage. It may be from the natural springs or the hard pan that we have underneath the area. If your study shows this can be corrected - hallelujah.
No Name		39 years	No	N/R	No	Crawl Space - D	N/R	Yes	Avondal & Wellington anytime it rains	No	N/A	No	No	Clearing of trees creates more run-off.
No name		20 years	No	N/R	No	Crawl Space - E	N/R	Yes	2-3" on 3300 block-Winstead Rd near Charlotte Spikes residence Many dates	No	N/A	No	N/R	Comment on #3: Not flooding, but water standing in the yard.Comment on #9: Some, I think. Not flooding, but water running on to the property.

RESOLUTION TO CITIZENS COMPLAINTS

	Address	Erosion?	House/Yard Flooding?	Street Flooding?	Storm Drainage Problems?	Problem to be Resolved by Recommended Alternative	Problem to be Resolved by City Maintenance	No Resolution	No Problems
1	100 Bristol Court	Yes	No	No	Yes			X	
2	100 Hampton Court	No	No	No	No				X
3	100 Tam O'Shanter	No	Yes	Yes	Yes		X		
4	1004 Leighton Dr	No	No	No	No				X
5	101 Newby Ct	No	No	Yes	Yes		X		
6	1021 Turnstone Drive	No	No	No	No				X
7	1033 Turnshore Dr	No	No	No	No				X
8	104 Essex Ct	No	No	No	Yes		X		
9	104 Hampton Court	No	No	Yes	No			X	
10	104 Shannon Ct	No	No	No	No				X
11	105 Buckingham Court	No	No	No	No				X
12	105 Essex Court	No	No	No	No				X
13	105 Litchfield Court	Yes	No	No	Yes			X	
14	105 Nottingham Court	Yes	No	No	Yes			X	
15	105 Shannon Court	No	No	No	No				X
16	108 Edinborough Court	No	No	No	No				X
17	109 Buckingham Ct	No	No	No	No				X
18	109 Dartmoor Ct	No	No	No	No				X
19	109 Hillside Ct.	No	No	No	No				X
20	1108 Westminster Lane	Yes	No	No	Yes			X	
21	112 Avondale Ct.	No	No	No	No				X
22	112 Tam O'Shanter Dr	No	Yes	Yes	No	X			
23	113 Avondale Ct	No	No	Yes	No			X	
24	116 Edinborough Ct	Yes	No	Yes	Yes			X	
25	117 Avondale Ct	No	Yes	No	Yes			X	
26	117 Edinborough St	Yes	No	No	Yes			X	
27	117 Newby Ct	No	No	No	No				X
28	117 Shannon Ct	No	No	No	No				X
29	117 Tam O'Shanter Drive	No	No	No	No				X
30	1208 Cheshire Lane	No	No	No	No				X
31	1209 Cheshire Lane	No	No	No	No				X

	Address	Erosion?	House/Yard Flooding?	Street Flooding?	Storm Drainage Problems?	Problem to be Resolved by Recommended Alternative	Problem to be Resolved by City Maintenance	No Resolution	No Problems
32	1217 Turnstone Dr	Yes	No	No	No			X	
33	1221 Turnstone Drive	No	No	No	No				X
34	1224 Nottingham Road	No	No	No	No				X
35	124 Shannon Court	Yes	Yes	Yes	Yes			X	
36	125 Avondale Ct.	No	No	No	Yes		X		
37	129 Wellington Court	No	No	No	Yes		X		
38	1404 Jeremy Lane	Yes	No	No	No			X	
39	1500 Jeremy Ln	No	No	Yes	No			X	
40	1505 Jeremy Lane	No	No	No	No				X
41	1508 Jeremy lane	No	Yes	No	No			X	
42	208 Kandemer Lane	No	No	Yes	No			X	
43	210 Gravely Drive	No	Yes	No	Yes	X			
44	2105 Edinborough Road	No	No	No	No				X
45	2116 Edinborough Rd	Yes	No	No	No			X	
46	2121 Edinborough Rd	No	No	Yes	No			X	
47	2137 Edinborough Road	No	No	No	No				X
48	216 Mayfair Drive	Yes	Yes	No	No			X	
49	220 Mayfair Drive	No	Yes	No	No			X	
50	2200 Robert Ryan Rd	No	Yes	Yes	No			X	
51	221 Kandemor Lane	No	No	Yes	No	X			
52	221 Timerlane Road	Yes	Yes	No	Yes			X	
53	229 Mayfair Drive	No	No	No	No				X
54	2805 Wellington Drive	No	Yes	No	No			X	
55	2900 Westminster Drive	No	No	No	Yes		X		
56	2901 Berkley Dr	No	No	No	Yes		X		
57	2901 Wellington Drive	No	No	No	No				X
58	2929 Berkley Drive	No	No	No	Yes		X		
59	293 Fairfield Drive	No	No	No	No				X
60	3001 Winstead Rd.	No	No	No	No				X
61	3013 Berkley Drive	No	No	No	Yes		X		
62	3021 Ridgecrest Drive	No	No	No	No				X
63	304 Fairfield Drive	No	No	Yes	No	X			
64	304 Gravely Drive	No	Yes	Yes	Yes	X			
65	309 Mayfair Drive	No	No	No	No				X

	Address	Erosion?	House/Yard Flooding?	Street Flooding?	Storm Drainage Problems?	Problem to be Resolved by Recommended Alternative	Problem to be Resolved by City Maintenance	No Resolution	No Problems
66	3100 Berkley Dr	No	No	No	No				X
67	3104 Berkley Drive	No	No	No	No				X
68	3108 RidgeCrest Dr	No	No	No	No				X
69	3124 Ridgecrest Dr	No	No	No	No				X
70	3125 Ridgecrest Dr	No	No	No	No				X
71	3133 Berkley Dr	Yes	Yes	No	No			X	
72	318 Gravely Dr.	Yes	Yes	Yes	Yes		X		
73	3201 Amherst Road	Yes	No	No	Yes			X	
74	3201 Hawthorned Road	No	No	No	No				X
75	3209 Hawthorne Rd	No	No	No	No				X
76	3212 Ridgecrest Drive	Yes	No	No	No			X	
77	3216 Ridgecrest Dr.	No	No	No	No				X
78	322 Gravey Dr	Yes	Yes	Yes	Yes	X			
79	3224 Ridgecrest	No	Yes	No	Yes			X	
80	3229 Amherst	No	No	Yes	No			X	
81	3233 Amerst	No	No	No	No				X
82	3309 Amherst Road	No	No	No	No				X
83	3312 Amherst Rd	No	No	No	No				X
84	3320 Winstead Road	No	No	Yes	No			X	
85	3321 Winstead Road	No	No	No	No				X
86	3401 Amherst Road	Yes	Yes	Yes	Yes			X	
87	3401 Winstead Road	No	No	No	No				X
88	3412 Sheffield Drive	Yes	No	No	Yes			X	
89	3420 Sheffield Drive	Yes	No	Yes	No			X	
90	3424 Mansfield Drive	No	No	No	No				X
91	3425 Mansfield Drive	No	No	No	No				X
92	3429 Mansfield Dr.	Yes	No	No	No			X	
93	3505 Mansfield Drive	No	No	No	No				X
94	3508 Sheffield Dr	No	No	No	No				X
95	3513 Chelsea Drive	No	No	No	No				X
96	3513 Sheffield Drive	No	No	No	No				X
97	3517 Mansfield Drive	Yes	No	No	No			X	
98	3517 Sheffield Dr	Yes	No	No	Yes			X	
99	3521 Mansfield Drive	Yes	No	No	Yes			X	

	Address	Erosion?	House/Yard Flooding?	Street Flooding?	Storm Drainage Problems?	Problem to be Resolved by Recommended Alternative	Problem to be Resolved by City Maintenance	No Resolution	No Problems
100	3521 Sheffield Drive	Yes	No	No	Yes			X	
101	3533 Manfield Dr	Yes	No	No	Yes			X	
102	3537 Mansfield Dr	Yes	Yes	Yes	Yes			X	
103	3541 Chelsea Dr	No	Yes	Yes	Yes			X	
104	3600 Sheffield Dr	No	No	No	No				X
105	3604 Sheffield Drive	No	No	Yes	No	X			
106	3608 Litchfield Drive	Yes	No	Yes	No			X	
107	3608 Mansfield Drive	No	No	No	No				X
108	3609 Mansfield Dr	Yes	No	Yes	Yes	X			
109	3609 Winstead Road	Yes	No	Yes	Yes			X	
110	3612 Shuffield Drive	No	No	No	No				X
111	3612 Winstead Road	Yes	No	Yes	Yes			X	
112	3613 Hawthorne	No	No	No	No				X
113	3616 Litchfield Dr	No	No	Yes	Yes		X		
114	3616 Sheffield Drive.	No	No	No	No				X
115	3617 Hawthorne Rd	No	No	Yes	No	X			
116	3617 Mansfield Drive	No	No	No	No				X
117	3617 Sheffield Drive	No	No	No	No				X
118	3620 Colonial Lane	No	No	No	Yes		X		
119	3620 Sheffield Drive	No	No	No	No				X
120	3624 Colonial Lane	Yes	Yes	No	Yes			X	
121	3625 Westridge Circle Drive	No	No	No	No				X
122	3629 Litchfield Drive	No	No	No	Yes		X		
123	3629 Winstead Road	No	No	No	No				X
124	3701 Hawthorne	No	No	Yes	No	X			
125	3701 Woodlawn Rd	Yes	No	Yes	No	X			
126	3705 Sheffield Dr	No	No	Yes	No	X			
127	3706 Gail Dr	Yes	No	No	No			X	
128	3708 Glouesten	No	No	No	No				X
129	3709 Hawthorne Rd	Yes	No	Yes	No			X	
130	3713 Winchester Road	No	No	No	No				X
131	3716 Winchester Road	No	No	No	No				X
132	3717 Winchester Rd	No	No	Yes	No	X			
133	3721 Winchester Road	Yes	No	Yes	Yes	X			

	Address	Erosion?	House/Yard Flooding?	Street Flooding?	Storm Drainage Problems?	Problem to be Resolved by Recommended Alternative	Problem to be Resolved by City Maintenance	No Resolution	No Problems
134	3782 Loblolly Drive	No	No	No	No				X
135	3786 Loblolly Dr	No	No	No	No				X
136	3801 Hawthorne Road	Yes	No	No	Yes			X	
137	3801 Woodlawn Road	No	No	Yes	No	X			
138	3804 Hawthorne Rd	Yes	Yes	Yes	No	X			
139	3808 Gloucester Road	Yes	No	Yes	Yes			X	
140	3812 Gloucester Road	No	No	No	No				X
141	3817 Howthere Road	No	No	No	No				X
142	3819 Woodlawn Road	No	Yes	Yes	No	X			
143	3821 Mansfield Drive	No	Yes	Yes	Yes	X			
144	3833 & 3829 Mansfield Road	No	No	No	No				X
145	3833 West Moreland Drive	No	Yes	Yes	Yes	X			
146	3859 Hawthorne Road	No	No	No	No				X
147	3900 Hampton Drive	No	No	Yes	No			X	
148	3900 Hawthorne	No	No	Yes	No	X			
149	3904 Woodstock Road	Yes	Yes	Yes	Yes			X	
150	3909 Sunset Ave.	No	No	No	No				X
151	3912 Hawthorne Rd	No	No	Yes	No	X			
152	3993 Sunset Avenue	No	No	No	No				X
153	4000 Hawthorne Rd	No	No	Yes	No	X			
154	401 Fairfield Drive	No	No	Yes	No	X			
155	4012 Lochinvar Lane	No	No	Yes	No	X			
156	4016 Hawthorne Road	No	No	Yes	No	X			
157	4017 Hawthorne Rd	No	No	No	Yes		X		
158	4037 Brassfield Drive	No	No	No	No				X
159	405 Fairfield Dr	No	No	No	No				X
160	4165 Meadowview Ln	Yes	No	No	No			X	
161	5005 Brassfield	No	No	No	No				X
162	5009 Brassfield Dr	Yes	Yes	Yes	No			X	
163	501 St Mary's	No	No	Yes	No	X			
164	5021 Brassfield Drive	No	No	No	No				X
165	5031 Brassfield Dr	No	No	No	No				X
166	5032 Brassfield Drive	No	Yes	No	Yes			X	
167	601 Chad Street	No	No	Yes	No			X	

	Address	Erosion?	House/Yard Flooding?	Street Flooding?	Storm Drainage Problems?	Problem to be Resolved by Recommended Alternative	Problem to be Resolved by City Maintenance	No Resolution	No Problems
168	601 Nichole Lane	Yes	Yes	No	Yes			X	
169	609 Nichole Lane	No	Yes	No	No			X	
170	617 Chad Street	Yes	No	No	No			X	
171	708 Dana Lane	No	No	No	No				X
172	709 Nichole Lane	No	No	Yes	No			X	
173	906 S Winstead	No	No	No	No				X
174		No	No	Yes	No				
175		No	No	Yes	No				

Maple Creek Tributary #1 Watershed Study

Public Workshop for Existing Conditions Analysis

January 22, 2009

Utility Billing

- Equivalent Residential Unit (ERU) = 2,519 sf impervious area
- Single Family – Billed one ERU
- Multi-Family/Commercial/Industrial – Billed based on # of ERU's.
  - Computed from aerial photos, approved construction plans, and site inspections.
  - Multi-Family – billed based on # of ERU's for complex divided by number of units.
- ERU = $3.25
  - Based on initial budget
  - Raised to $3.75 in FY06

Introduction of Project Team

City Staff

- Blair Hinkle – Assistant Director of Public Works & Stormwater Manager
- Jonathan Boone – Director of Public Works
- Karen Callaway – Stormwater Engineer

WK Dickson Staff

- Scott Sigmon – Project Manager
- Ken Carper – Stormwater Director
- Ebony Fitchett – Project Engineer
- Neil Trentacosti – Project Engineer

Functions of Utility

- Administration
  - Stormwater Manager
  - Stormwater Engineer
  - GIS Technician / Stormwater Billing
- Operations
  - Ditch Maintenance – 5 crews >100 miles on 8-10 week schedule
  - Residential Pond Maintenance
  - Construction Crews
  - Street Sweepers – 3 sweepers 235 miles on monthly basis
- Capital Planning
  - Five year plan
  - Updated annually based on initial needs assessment and new issues
  - Basin Master Plan → Specific Designs → Construction

Program Inception

- State regulations took effect in 2001:
  - NPDES, Phase 2
  - Tar-Pamlico NSW
  - "Six Main Measures":
- Stormwater Advisory Committee formed to determine best approach to funding
  - Property tax increase – General Fund
  - Stormwater utility – Enterprise Fund
- Stormwater utility went into effect in FY04 (July 1, 2003)
  - Based on Impervious Area

Project Goals

- **Maintain infrastructure for flood control and public safety**
  - Roadway Culverts
  - Streams – capacity and stability
  - Roadside Ditches
  - Pipes and Inlets
- **Enhance Water Quality**
  - Streams – erosion control and enhancement
  - Stormwater Treatment Practices
  - Other approaches

Stormwater Management Master Planning

- **Watershed Approach**
- **High Priority Projects**
- **Master Plan Phases**
  - **Existing Conditions Analysis – Finding the Problems**
  - **Alternative Analysis – Finding the Solutions**
  - **Design – Designing the Solutions**
  - **Permitting – State and Federal Agencies**
  - **Easement Acquisition – Allowing Access**
  - **Construction – Implementing the Solutions**

Maple Creek Tributary #1 Watershed

Existing Conditions Overview

- Watershed Characteristics
- Engineering Analysis
- Applying Citizen Input

Engineering Analysis

- Determine runoff from watershed
- Analyze flow through streams and culverts
- Perform condition assessment of infrastructure
- Evaluate Citizen Information
- Compare results with historical data

Watershed Characteristics

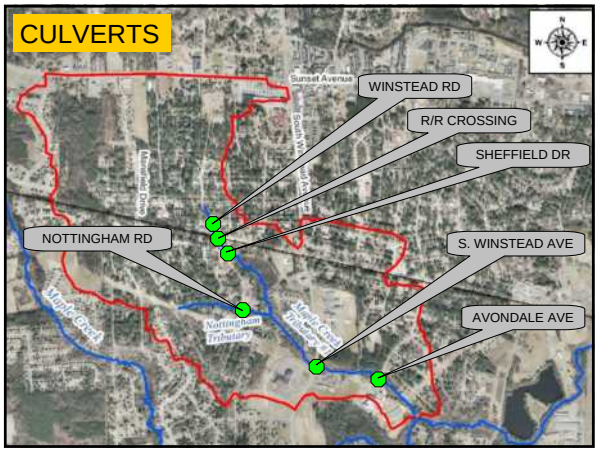
- 741 Acre Watershed (1.2 Square Miles)
- Primarily Residential
  - **76% residential**
  - **14% agricultural and split land use (i.e., churches)**
  - **10% commercial**
- Watershed area has nearly reached built-out conditions (90%)

Applying Citizen Input

- Project Kick-off Meeting
- Have the residents communicate the problems
- Drainage Questionnaires
  - Questionnaires were sent out in December
  - Complete online at *http://rockymount.wkdickson.com*
- Follow-up Field Investigation/Survey

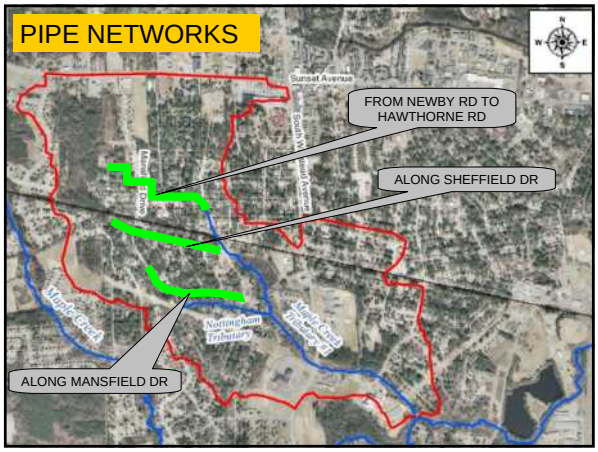
Project Components Evaluated

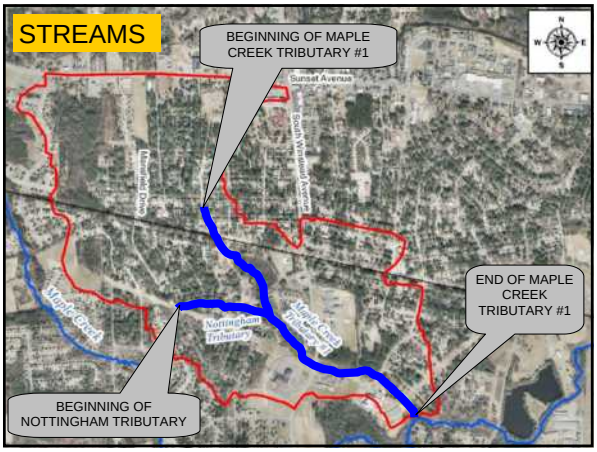
- Streams
- Culverts
- Underground Pipe Systems



Project Components

- Culvert Crossings
  - Maple Creek Tributary #1
    - **Winstead Road**
    - **Railroad Crossing Culvert**
    - **Sheffield Drive**
    - **South Winstead Avenue**
    - **Avondale Avenue**
  - Nottingham Tributary
    - **Nottingham Road**





Project Schedule

- Planning Report
- Second Public Meeting
- Design
- Third Public Meeting
- Start of 1st Phase of construction could begin as early as Spring 2011

Project Exhibits

- Citizen Input Map
- Landuse Map
- Watershed Area / Sub-basin Map
- Pipe Network Map

Break-Out Session

General Q & A

- Project Team will answer general stormwater related questions
- Please hold specific questions for the break-out session

General Q & A

Maple Creek Tributary #1 Watershed Study

Review of Existing Conditions Analysis and Proposed Alternatives

March 19, 2009

Introduction of Project Team

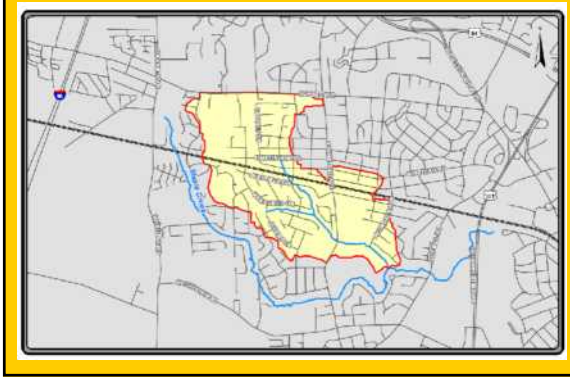
City Staff
- Blair Hinkle – Assistant Director of Public Works & Stormwater Manager
- Jonathan Boone – Director of Public Works
- Karen Callaway – Stormwater Engineer

WK Dickson Staff
- Scott Sigmon – Project Manager
- Ebony Fitchett – Project Engineer
- Neil Trentacosti – Project Engineer

Project Goals

- Maintain infrastructure for flood control and public safety
  - Roadway Culverts
  - Streams – capacity and stability
  - Roadside Ditches
  - Pipes and Inlets
- Enhance Water Quality
  - Streams – erosion control and enhancement
  - Stormwater Treatment Practices
  - Other approaches

Maple Creek Tributary #1 Watershed



Watershed Characteristics

- 741 Acre Watershed (1.2 Square Miles)
- Primarily Residential
  - 85% residential
  - 10% agricultural and split land use (i.e., churches)
  - 5% commercial
- Watershed area has nearly reached built-out conditions (over 90%)

Project Components Evaluated

- Culverts
  - Winstead Road
  - Railroad Crossing
  - Sheffield Drive
  - South Winstead Avenue
  - Avondale Avenue
  - Nottingham Road
- Closed Pipe Systems
  - Mansfield Area
- Streams
  - Nottingham Tributary
  - Maple Creek Trib. #1

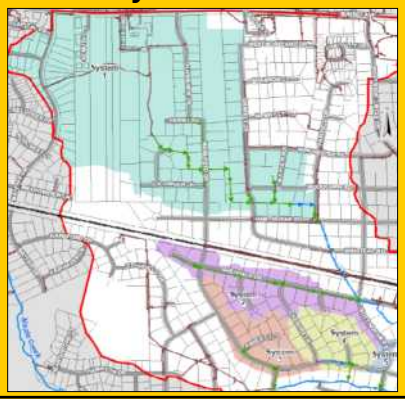
Existing Conditions

- Modeling Assumptions
- Closed Systems
- Culverts
- Streams

Modeling Assumptions

- Sub-Basin 1B
  - Flow from area drained to Sunset Avenue and was not included in our project
- Resident upstream of railroad did not experience finished floor flooding during Hurricane Floyd
  - Utilized feedback during public meeting to estimate flood attenuation
- Curve Numbers for Proposed Conditions
  - Calculated for current undeveloped land use

Closed Systems Evaluated

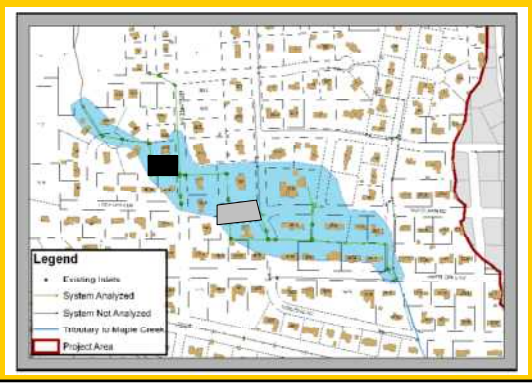


Closed System Review

- Systems 1 - Mansfield through Hawthorne
  - Upstream Pipe size: 18" RCP
  - Flow: 60 cfs (25-year) – severely undersized
  - Major flooding (see pictures from Mr. Williams – 3605 Winstead Road)
- Systems 2, 3, 4
  - Passes 2-year design storm
- System 5
  - Passes 25-year design storm

Representative Flooding Area

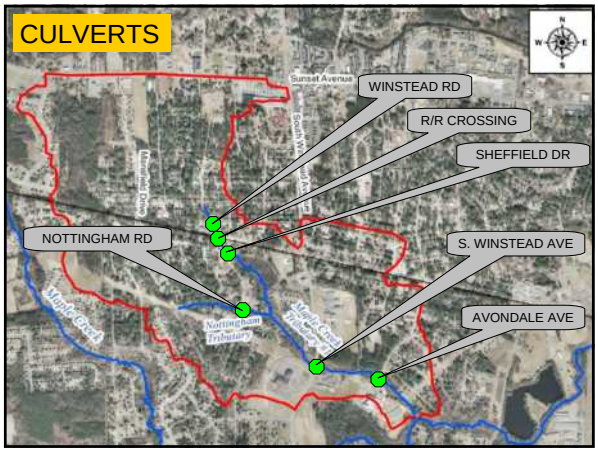
Flooding and Attenuation



Storage vs. Non-Storage

- Storage area upstream of the tributary
- Accounting for storage lowers flows

Location	25-year w/o storage (cfs)	25-year w/ storage (cfs)
U/S Limit of Maple Creek Trib#1	277	298
Winstead Avenue	341	172
Railroad Culvert	299	202
Sheffield Drive	299	202
Confluence of Mansfield and Nottingham Trib	738	706
South Winstead Avenue	718	700
Avondale Avenue	961	946
D/S Limit of Maple Creek Trib #1	1029	1008



Current Level of Service

Location	Structure Size and Material*	Required Level of Service (years)	Actual Level of Service (years)
Winstead Road	Double 5.5' x 4' CMP	25	<2
Railroad Crossing	72" Diameter CMP	N/A	100
Sheffield Drive	48" Diameter CMP	25	<2
South Winstead Avenue	Double 6' x 6' RCBC	50	50
Avondale Avenue	9.7' X 6.1'CMP	25	<2
Nottingham Road (Reach 2)	Double 3' X 4.4' CMP	25	2

Winstead Road

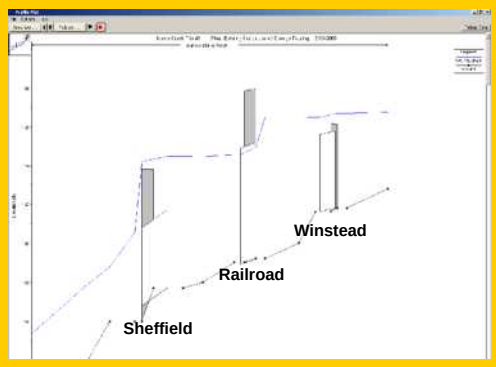
- Size: Double 5.5' x 4.0' CMP
- Condition: Good
- Meets 25-year Design Requirements: No

Railroad Crossing

- Size: 72" Diameter CMP
- Condition: Good

Sheffield Drive

- Size: 48" Diameter CMP
- Condition: Good
- Meets 25-year Design Requirements : No



South Winstead Avenue

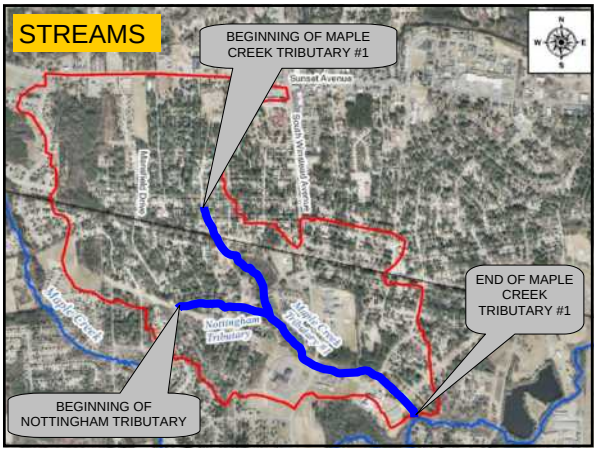
- Size: Double 6' x 6' RCBC
- Condition: Recent Construction
- Passing 50-yr Freeboard: Yes

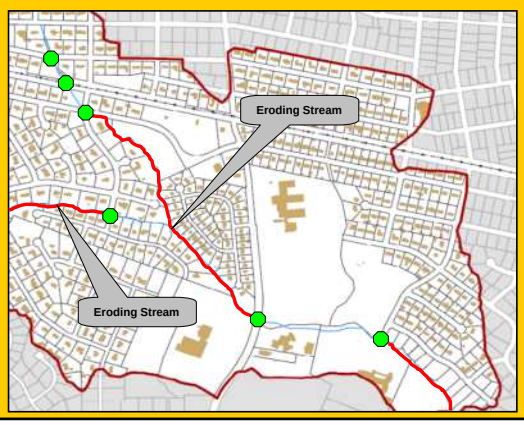
Avondale Avenue

- Size: 9.7' x 6.1' CMP
- Condition: Poor
- Meets 25-year Design Requirements: No

Nottingham Road

- Size: Double 3.0' x 4.4' CMP
- Condition: Poor
  - Endwall is failing; invert is rusted through
- Meets 25-year Design Requirements: No





Discussion of Proposed Alternatives

Closed Systems

Proposed Alternatives and Recommendations

Mansfield Area Recommendations

System 1

- Alternative 1
  - Construct new alignment down Mansfield Drive to Hawthorne Road
- Alternative 2
  - Construct new alignment down Mansfield Drive to the Railroad right-of-way

Mansfield Area Recommendations

System 1

- Required pipe size would not be feasible unless stream is lowered by two feet
- Stream would need to be lowered from Sheffield to Hawthorne – approximately 1,100 feet
- An Individual Permit would be required – cost would be approx $323 / LF

Mansfield Area Recommendations

- System 2
  - Upsize existing pipe alignment
- System 3
  - Upsize existing pipe alignment
- System 4
  - Upsize existing pipe alignment
- System 5
  - No improvements required

Culvert Crossings

Proposed Alternatives and Recommendations

Proposed Improvements

- Winstead Road
  - Required Size to pass the 25-yr: Double 12' x 6' RCBCs
  - Channel improvements (lower stream)
- Railroad Crossing
  - Add endwall and 54" RCP pipe beside existing pipe (jack & bore)
  - Channel improvements (lower stream)
- Sheffield Drive
  - Required Size to pass the 25-yr: 11' x 6' RCBC
  - Channel improvements (lower stream)

Proposed Improvements

- South Winstead Avenue
  - No proposed improvements
- Avondale Avenue
  - Required Size to pass the 25-yr: Double 10'x 8' RCBCs
- Nottingham Road
  - Required Size to pass the 25-yr: 8' x 6' RCBC

Storage vs. Non-Storage

- Storage area upstream of the railroad
- Accounting for storage lowers flows

Location	25-year w/o storage (cfs)	25-year w/ storage (cfs)
U/S Limit of Maple Creek Trib#1	277	298
Winstead Avenue	341	172
Railroad Culvert	299	202
Sheffield Drive	299	202
Confluence of Mansfield and Nottingham Trib	738	706
South Winstead Avenue	718	700
Avondale Avenue	961	946
D/S Limit of Maple Creek Trib #1	1029	1008

Effects of Proposed Alternatives

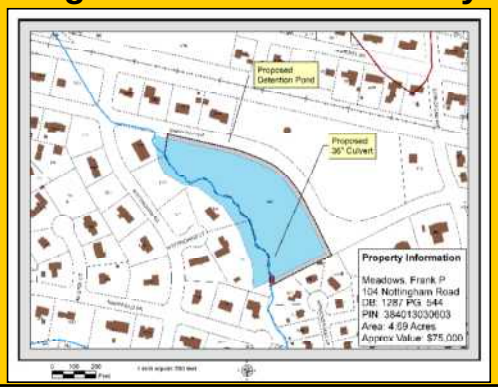
- WSELs Increases by One Foot or more
  - Between Sheffield Drive and South Winstead Avenue
- Increased WSEL at S. Winstead Avenue
  - Now overtops in the 50-year storm

Project Costs

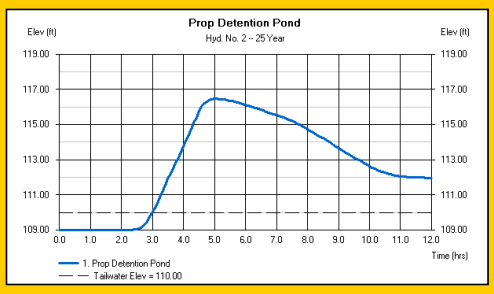
Discussion of Additional Alternatives

- On-line floodplain detention facility in vacant property downstream of Sheffield
- Add a floodplain culvert at South Winstead Avenue
- Include stream restoration between Sheffield and Winstead Ave

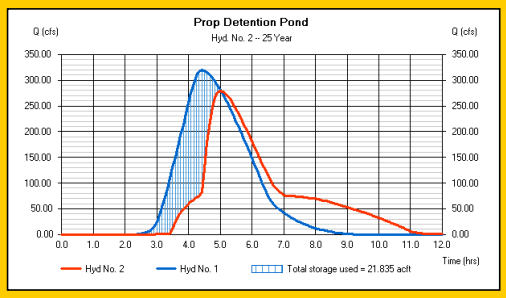
Regional Detention Facility



Detention Pond Flow Graph



Detention Pond Total Storage



Realistic Path Forward

- Maple Creek Tributary #1
  - Replace Avondale Avenue
  - Add bank pins to monitor erosion
  - Consider flood-proofing for repetitive loss properties
- Nottingham Tributary
  - Replace Nottingham Road
  - Add bank pins to monitor erosion

Additional Alternatives to Consider?

Maple Creek Tributary #1 Watershed Study

Review of Existing Conditions Analysis and Proposed Alternatives

June 15, 2009

Introduction of Project Team

City Staff

- Blair Hinkle – Assistant Director of Public Works & Stormwater Manager
- Jonathan Boone – Director of Public Works
- Karen Callaway – Stormwater Engineer

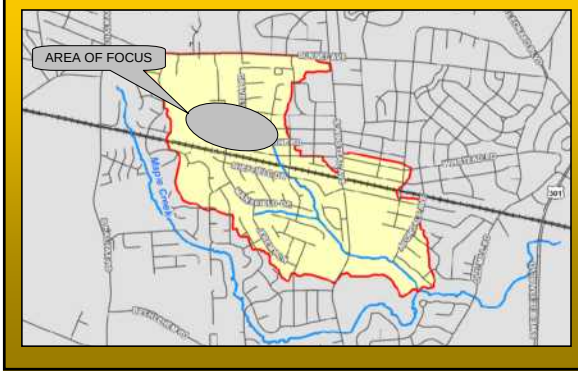
WK Dickson Staff

- Scott Sigmon – Project Manager
- Ken Carper –Program Director

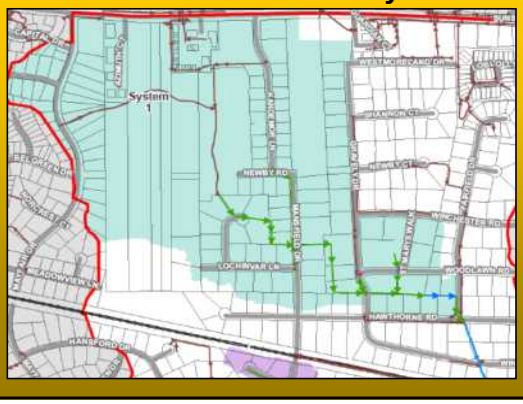
Meeting Agenda

- Brief Overview of Stormwater Study
- Existing Conditions
- Proposed Design
- Additional Alternatives
- Question & Answer Session

Maple Creek Tributary #1 Watershed

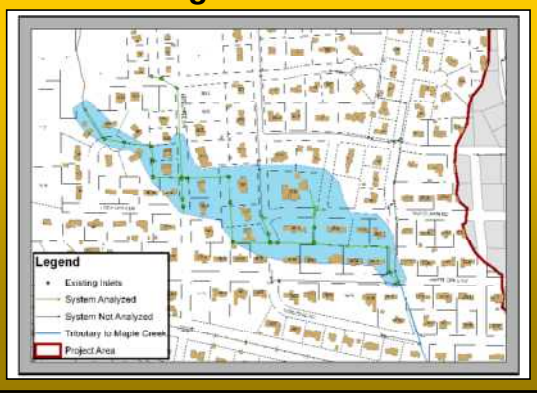


Mansfield / Hawthorne System

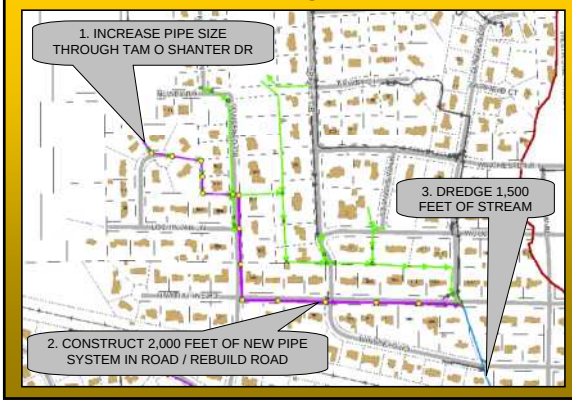


Representative Flooding

Flooding and Attenuation



Standard Design / Solution



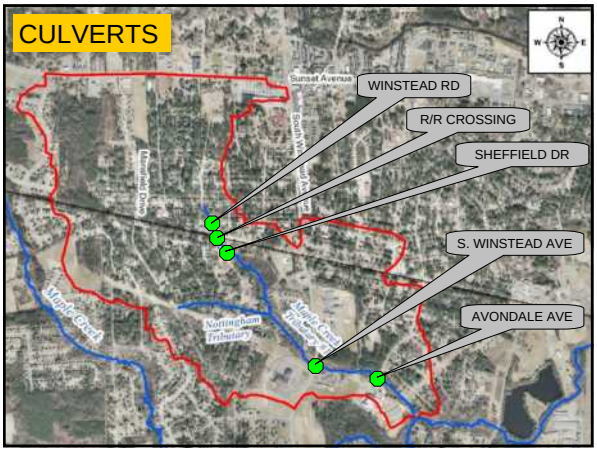
Mansfield / Hawthorne System

- Cost: $2.1 Million
- Decreased flooding in the vicinity of Mansfield / Hawthorne / Gravely
- However, increased flooding downstream of Hawthorne

3605 Winstead Road – upstream of the railroad stream crossing

Author Williams, lived here since 1994 – never flooded – if closed system were built, he would more than likely flood – flows increase by 33%

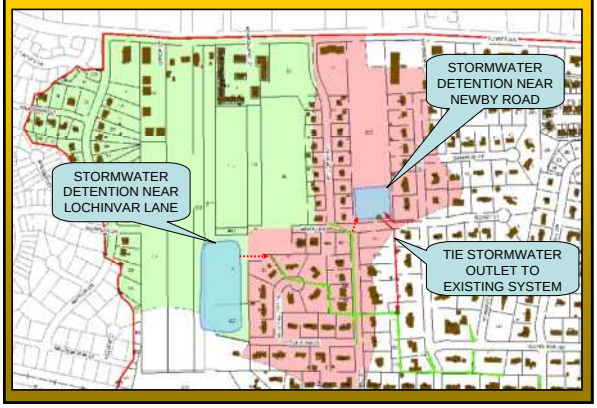
CULVERTS



Overall Improvements

Costs	
Mansfield / Hawthorne System	$2.1 Million
Winstead Road	$0.6 Million
Railroad Crossing	$0.2 Million
Sheffield Drive	$0.5 Million
Avondale Avenue	$0.7 Million
Stream Grading / Dredging	$1.8 Million
Total Project Cost	**$5.9 Million**

Additional Alternatives



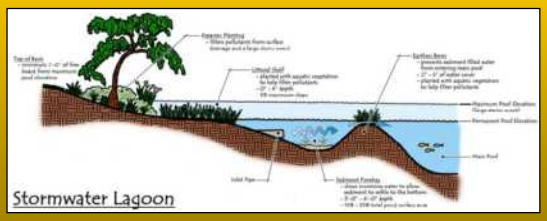
Natural Stormwater Drainage Practices

BMP's (Best Management Practices)

- Runoff Conveyance Practices
- Runoff Storage Practices
- Filtration Practices
- Infiltration Practices

BMP's (Best Management Practices)

- Runoff Conveyance Practices
- Runoff Storage Practices



Forebays

- Provides sedimentation area
- Provides cleanout area
- Vegetation on earthen dam filters stormwater

Littoral/ Aquatic Shelves

- Provides aerobic zone
- Promotes growth of beneficial microorganisms
- Increases surface area
- Safety zone
- Area of greatest biologic activity

Combined Benefits

- Slows the flow of water
- Provides wildlife habitat
- Creates beauty
- Cleans the water

Example Project Under Construction

Stormwater Pond One Year Following Planting

Final Stormwater Pond – Littoral/ Aquatic Shelves

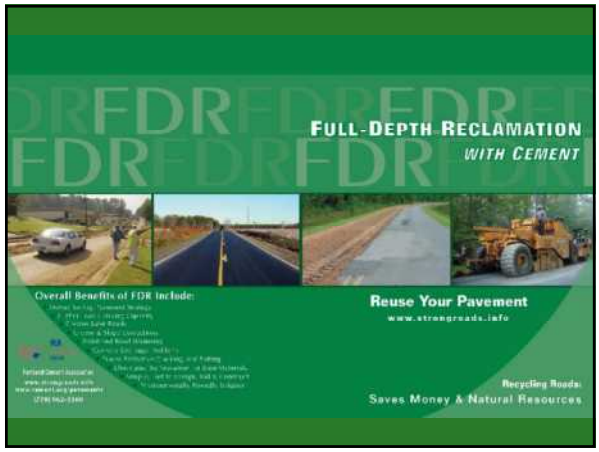
Alternatives

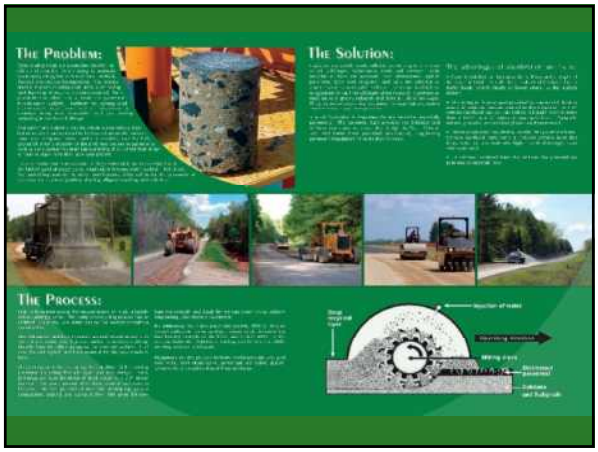
Costs	
Lochinvar Stormwater Detention	$0.7 Million
Newby Stormwater Detention	$0.5 Million
Total Project Cost	$1.2 Million

Alternatives

- Cost: $1.2 Million (vs. $ 5.9 Million)
- Decreased flooding in the vicinity of Mansfield / Hawthorne / Gravely
- No increased flooding downstream of Hawthorne Road

General Q & A


FULL-DEPTH RECLAMATION
WITH CEMENT
Overall Benefits of FDR Include:
Reuse Your Pavement
www.strongroads.info
Recycling Roads:
Saves Money & Natural Resources


The Problem:
The Solution:
The Process:

Maple Creek Tributary #1 Watershed Study

Review of Existing Conditions Analysis and Proposed Alternatives

September 3, 2009

Introduction of Project Team

City Staff

- Blair Hinkle – Assistant Director of Public Works & Stormwater Manager
- Jonathan Boone – Director of Public Works
- Karen Callaway – Stormwater Engineer

WK Dickson Staff

- Scott Sigmon – Project Manager
- Scott Whalen – Stormwater Director
- Neil Trentacosti – Project Designer
- Ebony Hagans – Project Engineer

Meeting Agenda

- Brief Overview of Stormwater Study
- Existing Conditions
- Proposed Design
- Additional Alternatives
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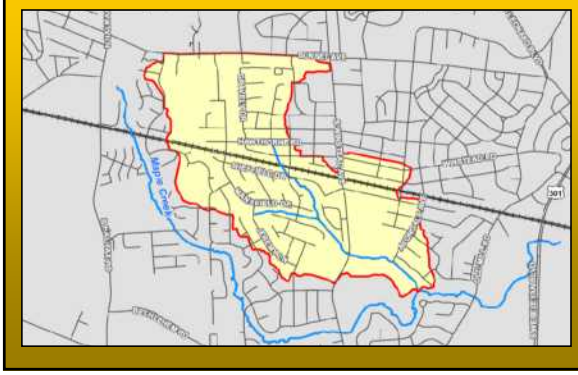
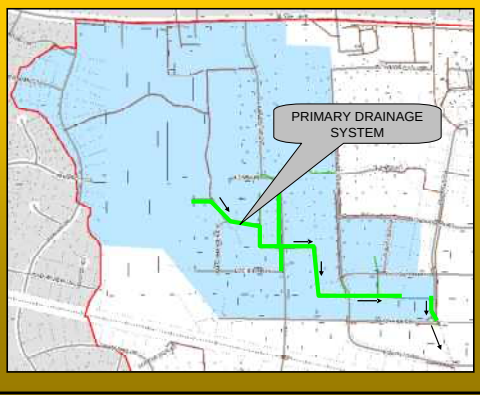
Maple Creek Tributary #1 Watershed



Mansfield / Hawthorne System



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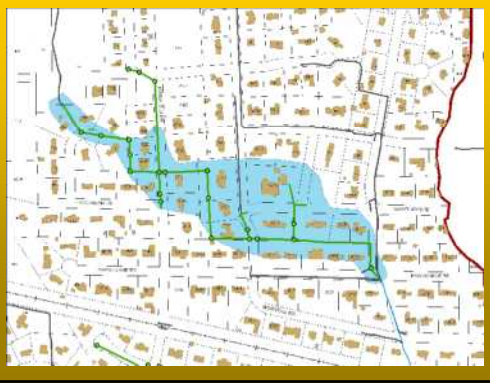
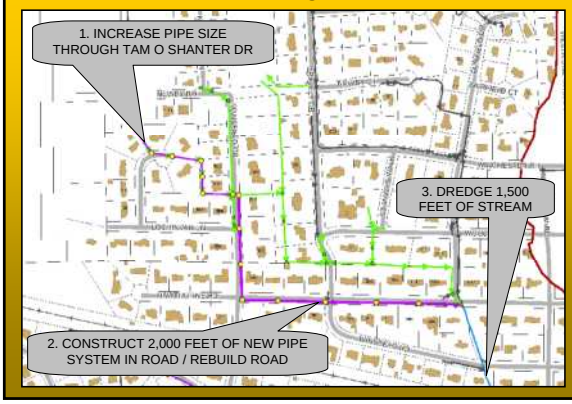


Standard Design / Solution



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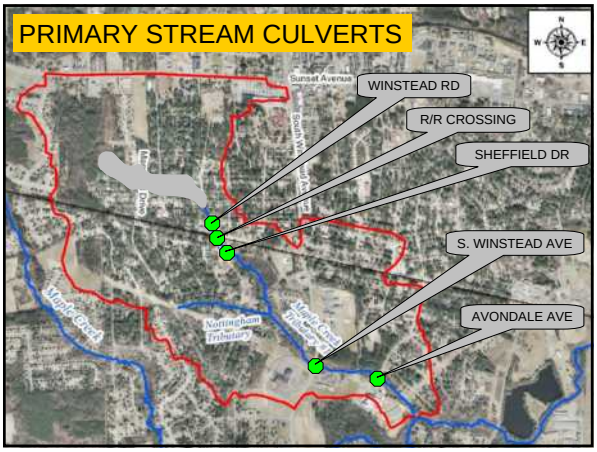
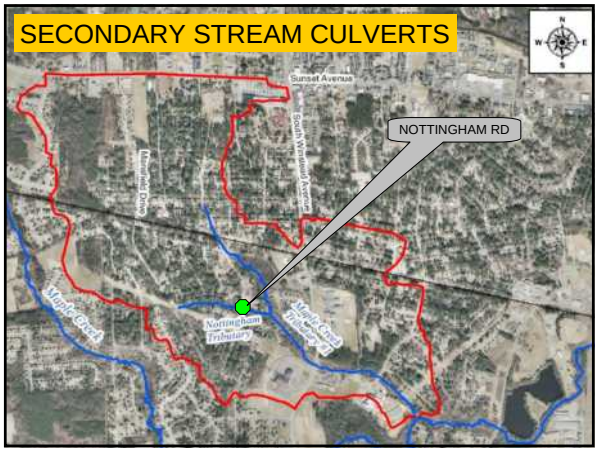
PRIMARY STREAM CULVERTS



SECONDARY STREAM CULVERTS

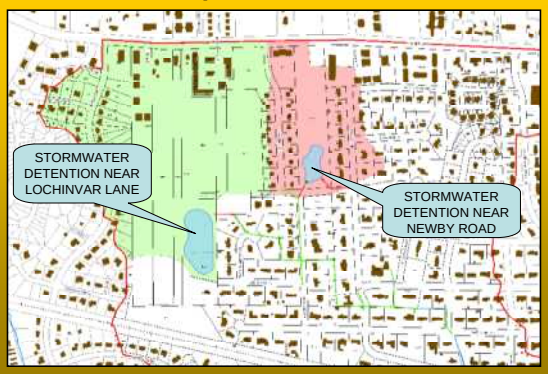


Overall Improvements

Costs

Mansfield / Hawthorne System	$2.1 Million
Winstead Road	$0.6 Million
Railroad Crossing	$0.2 Million
Sheffield Drive	$0.5 Million
Avondale Avenue	$0.7 Million
Stream Grading / Dredging	$1.8 Million
Nottingham Road	$0.3 Million
Total Project Cost	**$6.2 Million**

Conceptual Alternatives



Natural Stormwater Drainage Practices

BMP's (Best Management Practices)

- Runoff Conveyance Practices
- Runoff Storage Practices
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BMP's (Best Management Practices)

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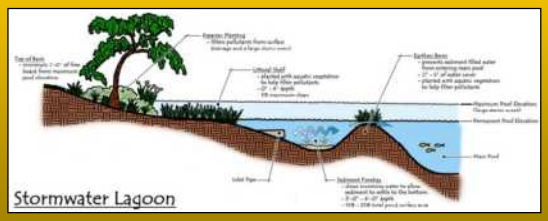

Forebays

- Provides sedimentation area
- Provides cleanout area
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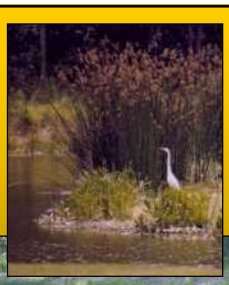
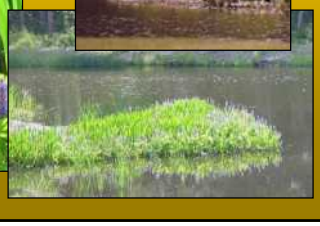
Combined Benefits

- Slows the flow of water
- Provides wildlife habitat
- Creates beauty
- Cleans the water





Example Project Under Construction

Stormwater Pond One Year Following Planting

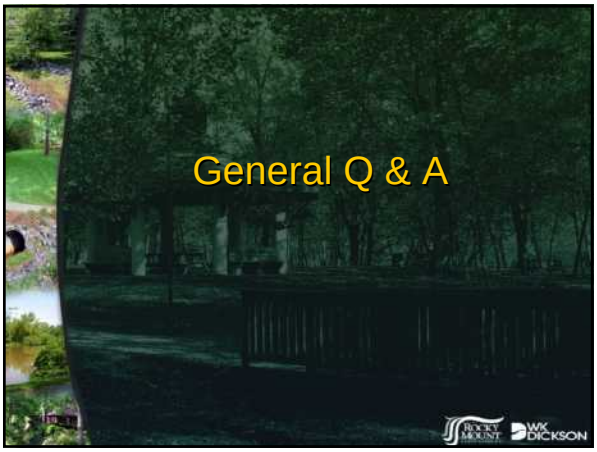
Final Stormwater Pond – Littoral/ Aquatic Shelves

Alternatives

Costs	
Lochinvar Stormwater Detention	$0.7 Million
Newby Stormwater Detention	$0.5 Million
Nottingham Road Culvert	$0.3 Million
Total Project Cost	$1.5 Million

Alternatives

- Cost: $1.5 Million (vs. $ 6.2 Million)
- Decreased flooding in the vicinity of Mansfield / Hawthorne / Gravely
- No increased flooding downstream of Hawthorne Road


General Q & A
ROCKY MOUNT
WK DICKSON

M E E T I N G M I N U T E S

720 Corporate Center Drive, Raleigh, North Carolina 27607 919.782.0495

DATE: FEBRUARY 10, 2009

TO: BLAIR HINKLE

FROM: SCOTT SIGMON

WKD #: 80450.00.RA (MAPLE CREEK TRIBUTARY #1)

Maple Creek Tributary #1

Public Meeting #1 – January 22, 2009

5:30 pm at City Hall – 3rd Floor Council Chamber

Maple Creek Tributary #1 Design Team Participants:

- Blair Hinkle – Assistant Director of Public Works & Stormwater Manager
- Jonathan Boone, P.E. – Director of Public Works
- Karen Callaway – Stormwater Engineer
- Scott Sigmon, P.E. – Project Manager, WK Dickson
- Ken Carper, P.E. – Stormwater Director, WK Dickson
- Neil Trentacosti – Project Engineer, WK Dickson
- Ebony Fitchett – Project Engineer, WK Dickson

Summary of Blair Hinkle's/Scott Sigmon's PowerPoint Presentation (See Attachment):

Blair Hinkle

- Introduced design team participants.
- Discussed the overview of the stormwater program and described services provided by the Public Works Department.
- Discussed state regulations that took effect in 2001, thus requiring the need for stormwater funding.
- Discussed the Storm drain utility fee that was added in 2003. Blair described the program, how the rates were created, and how the revenue is used.

Scott Sigmon

- Discussed the project goals.
- Discussed the method of approaching the project (watershed approach, high priority projects first, and master plan phases). Emphasized that the meeting was to look at the existing conditions and find the current problems.
- Discussed the boundaries of the project area and how we would analyze the existing conditions of the area. Emphasized that the citizen input was critical in this process.
- Discussed the drainage questionnaires that were sent out and how they could be completed. Talked about what would be done with the information we received.
- Discussed the project schedule.
- Discussed the displayed project exhibits and asked for input after the presentation.

Questions Asked by Public About General Project Items:

The following section presents the questions from citizens (C) and responses provided by Scott Sigmon (SS) or Blair Hinkle (BH):

- C: There was a question about how this watershed was chosen and if it was the first area to be studied.
  BH: This is not the first area to be studies. All watershed's in the City were categorized and ranked. The watersheds with the highest rank were studied first and we will continue to study all subsequent watersheds until they have all been evaluated.

- C: There was a question about another watershed that drains to Maple Creek.
  BH: That will be Maple Creek Tributary #2 and is a separate project.

Comments from plan sheets presented on foam board

<u>Maple Creek Tributary #1</u>

- There is a 30" culvert behind 3416 Sheffield Drive that backs up all the time
- Yard flooding at 101 Litchfield Drive
- Pipe blocked under road at Mansfield and Chelsea
- Culvert at Sheffield and Nottingham is unstable/blown out

M E E T I N G M I N U T E S

720 Corporate Center Drive, Raleigh, North Carolina 27607 919.782.0495

DATE: MARCH 19, 2009

TO: BLAIR HINKLE

FROM: SCOTT SIGMON, P.E.

WKD #: 80450.00.RA (MAPLE CREEK TRIBUTARY #1 WATERSHED STUDY)

City of Rocky Mount – City Hall Complex at 12:00 pm

Maple Creek Tributary #1 – Review of Existing Conditions Analysis and Proposed Alternatives

Maple Creek Tributary #1 Design Team Participants:

- Blair Hinkle – Assistant Director of Public Works & Stormwater Manager
- Jonathan Boone, P.E – Director of Public Works
- Karen Callaway – Stormwater Engineer
- Brad Kerr, P.E – Director of Engineering
- Scott Sigmon, P.E – Project Manager, WK Dickson
- Scott Whalen, P.E – Vice President, WK Dickson
- Ebony Fitchett – Project Engineer, WK Dickson

Summary of Recommendations from Presentation:

- Replace Avondale Avenue culvert based on the assumption that it is a City owned street. Karen agreed to confirm if this was a City street or a private right-of-way.
- Replace Nottingham Road culvert.
- Add bank pins to monitor erosion along unstable portions of Maple Creek Tributary #1 and Nottingham Tributary.
- Consider flood-proofing for repetitive loss properties.

- Other project implementations will require careful consideration and additional discussion.

Summary of Meeting Comments:

- Review approved plans for new subdivision near Newby Road.
    - Be sure the new proposed pipe alignment is taken into consideration during this watershed study.
- Consider adding an open ditch along railroad instead of the proposed closed system (design for 10-year storm).
    - This could be a more cost effective option.
    - An open ditch could provide possible water quality benefits.
- Open property upstream of Mansfield Drive – City may want to consider purchasing this very property for runoff storage.
    - Located east of Newby Road and south of Sunset Avenue
    - Evaluate contributing drainage are to this property and assess if it would be feasible to consider runoff storage at this location.
- Online Detention – Do you anticipate any permitting concerns from NCDENR?
    - On past similar projects it has not been a concern in terms of permitting if built for the purposes of attenuating peak flow; water quality benefits, if there were any, would be minimal.
- Avondale Avenue and Nottingham Road are both at the end of their life cycle regarding age and condition.
    - Would be a higher priority in terms of replacement for safety reasons.
- As an alternative to recommending closed systems along the southern portion of Mansfield, consider utilizing in-house maintenance crews to keep drains cleared and functioning properly, etc.
    - Will consider reconstructing roadside swales along Mansfield Drive to hold water, maybe add additional cross-sectional area with gentler slope to maximize storage (can be used as a pipe trench later).
- For next public meeting, a brief executive summary should be prepared to address the following:

- Two million dollar cost to fix nuisance flooding that would causes increased flooding to downstream property owners; resulting in additional spin-off projects that would cost an additional $4 million to address.
- Potential permitting concerns as a result of the projects.
- 2 – 3 page document in laymen's terms to explain why the project is not fixing the problem and good use of taxpayers' money.
- Work with property owners who are experiencing the most property damage and try to help them flood-proof as an alternative.

Actions Items

- Not sure if the Avondale Avenue Crossing is in the City's ROW?
  - Karen will confirm if this was a City street or a private right-of-way.
- Contact representative from railroad.
  - Blair will get in touch with railroad personnel.
- Begin formulating an approach on how to present this to the public (2-3 weeks).
  - Schedule another meeting prior to public meeting to discuss costs, alternatives, what / how to relay to public.

M E E T I N G M I N U T E S

720 Corporate Center Drive, Raleigh, North Carolina 27607 919.782.0495

DATE: SEPTEMBER 10, 2009

TO: BLAIR HINKLE

FROM: SCOTT SIGMON

WKD #: 80450.00.RA (MAPLE CREEK TRIBUTARY #1 WATERSHED STUDY)

September 3, 2009 at 6:00PM – Calvary Baptist Church (Rocky Mount, North Carolina)

Public Meeting #3 – Maple Creek Tributary #1 Watershed Study: Review of Existing Conditions Analysis and Proposed Alternatives

Maple Creek Tributary #1 Project Team Participants:

- Blair Hinkle – Assistant Director of Public Works & Stormwater Manager
- Jonathan Boone, P.E. – Director of Public Works
- Karen Callaway – Stormwater Engineer
- Scott Sigmon, P.E. – Project Manager, WK Dickson
- Scott Whalen, P.E. – Stormwater Director, WK Dickson
- Neil Trentacosti – Project Designer, WK Dickson
- Ebony Hagans, P.E. – Project Engineer, WK Dickson

Meeting Agenda:

- Brief Overview of Stormwater Study
- Existing Conditions
- Proposed Design
- Additional Alternatives
- Question and Answer Session

Meeting Presentation: (See Attached PowerPoint)

- Presenters were Blair Hinkle and Scott Sigmon

        - The City commented that they are not opposed to using alternate properties for the Lochinvar detention pond. 3917 and 3921 Sunset Avenue should be looked at as potential sites.
        - One problem with the Lochinvar detention pond is the abundance of trees on the selected properties. Homeowners may not want to clear all of the trees in this area.
- Detention Pond Alternative #2 was discussed including cost, property acquisition, tree clearing, soil borings, and pocket wetlands. The flow reduction from approximately 60 cfs to 15 cfs was mentioned.
        - It was noted that we may not want to use already built out properties.
        - The City noted that we should look at taking the flow down Gravely instead of between the houses.
        - The City noted that the Right of Way easement between Mansfield and Gravely may no longer exist. Blair was going to look into this further.
        - Scott noted that this alternative would not put the system into compliance with the 25-year storm, but it would be very close.

- Blair commented that the City would like to update the Nottingham culvert but would not like to update the Avondale culvert.

Action Items:

- WK Dickson to look into lining the Nottingham culvert and installing new end walls.
- WK Dickson to move the Newby detention pond to 3805 Sunset Avenue
- WK Dickson to put together power point presentation and send to Blair by Thursday afternoon for his review (do not show Alternate #1, just pond alternative).

M E E T I N G M I N U T E S

720 Corporate Center Drive, Raleigh, North Carolina 27607 919.782.0495

DATE: JUNE 10, 2009

TO: BLAIR HINKLE

FROM: SCOTT SIGMON

WKD #: 80450.00.RA (MAPLE CREEK TRIBUTARY #1)

Maple Creek Tributary #1

Detention Pond Alternatives Meeting – June 10, 2009

10:00 a.m. at City Hall – 2rd Floor Conference Room

Maple Creek Tributary #1 Design Team Participants:

- Blair Hinkle – Assistant Director of Public Works & Stormwater Manager
- Jonathan Boone, P.E – Director of Public Works
- Brad Kerr, P.E. – Engineering Director
- Karen Callaway – Stormwater Engineer
- Scott Sigmon, P.E – Project Manager, WK Dickson
- Neil Trentacosti – Project Engineer, WK Dickson

Summary of Design Alternatives:

- Scott reviewed the original Alternative #1 that took water along Mansfield Drive to Hawthorne Road and outlets at Fairfield Drive. The cost of this alternative and the complications with it were also discussed.
- Detention Pond Alternative #1 was discussed including cost, property acquisition, tree clearing, soil borings, and pocket wetlands. The flow reduction from approximately 180 cfs to 60 cfs was mentioned.
    - Blair wanted to make sure that WK Dickson reiterates the holistic approach to the design at the public meeting on Monday.

Question and Answer Session:

Q: Is the pond located south of the condos on 301 the type of pond you are talking about? It sits on corner near Texaco across from Japanese restaurant. What kind of pond is it there?

A: The pond that you are referring to is a wet pond that was built for the subdivision.

Q: My concern is the pond scum and the lack of maintenance on these types of ponds. How will this be handled?

A: This only becomes an issue when the pond is not designed and built properly. As seen in the pictures from the presentation, the pond takes time to become established. After a year or so, it should not be a problem. Another concern that is frequently expressed is mosquitoes – there are certain types of fish that feed on mosquitoes. These will be incorporated into the pond.

Q: These ponds could be a potential problem for children - will the pond be fenced in?

A: More than likely the ponds will not be fenced in but we understand how it could be perceived as a hazard to children. Safety measures will be considered during the design phase.

Q: Is there any drainage under the railroad tracks?

A: There is a major culvert located under the tracks along the main stem of the tributary. Several issues related to drainage in the railroad right-of-way have been previously brought to our attention. A meeting is being scheduled with railroad personnel and it will be handled separately.

Q: What is the timeframe for starting the project?

A: We are at a conceptual level. The affected property owners need to be contacted and brought into the planning discussions. Once the City obtains the support of the land owners, the design work will need to be completed. There are also administrative details that need to be worked through. Assuming everything goes as planned, the process would be a minimum of 12 months.

Q: What would be the impacts to the rest of the property that surrounds the site proposed for the Lochinvar detention pond?

A: We will discuss this specifically with you following the meeting.

Q: Are there any other projects connected to this watershed area?

A: No, we focused on the upstream portion of the watershed area because this are had the more significant flooding. They were a lot more serious than nuisance flooding issues identified in the downstream section of the watershed. The City's maintenance crews can be used to resolve the nuisance flooding.

Q: The location on the map for the Lochinvar pond is the highest point in the area. Why was it chosen?

A: Although it is the highest point, it will be excavated and lowered to a desired design elevation low enough to drain the adjacent areas. This location was chosen to help minimize the number of properties affected by the design and the number of easements the City would need to obtain in order to build the project.

Q: How big are the ponds?

A: The exact size of the ponds has not been determined. This is still on a concept level. Based on preliminary analysis, the smaller pond will be about 1 acre and the larger one about 4 acres. They will be about 6 to 7 feet deep.

Q: Is the area outlined on map the water or land area of the pond?

A: It is the area the pond will be when it is full, but again this has only presented at a conceptual level.

Additional Comments:

- Resident at 3113 Berkeley Drive believes the ditch running along his backyard needs to be cleared out.

- Eroded stream banks located at 1404 Jeremy Lane and 3533 Mansfield Drive. Several meeting attendees commented on the significant erosion problems downstream of the Jeremy Lane (at the beginning of the Nottingham Tributary).
- One meeting attendee pointed out that the historic name for the main stream was Jumping Run Creek.

APPENDIX E

Project: Maple Creek Tributary #1, Rocky Mount, NC

Prepared by: EVF

Date: February 10, 2009

Sufficiency Evaluation - Existing Conditions With Storage Routing

Does not meet design criteria

Design Storm 2-Year Flood

Crossing	Culvert Size	Culvert Height (ft)	EG U/S (ft)	WSEL (ft)	EG IC (ft)	EG OC (ft)	Min Weir Elevation (ft)	Q Culvert (cfs)	Q Weir	Delta WS (cfs)	Inv. U/S (ft)	Inv. D/S (ft)	Culvert Vel D/S (ft/s)	Culvert Vel (ft/s)	Freeboard (ft)	U/S Head	HW/D
Winstead Road	Double 5.5' x 4' CMP	4.0	125.82	125.81	123.49	125.82	126.17	49		0.06	121.79	121.61	1.4	1.4	0.36	4.02	1.01
Railroad Culvert	72" DIA. CMP	6.0	125.76	125.75	124.93	125.76	127.97	167		1.39	119.2	118.92	6.2	6.2	2.22	6.55	1.09
Sheffield Drive	48" DIA. CMP	4.0	124.31	124.3	124.23	124.31	123.85	113.65	45.35	4.15	117.73	116.8	10.1	9.0	-0.45	6.57	1.64
South Winstead Avenue	Double 6' x 6' RCBC	6.0	105.41	105.18	104.62	105.41	109.37	356		0.79	99.79	99.5	6.1	6.3	4.19	5.39	0.90
Avondale Avenue	9.7' x 6.1' CMP	6.1	101.03	101.02	100.94	101.03	100.61	322.66	92.34	2.03	94.34	93.87	7.5	7.7	-0.41	6.68	1.10
Nottingham Road	Double 3' x 4.4' CMP	4.4	115.96	115.94	115.07	115.96	117.6	153		3.47	110.33	109.71	9.9	7.4	1.66	5.61	1.28

Design Storm 10-Year Flood

Crossing	Culvert Size	Culvert Height (ft)	EG U/S (ft)	WSEL (ft)	EG IC (ft)	EG OC (ft)	Min Weir Elevation (ft)	Q Culvert (cfs)	Q Weir	Delta WS (cfs)	Inv. U/S (ft)	Inv. D/S (ft)	Culvert Vel D/S (ft/s)	Culvert Vel (ft/s)	Freeboard (ft)	U/S Head	HW/D
Winstead Road	Double 5.5' x 4' CMP	4.0	126.5	126.47	125.4	126.5	126.17	135.2	35.8	0.61	121.79	121.61	3.9	3.9	-0.30	4.68	1.17
Railroad Culvert	72" DIA. CMP	6.0	126.02	126.01	125.19	126.02	127.97	178		1.53	119.2	118.92	6.5	6.5	1.96	6.81	1.14
Sheffield Drive	48" DIA. CMP	4.0	124.42	124.41	124.33	124.42	123.85	114.54	63.46	4.07	117.73	116.8	9.7	9.1	-0.56	6.68	1.67
South Winstead Avenue	Double 6' x 6' RCBC	6.0	107.04	106.92	106.44	107.04	109.37	566		1.75	99.79	99.5	8.3	8.5	2.45	7.13	1.19
Avondale Avenue	9.7' x 6.1' CMP	6.1	101.6	101.58	101.52	101.6	100.61	322.97	428.03	1.75	94.34	93.87	7.0	7.1	-0.97	7.24	1.19
Nottingham Road	Double 3' x 4.4' CMP	4.4	118.55	118.54	118.13	118.55	117.6	203.3	41.71	5.1	110.33	109.71	10.5	9.8	-0.94	8.21	1.87

Design Storm 25-Year Flood

Crossing	Culvert Size	Culvert Height (ft)	EG U/S (ft)	WSEL (ft)	EG IC (ft)	EG OC (ft)	Min Weir Elevation (ft)	Q Culvert (cfs)	Q Weir	Delta WS (cfs)	Inv. U/S (ft)	Inv. D/S (ft)	Culvert Vel D/S (ft/s)	Culvert Vel (ft/s)	Freeboard (ft)	U/S Head	HW/D
Winstead Road	Double 5.5' x 4' CMP	4.0	126.72	126.70	125.41	126.72	126.17	88.63	83.37	0.2	121.79	121.61	2.6	2.6	-0.53	4.91	1.23
Railroad Culvert	72" DIA. CMP	6.0	126.51	126.51	125.78	126.51	127.97	202		1.93	119.2	118.92	7.3	7.2	1.46	7.31	1.22
Sheffield Drive	48" DIA. CMP	4.0	124.5	124.5	124.44	124.5	123.85	113.57	88.43	3.93	117.73	116.8	9.3	9.0	-0.65	6.77	1.69
South Winstead Avenue	Double 6' x 6' RCBC	6.0	108.18	108.1	108.18	107.95	109.37	700		2.85	99.79	99.5	10.1	10.0	1.27	8.31	1.39
Avondale Avenue	9.7' x 6.1' CMP	6.1	101.81	101.78	101.73	101.81	100.61	311.13	634.87	1.63	94.34	93.87	6.8	6.8	-1.17	7.44	1.22
Nottingham Road	Double 3' x 4.4' CMP	4.4	119.3	119.29	119.01	119.3	117.6	204.22	146.78	4.94	110.33	109.71	9.9	9.9	-1.69	8.96	2.04

Design Storm 50-Year Flood

Crossing	Culvert Size	Culvert Height (ft)	EG U/S (ft)	WSEL (ft)	EG IC (ft)	EG OC (ft)	Min Weir Elevation (ft)	Q Culvert (cfs)	Q Weir	Delta WS (cfs)	Inv. U/S (ft)	Inv. D/S (ft)	Culvert Vel D/S (ft/s)	Culvert Vel (ft/s)	Freeboard (ft)	U/S Head	HW/D
Winstead Road	Double 5.5' x 4' CMP	4.0	126.89	126.87	125.41	126.89	126.17	46.14	125.86	0.04	121.79	121.61	1.3	1.3	-0.70	5.08	1.27
Railroad Culvert	72" DIA. CMP	6.0	126.83	126.83	126.09	126.83	127.97	215		2.16	119.2	118.92	7.7	7.6	1.14	7.63	1.27
Sheffield Drive	48" DIA. CMP	4.0	124.58	124.58	124.49	124.58	123.85	113.23	101.77	3.89	117.73	116.8	9.1	9.0	-0.73	6.85	1.71
South Winstead Avenue	Double 6' x 6' RCBC	6.0	109.14	109.08	109.14	108.78	109.37	792		3.7	99.79	99.5	14.2	11.0	0.29	9.29	1.55
Avondale Avenue	9.7' x 6.1' CMP	6.1	101.98	101.95	101.85	101.98	100.61	311.03	758.97	1.63	94.34	93.87	6.8	6.8	-1.34	7.61	1.25
Nottingham Road	Double 3' x 4.4' CMP	4.4	119.62	119.61	119.35	119.62	117.6	199.74	222.26	4.72	110.33	109.71	9.6	9.6	-2.01	9.28	2.11

Design Storm 100-Year Flood

Crossing	Culvert Size	Culvert Height (ft)	EG U/S (ft)	WSEL (ft)	EG IC (ft)	EG OC (ft)	Min Weir Elevation (ft)	Q Culvert (cfs)	Q Weir	Delta WS (cfs)	Inv. U/S (ft)	Inv. D/S (ft)	Culvert Vel D/S (ft/s)	Culvert Vel (ft/s)	Freeboard (ft)	U/S Head	HW/D
Winstead Road	Double 5.5' x 4' CMP	4.0	127.19	127.17	125.41	127.19	126.17	29.33	142.67	0.01	121.79	121.61	0.9	0.9	-1.00	5.38	1.35
Railroad Culvert	72" DIA. CMP	6.0	127.16	127.16	126.41	127.16	127.97	228		2.45	119.2	118.92	8.2	8.1	0.81	7.96	1.33
Sheffield Drive	48" DIA. CMP	4.0	124.61	124.6	124.5	124.61	123.85	112.22	115.78	3.81	117.73	116.8	8.9	8.9	-0.75	6.87	1.72
South Winstead Avenue	Double 6' x 6' RCBC	6.0	109.59	109.55	109.59	109.23	109.37	833.66	27.34	4.09	99.79	99.5	14.7	11.6	-0.18	9.76	1.63
Avondale Avenue	9.7' x 6.1' CMP	6.1	102.08	102.04	101.97	102.08	100.61	304.7	876.3	1.55	94.34	93.87	6.6	6.6	-1.43	7.70	1.26
Nottingham Road	Double 3' x 4.4' CMP	4.4	119.79	119.78	119.54	119.79	117.6	197.03	272.97	4.6	110.33	109.71	9.5	9.5	-2.18	9.45	2.15

Sufficiency Evaluation (City of Rocky Mount Stormwater Design Manual)

- Residential Local and Collector Roadways – 25-year design storm with 1 foot of freeboard.
- Commercial Local and Collector Roadways – 50-year design storm with 0.5 foot of freeboard.
- Industrial Local and Collector Roadways – 50-year design storm with 0.5 foot of freeboard.
- Minor and Major Arterial Roadways – 50-year design storm with 0.5 foot of freeboard.
- HW/D (headwater depth to culvert depth) <1.2.

Project: Maple Creek Tributary #1, Rocky Mount, NC

Prepared by: EVF

Date: February 17, 2009

PROPOSED CULVERTS:

- Winstead Road – Double 12' x 5' RCBC (blocked 1 ft at bottom)
- Railroad Culvert – 54" RCP (also add endwall – entrance loss coefficient changed from 0.9 to 0.5)
- Sheffield Drive – 11' x 6' RCBC (blocked 1 ft at bottom)
- South Winstead Avenue – no changes
- Avondale Avenue – Double 10' x 8' RCBCs (blocked 1 ft at bottom of one of the box culverts)
    - Raised road up 18"
- Nottingham Road – 8' x 6' RCBC (blocked 1 ft at bottom)

Sufficiency Evaluation - Proposed Conditions Without Storage Routing

Does not meet design criteria

Design Storm 2-Year Flood

Crossing	Culvert Size	Culvert Height (ft)	EG U/S (ft)	WSEL (ft)	EG IC (ft)	EG OC (ft)	Min Weir Elevation (ft)	Q Culvert (cfs)	Q Weir	Delta WS (cfs)	Inv. U/S (ft)	Inv. D/S (ft)	Culvert Vel D/S (ft/s)	Culvert Vel (ft/s)	Freeboard (ft)	U/S Head	HW/D
Winstead Road	12' x 5' RCBC	5.0	122.84	122.83	119.93	122.84	126.17	52.37		0.01	118.63	118.31	1.0	1.0	3.34	4.2	0.84
Winstead Road	12' x 5' RCBC	5.0	122.84	122.83	120.63	122.83	126.17	35.63		0.01	118.63	118.31	0.9	0.9	3.34	4.2	0.84
Railroad Culvert	54" DIA. RCP	4.5	122.63	122.53	121.13	122.61	127.97	70.63		0.8	117.2	116.92	5.6	5.6	5.44	5.33	1.18
Railroad Culvert	72" DIA. CMP	6.0	122.63	122.53	121.73	122.64	127.97	133.37		0.8	117.2	116.92	5.5	5.6	5.44	5.33	0.89
Sheffield Drive	11' x 6' RCBC	6.0	121.36	121.24	121.33	121.36	123.85	196		0.73	116.93	116	5.1	8.3	2.61	4.31	0.72
South Winstead Avenue	Double 6' x 6' RCBC	6.0	105.91	105.74	105.19	105.91	109.37	419		1.09	99.79	99.5	6.8	7.0	3.63	5.95	0.99
Avondale Avenue	10' x 8' RCBC	8.0	99.48	99.38	97.43	99.49	102.11	266.19		0.22	93	92.46	4.0	4.3	2.73	6.38	0.80
Avondale Avenue	10' x 8' RCBC	8.0	99.48	99.38	97.84	99.46	102.11	214.81		0.22	93	92.46	3.8	4.2	2.73	6.38	0.80
Nottingham Road	8' x 6' RCBC	6.0	113.5	113.42	113.47	113.5	117.6	151		1.13	108.93	108	5.7	8.5	4.18	4.49	0.75

Design Storm 10-Year Flood

Crossing	Culvert Size	Culvert Height (ft)	EG U/S (ft)	WSEL (ft)	EG IC (ft)	EG OC (ft)	Min Weir Elevation (ft)	Q Culvert (cfs)	Q Weir	Delta WS (cfs)	Inv. U/S (ft)	Inv. D/S (ft)	Culvert Vel D/S (ft/s)	Culvert Vel (ft/s)	Freeboard (ft)	U/S Head	HW/D
Winstead Road	12' x 5' RCBC	5.0	123.51	123.50	120.42	123.51	126.17	83.43		0.03	118.63	118.31	1.4	1.4	2.67	4.87	0.97
Winstead Road	12' x 5' RCBC	5.0	123.51	123.50	121.07	123.51	126.17	60.57		0.03	118.63	118.31	1.3	1.3	2.67	4.87	0.97
Railroad Culvert	54" DIA. RCP	4.5	123.3	123.25	121.5	123.28	127.97	79.81		1.09	117.2	116.92	6.4	6.4	4.72	6.05	1.34
Railroad Culvert	72" DIA. CMP	6.0	123.3	123.25	122.34	123.31	127.97	162.19		1.09	117.2	116.92	6.2	6.2	4.72	6.05	1.01
Sheffield Drive	11' x 6' RCBC	6.0	121.81	121.69	121.8	121.81	123.85	236		0.83	116.93	116	5.6	8.8	2.16	4.76	0.79
South Winstead Avenue	Double 6' x 6' RCBC	6.0	107.18	107.06	106.66	107.18	109.37	594		2.03	99.79	99.5	8.9	9.0	2.31	7.27	1.21
Avondale Avenue	10' x 8' RCBC	8.0	100.18	100	99.06	100.19	102.11	418.59		0.54	93	92.46	6.0	6.6	2.11	7.00	0.88
Avondale Avenue	10' x 8' RCBC	8.0	100.18	100	99.39	100.17	102.11	350.41		0.54	93	92.46	5.8	6.5	2.11	7.00	0.88
Nottingham Road	8' x 6' RCBC	6.0	115.06	114.98	115.06	115.03	117.6	258		1.57	108.93	108	7.3	10.1	2.62	6.05	1.01

Design Storm 25-Year Flood

Crossing	Culvert Size	Culvert Height (ft)	EG U/S (ft)	WSEL (ft)	EG IC (ft)	EG OC (ft)	Min Weir Elevation (ft)	Q Culvert (cfs)	Q Weir	Delta WS (cfs)	Inv. U/S (ft)	Inv. D/S (ft)	Culvert Vel D/S (ft/s)	Culvert Vel (ft/s)	Freeboard (ft)	U/S Head	HW/D
Winstead Road	12' x 5' RCBC	5.0	125.1	125.09	120.74	125.1	126.17	106.6		0.05	118.63	118.31	1.8	1.8	1.08	6.46	1.29
Winstead Road	12' x 5' RCBC	5.0	125.1	125.09	121.41	125.1	126.17	82.4		0.05	118.63	118.31	1.7	1.7	1.08	6.46	1.29
Railroad Culvert	54" DIA. RCP	4.5	125	124.98	122.65	125.01	127.97	105.02		1.92	117.2	116.92	8.4	8.4	2.99	7.78	1.73
Railroad Culvert	72" DIA. CMP	6.0	125	124.98	123.55	124.99	127.97	220.98		1.92	117.2	116.92	7.8	7.8	2.99	7.78	1.30
Sheffield Drive	11' x 6' RCBC	6.0	122.77	122.67	122.77	122.75	123.85	326		1.17	116.93	116.00	6.6	9.9	1.18	5.74	0.96
South Winstead Avenue	Double 6' x 6' RCBC	6.0	108.42	108.35	108.42	108.1	109.37	721		3.14	99.79	99.5	10.5	10.3	1.02	8.56	1.43
Avondale Avenue	10' x 8' RCBC	8.0	100.95	100.91	100.07	100.96	102.11	522.34		1.08	93	92.46	7.5	7.5	1.20	7.91	0.99
Avondale Avenue	10' x 8' RCBC	8.0	100.95	100.91	100.31	100.94	102.11	439.66		1.08	93	92.46	7.3	7.3	1.20	7.91	0.99
Nottingham Road	8' x 6' RCBC	6.0	116.08	116.01	116.98	116.08	117.6	358		1.73	108.93	108	9.0	9.0	1.59	7.08	1.18

Design Storm 50-Year Flood

Crossing	Culvert Size	Culvert Height (ft)	EG U/S (ft)	WSEL (ft)	EG IC (ft)	EG OC (ft)	Min Weir Elevation (ft)	Q Culvert (cfs)	Q Weir	Delta WS (cfs)	Inv. U/S (ft)	Inv. D/S (ft)	Culvert Vel D/S (ft/s)	Culvert Vel (ft/s)	Freeboard (ft)	U/S Head	HW/D
Winstead Road	12' x 5' RCBC	5.0	126.74	126.73	120.35	126.74	126.17	79.33	78.39	0.03	118.63	118.31	1.3	1.3	-0.56	8.10	1.62
Winstead Road	12' x 5' RCBC	5.0	126.74	126.73	121.1	126.74	126.17	62.28	78.39	0.03	118.63	118.31	1.3	1.3	-0.56	8.10	1.62
Railroad Culvert	54" DIA. RCP	4.5	126.7	126.68	124.05	126.71	127.97	128.81		2.9	117.2	116.92	10.3	10.3	1.29	9.48	2.11
Railroad Culvert	72" DIA. CMP	6.0	126.7	126.68	124.78	126.69	127.97	271.19		2.9	117.2	116.92	9.6	9.6	1.29	9.48	1.58
Sheffield Drive	11' x 6' RCBC	6.0	123.51	123.43	123.51	123.45	123.85	400		1.52	116.93	116.00	7.4	10.5	0.42	6.50	1.08
South Winstead Avenue	Double 6' x 6' RCBC	6.0	109.52	109.47	109.52	109.13	109.37	826.66	10.34	4.09	99.79	99.5	14.6	11.5	-0.1	9.68	1.61
Avondale Avenue	10' x 8' RCBC	8.0	101.36	101.32	100.68	101.37	102.11	588.73		1.39	93	92.46	8.4	8.4	0.79	8.32	1.04
Avondale Avenue	10' x 8' RCBC	8.0	101.36	101.32	100.89	101.35	102.11	498.27		1.39	93	92.46	8.3	8.3	0.79	8.32	1.04
Nottingham Road	8' x 6' RCBC	6.0	117.34	117.31	118.14	117.34	117.6	426		2.51	108.93	108	10.7	10.7	0.29	8.38	1.40

Design Storm 100-Year Flood

Crossing	Culvert Size	Culvert Height (ft)	EG U/S (ft)	WSEL (ft)	EG IC (ft)	EG OC (ft)	Min Weir Elevation (ft)	Q Culvert (cfs)	Q Weir	Delta WS (cfs)	Inv. U/S (ft)	Inv. D/S (ft)	Culvert Vel D/S (ft/s)	Culvert Vel (ft/s)	Freeboard (ft)	U/S Head	HW/D
Winstead Road	`	5.0	126.77	126.76	120.47	126.77	126.17	87.4	88.97	0.04	118.63	118.31	1.5	1.5	-0.59	8.13	1.63
Winstead Road	12' x 5' RCBC	5.0	126.77	126.76	121.2	126.77	126.17	68.62	88.97	0.04	118.63	118.31	1.4	1.4	-0.59	8.13	1.63
Railroad Culvert	54" DIA. RCP	4.5	126.72	126.71	124.07	126.73	127.97	129.13		2.92	117.2	116.92	10.3	10.3	1.26	9.51	2.11
Railroad Culvert	72" DIA. CMP	6.0	126.72	126.71	124.8	126.72	127.97	271.87		2.92	117.2	116.92	9.6	9.6	1.26	9.51	1.59
Sheffield Drive	11' x 6' RCBC	6.0	123.51	123.44	123.51	123.46	123.85	401		1.53	116.93	116	7.4	10.6	0.41	6.51	1.09
South Winstead Avenue	Double 6' x 6' RCBC	6.0	109.75	109.7	109.79	109.75	109.37	867.13	72.87	4.01	99.79	99.5	12.0	12.0	-0.33	9.91	1.65
Avondale Avenue	10' x 8' RCBC	8.0	101.87	101.83	101.33	101.88	102.11	655.33		1.74	93	92.46	9.4	9.4	0.28	8.83	1.10
Avondale Avenue	10' x 8' RCBC	8.0	101.87	101.83	101.79	101.85	102.11	554.67		1.74	93	92.46	9.2	9.2	0.28	8.83	1.10
Nottingham Road	8' x 6' RCBC	6.0	118.18	118.16	118.42	118.18	117.6	465.09	14.91	3	108.93	108	11.6	11.6	-0.56	9.23	1.54

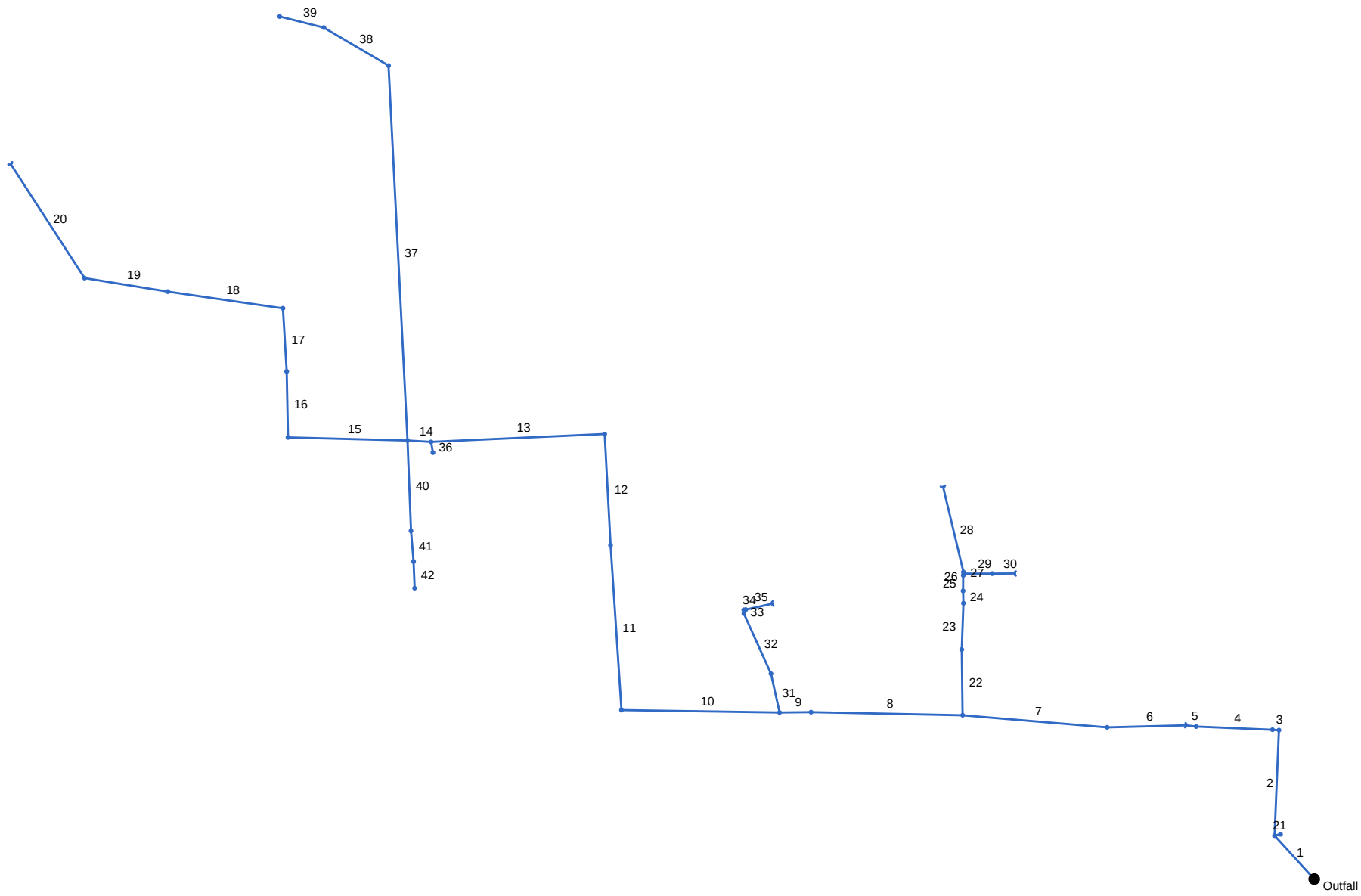
Sufficiency Evaluation (City of Rocky Mount Stormwater Design Manual)

- Residential Local and Collector Roadways – 25-year design storm with 1 foot of freeboard.
- Commercial Local and Collector Roadways – 50-year design storm with 0.5 foot of freeboard.
- Industrial Local and Collector Roadways – 50-year design storm with 0.5 foot of freeboard.
- Minor and Major Arterial Roadways – 50-year design storm with 0.5 foot of freeboard.
- HW/D (headwater depth to culvert depth) <1.2.

APPENDIX F

EXISTING CLOSED SYSTEMS

Existing System #1



Project File: System 1.stm	Number of lines: 42	Date: 07-21-2009

Hydraflow Storm Sewers Extension v6.052

Storm Sewer Inventory Report

Line No.	Alignment				Flow Data				Physical Data								Line ID
	Dnstr line No.	Line length (ft)	Defl angle (deg)	Junc type	Known Q (cfs)	Drng area (ac)	Runoff coeff (C)	Inlet time (min)	Invert El Dn (ft)	Line slope (%)	Invert El Up (ft)	Line size (in)	Line shape	N value (n)	J-loss coeff (K)	Inlet/ Rim El (ft)	
1	End	89.0	-132.4	MH	0.00	0.00	0.00	0.0	122.92	0.04	122.96	36x58	Ell	0.024	1.00	127.07	cmp
2	1	159.6	44.8	MH	0.00	0.00	0.00	0.0	123.06	0.51	123.88	36	Cir	0.013	1.00	126.79	rcp
3	2	9.7	-88.0	Genr	0.00	0.53	0.50	5.0	123.93	0.31	123.96	36	Cir	0.024	0.50	129.63	cmp
4	3	115.6	-2.0	Genr	0.00	0.00	0.00	0.0	123.96	0.21	124.20	48x144	Ell	0.035	0.50	129.46	open channel
5	4	15.2	4.4	Hdwl	0.00	0.54	0.50	5.0	124.20	-0.26	124.16	35x58	Ell	0.013	0.50	129.46	culvert
6	5	119.3	-8.3	Genr	0.00	1.32	0.50	5.0	124.16	0.18	124.38	48x144	Ell	0.035	0.50	127.62	open channel
7	6	219.2	6.3	Grate	0.00	0.81	0.50	5.0	124.38	0.22	124.87	36	Cir	0.013	1.49	128.28	rcp
8	7	229.1	-3.6	Grate	0.00	0.27	0.50	5.0	124.87	0.22	125.38	36	Cir	0.024	0.50	129.79	cmp
9	8	47.3	-2.1	Grate	0.00	0.60	0.50	5.0	125.38	0.15	125.45	36	Cir	0.024	1.47	130.28	cmp
10	9	239.0	1.8	Grate	0.00	0.62	0.50	5.0	125.65	0.27	126.29	24	Cir	0.013	1.50	131.80	rcp
11	10	249.6	85.3	Grate	0.00	1.33	0.50	5.0	126.53	0.53	127.86	24	Cir	0.013	0.50	132.05	rcp
12	11	168.4	0.8	Grate	0.00	1.80	0.50	7.0	127.88	0.46	128.65	24	Cir	0.013	1.50	132.05	rcp
13	12	262.5	-89.6	Curb	0.00	3.22	0.50	9.0	128.85	0.06	129.00	24	Cir	0.013	1.50	132.47	rcp
14	13	35.9	6.1	Curb	0.00	1.87	0.50	9.0	129.13	-0.14	129.08	24	Cir	0.013	1.50	131.21	rcp
15	14	180.5	-2.0	Grate	0.00	2.87	0.50	8.0	129.08	0.30	129.62	18	Cir	0.013	1.50	133.10	rcp-int
16	15	99.7	87.3	Grate	0.00	0.67	0.50	5.0	129.72	0.30	130.02	18	Cir	0.013	0.50	132.76	rcp-int
17	16	95.6	-2.2	Grate	0.00	1.13	0.50	6.0	130.12	0.30	130.41	18	Cir	0.013	1.47	133.64	rcp-int
18	17	175.9	-78.3	Grate	0.00	9.08	0.50	9.0	130.51	0.30	131.04	18	Cir	0.013	0.50	133.50	rcp-int
19	18	127.3	0.9	Grate	0.00	1.78	0.50	7.0	131.14	0.30	131.52	18	Cir	0.013	1.17	134.79	rcp-int
20	19	205.4	47.9	Hdwl	0.00	65.08	0.50	45.0	131.62	0.30	132.24	18	Cir	0.013	1.00	135.59	rcp-int
21	1	9.3	119.5	Curb	0.00	2.08	0.50	5.0	123.41	0.32	123.44	15	Cir	0.013	1.00	127.07	rcp-int
22	7	99.2	84.5	Grate	0.00	0.26	0.50	5.0	125.47	0.30	125.77	18	Cir	0.013	0.50	127.76	rcp-int
23	22	70.1	2.8	MH	0.00	0.00	0.00	0.0	125.87	0.30	126.08	18	Cir	0.013	0.15	127.50	rcp-int

Existing System #1 | Number of lines: 42 | Date: 07-21-2009

Storm Sewer Inventory Report

Line No.	Alignment				Flow Data				Physical Data								Line ID
	Dnstr line No.	Line length (ft)	Defl angle (deg)	Junc type	Known Q (cfs)	Drng area (ac)	Runoff coeff (C)	Inlet time (min)	Invert El Dn (ft)	Line slope (%)	Invert El Up (ft)	Line size (in)	Line shape	N value (n)	J-loss coeff (K)	Inlet/ Rim El (ft)	
24	23	18.7	-3.9	MH	0.00	0.00	0.00	0.0	127.71	-0.64	127.59	18x18	Ell	0.035	0.15	127.50	open channel
25	24	23.3	2.3	MH	0.00	0.00	0.00	0.0	127.65	0.13	127.68	12	Cir	0.013	0.34	128.35	culvert-int
26	25	2.9	17.0	MH	0.00	0.00	0.00	0.0	127.75	0.69	127.77	18x18	Ell	0.035	0.96	128.35	open channel
27	26	2.6	-28.4	MH	0.00	0.00	0.00	0.0	127.77	0.77	127.79	18x18	Ell	0.035	0.15	128.35	open channel
28	27	132.1	-2.6	Hdwl	0.00	3.34	0.50	5.0	127.90	0.30	128.30	12	Cir	0.013	1.00	130.02	rcp-int
29	26	43.0	72.4	MH	0.00	0.00	0.00	0.0	127.77	1.21	128.29	18x18	Ell	0.035	0.15	128.41	open channel
30	29	34.1	-0.2	Hdwl	0.00	2.63	0.50	6.0	128.40	0.29	128.50	12	Cir	0.013	1.00	128.00	culvert
31	9	60.0	78.3	Grate	0.00	0.34	0.50	5.0	126.30	0.52	126.61	15	Cir	0.013	0.50	129.43	rcp-int
32	31	99.9	-11.7	MH	0.00	16.94	0.50	24.0	126.71	0.40	127.11	15	Cir	0.013	0.45	130.07	rcp-int
33	32	5.5	23.0	MH	0.00	0.00	0.00	0.0	129.49	-7.96	129.05	18x18	Ell	0.035	1.00	130.07	open channel
34	33	3.0	85.5	MH	0.00	0.00	0.00	0.0	129.05	-9.09	128.78	18x18	Ell	0.035	0.15	130.07	open channel
35	34	40.9	-7.0	Hdwl	0.00	1.02	0.50	7.0	128.78	0.05	128.80	15	Cir	0.013	1.00	128.80	culvert-int
36	13	16.4	-96.9	MH	0.00	0.12	0.50	5.0	129.56	0.49	129.64	15	Cir	0.013	1.00	132.47	rcp-int
37	14	567.5	83.6	Curb	0.00	1.65	0.50	7.0	130.10	-0.18	129.10	24	Cir	0.013	1.29	133.62	rcp
38	37	113.5	-56.6	Curb	0.00	0.20	0.50	5.0	129.20	1.21	130.57	18	Cir	0.013	0.50	136.25	rcp-int
39	38	68.8	-16.4	Curb	0.00	7.21	0.50	17.0	130.65	0.31	130.86	15	Cir	0.013	1.00	133.66	rcp-int
40	14	136.7	-95.7	Grate	0.00	5.57	0.50	9.0	130.90	0.30	131.31	15	Cir	0.013	0.50	132.01	rcp-int
41	40	46.5	-3.0	Grate	0.00	0.18	0.50	5.0	131.31	0.30	131.45	15	Cir	0.013	0.50	132.28	rcp-int
42	41	40.4	3.2	Grate	0.00	1.59	0.50	5.0	131.45	0.30	131.57	15	Cir	0.013	1.00	131.98	rcp-int

Existing System #1 | Number of lines: 42 | Date: 07-21-2009

Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line size (in)	Line shape	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line slope (%)	HGL down (ft)	HGL up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns line No.	Junction Type
1	cmp	242.7	36x58	Ell	89.0	122.92	122.96	0.045	125.92*	137.61*	n/a	144.67	End	Manhole
2	rcp	239.3	36	Cir	159.6	123.06	123.88	0.514	144.67*	165.23*	17.82	183.05	1	Manhole
3	cmp	239.3	36	Cir	9.7	123.93	123.96	0.309	183.05*	187.32*	8.91	196.23	2	Generic
4	open channel	239.4	48x144	Ell	115.6	123.96	124.20	0.208	214.04*	215.55*	n/a	215.86	3	Generic
5	culvert	239.5	35x58	Ell	15.2	124.20	124.16	-0.264	216.49*	217.11*	n/a	220.75	4	OpenHeadwall
6	open channel	239.6	48x144	Ell	119.3	124.16	124.38	0.184	228.02*	229.58*	n/a	229.89	5	Generic
7	rcp	237.7	36	Cir	219.2	124.38	124.87	0.224	229.89*	257.74*	26.19	283.93	6	Grate
8	cmp	225.4	36	Cir	229.1	124.87	125.38	0.223	283.93*	373.15*	7.90	381.05	7	Grate
9	cmp	225.0	36	Cir	47.3	125.38	125.45	0.148	381.05*	399.42*	23.16	422.58	8	Grate
10	rcp	191.1	24	Cir	239.0	125.65	126.29	0.268	422.58*	593.32*	86.32	679.64	9	Grate
11	rcp	190.2	24	Cir	249.6	126.53	127.86	0.533	679.64*	856.17*	28.49	884.66	10	Grate
12	rcp	187.9	24	Cir	168.4	127.88	128.65	0.457	884.66*	1000.98*	83.44	1084.42	11	Grate
13	rcp	184.9	24	Cir	262.5	128.85	129.00	0.057	1084.42*	1259.86*	80.75	1340.61	12	Curb-Horiz
14	rcp	178.8	24	Cir	35.9	129.13	129.08	-0.139	1340.61*	1363.10*	75.58	1438.68	13	Curb-Horiz
15	rcp-int	145.9	18	Cir	180.5	129.08	129.62	0.299	1438.68*	1787.05*	158.91	1945.96	14	Grate
16	rcp-int	140.7	18	Cir	99.7	129.72	130.02	0.301	1945.96*	2125.02*	49.29	2174.32	15	Grate
17	rcp-int	139.5	18	Cir	95.6	130.12	130.41	0.304	2174.32*	2343.12*	142.52	2485.64	16	Grate
18	rcp-int	137.6	18	Cir	175.9	130.51	131.04	0.301	2485.64*	2787.58*	47.11	2834.69	17	Grate
19	rcp-int	121.2	18	Cir	127.3	131.14	131.52	0.298	2834.69*	3004.27*	85.53	3089.79	18	Grate
20	rcp-int	118.0	18	Cir	205.4	131.62	132.24	0.302	3089.79*	3349.36*	69.35	3418.71	19	OpenHeadwall
21	rcp-int	8.64	15	Cir	9.3	123.41	123.44	0.322	144.67*	144.84*	0.77	145.61	1	Curb-Horiz
22	rcp-int	24.75	18	Cir	99.2	125.47	125.77	0.302	283.93*	289.44*	1.52	290.97	7	Grate
23	rcp-int	23.79	18	Cir	70.1	125.87	126.08	0.300	290.97*	294.56*	0.42	294.99	22	Manhole
24	open channel	23.80	18x18	Ell	18.7	127.71	127.59	-0.642	297.80*	304.77*	n/a	305.19	23	Manhole

Existing System #1 | Number of lines: 42 | Run Date: 07-21-2009

NOTES: Return period = 25 Yrs. ; *Surcharged (HGL above crown).

Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line size (in)	Line shape	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line slope (%)	HGL down (ft)	HGL up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns line No.	Junction Type
25	culvert-int	23.82	12	Cir	23.3	127.65	127.68	0.129	305.19*	315.63*	4.86	320.49	24	Manhole
26	open channel	23.82	18x18	Ell	2.9	127.75	127.77	0.687	334.79*	335.87*	n/a	338.59	25	Manhole
27	open channel	13.81	18x18	Ell	2.6	127.77	127.79	0.772	341.41*	341.74*	0.14	341.88	26	Manhole
28	rcp-int	13.87	12	Cir	132.1	127.90	128.30	0.303	341.88*	361.91*	4.85	366.76	27	OpenHeadwall
29	open channel	10.54	18x18	Ell	43.0	127.77	128.29	1.210	341.41*	344.55*	0.08	344.63	26	Manhole
30	culvert	10.55	12	Cir	34.1	128.40	128.50	0.293	344.63*	347.63*	2.81	350.43	29	OpenHeadwall
31	rcp-int	46.39	15	Cir	60.0	126.30	126.61	0.517	422.58*	453.57*	11.11	464.68	9	Grate
32	rcp-int	45.57	15	Cir	99.9	126.71	127.11	0.401	464.68*	514.44*	9.65	524.09	31	Manhole
33	open channel	3.93	18x18	Ell	5.5	129.49	129.05	-7.957	545.53*	545.59*	0.08	545.66	32	Manhole
34	open channel	3.93	18x18	Ell	3.0	129.05	128.78	-9.091	545.74*	545.77*	0.01	545.78	33	Manhole
35	culvert-int	3.96	15	Cir	40.9	128.78	128.80	0.049	545.78*	545.94*	0.16	546.10	34	OpenHeadwall
36	rcp-int	0.50	15	Cir	16.4	129.56	129.64	0.488	1340.61*	1340.61*	0.00	1340.62	13	Manhole
37	rcp	26.57	24	Cir	567.5	130.10	129.10	-0.176	1438.68*	1446.51*	1.44	1447.95	14	Curb-Horiz
38	rcp-int	21.81	18	Cir	113.5	129.20	130.57	1.207	1447.95*	1452.85*	1.18	1454.03	37	Curb-Horiz
39	rcp-int	21.26	15	Cir	68.8	130.65	130.86	0.305	1454.03*	1461.49*	4.66	1466.16	38	Curb-Horiz
40	rcp-int	26.76	15	Cir	136.7	130.90	131.31	0.300	1438.68*	1462.15*	3.70	1465.85	14	Grate
41	rcp-int	7.32	15	Cir	46.5	131.31	131.45	0.301	1465.85*	1466.45*	0.28	1466.72	40	Grate
42	rcp-int	6.60	15	Cir	40.4	131.45	131.57	0.297	1466.72*	1467.15*	0.45	1467.60	41	Grate

Existing System #1 | Number of lines: 42 | Run Date: 07-21-2009

NOTES: Return period = 25 Yrs. ; *Surcharged (HGL above crown).

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	89.0	0.00	136.7	0.00	0.00	68.33	0.0	46.6	3.6	242.7	14.20	21.31	36 x 58 e	0.04	122.92	122.96	125.92	137.61	122.92	127.07	cmp
2	1	159.6	0.00	134.6	0.00	0.00	67.29	0.0	46.5	3.6	239.3	47.80	33.86	36	0.51	123.06	123.88	144.67	165.23	127.07	126.79	rcp
3	2	9.7	0.53	134.6	0.50	0.27	67.29	5.0	46.5	3.6	239.3	20.08	33.86	36	0.31	123.93	123.96	183.05	187.32	126.79	129.63	cmp
4	3	115.6	0.00	134.0	0.00	0.00	67.02	0.0	46.2	3.6	239.4	95.57	6.35	48 x 144 e	0.21	123.96	124.20	214.04	215.55	129.63	129.46	open channel
5	4	15.2	0.54	134.0	0.50	0.27	67.02	5.0	46.1	3.6	239.5	0.00	21.63	35 x 58 e	-0.26	124.20	124.16	216.49	217.11	129.46	129.46	culvert
6	5	119.3	1.32	133.5	0.50	0.66	66.75	5.0	45.8	3.6	239.6	90.07	6.36	48 x 144 e	0.18	124.16	124.38	228.02	229.58	129.46	127.62	open channel
7	6	219.2	0.81	132.2	0.50	0.41	66.09	5.0	45.7	3.6	237.7	31.53	33.63	36	0.22	124.38	124.87	229.89	257.74	127.62	128.28	rcp
8	7	229.1	0.27	125.1	0.50	0.14	62.57	5.0	45.5	3.6	225.4	17.04	31.89	36	0.22	124.87	125.38	283.93	373.15	128.28	129.79	cmp
9	8	47.3	0.60	124.9	0.50	0.30	62.44	5.0	45.5	3.6	225.0	13.89	31.83	36	0.15	125.38	125.45	381.05	399.42	129.79	130.28	cmp
10	9	239.0	0.62	106.0	0.50	0.31	52.99	5.0	45.4	3.6	191.1	11.70	60.84	24	0.27	125.65	126.29	422.58	593.32	130.28	131.80	rcp
11	10	249.6	1.33	105.4	0.50	0.67	52.68	5.0	45.3	3.6	190.2	16.51	60.55	24	0.53	126.53	127.86	679.64	856.17	131.80	132.05	rcp
12	11	168.4	1.80	104.0	0.50	0.90	52.01	7.0	45.3	3.6	187.9	15.29	59.82	24	0.46	127.88	128.65	884.66	1000.98	132.05	132.05	rcp
13	12	262.5	3.22	102.2	0.50	1.61	51.11	9.0	45.2	3.6	184.9	5.41	58.85	24	0.06	128.85	129.00	1084.42	1259.86	132.05	132.47	rcp
14	13	35.9	1.87	98.88	0.50	0.94	49.44	9.0	45.2	3.6	178.8	0.00	56.93	24	-0.14	129.13	129.08	1340.61	1363.10	132.47	131.21	rcp
15	14	180.5	2.87	80.61	0.50	1.44	40.31	8.0	45.2	3.6	145.9	5.74	82.56	18	0.30	129.08	129.62	1438.68	1787.05	131.21	133.10	rcp-int
16	15	99.7	0.67	77.74	0.50	0.34	38.87	5.0	45.1	3.6	140.7	5.76	79.64	18	0.30	129.72	130.02	1945.96	2125.02	133.10	132.76	rcp-int
17	16	95.6	1.13	77.07	0.50	0.57	38.54	6.0	45.1	3.6	139.5	5.79	78.97	18	0.30	130.12	130.41	2174.32	2343.12	132.76	133.64	rcp-int
18	17	175.9	9.08	75.94	0.50	4.54	37.97	9.0	45.1	3.6	137.6	5.76	77.86	18	0.30	130.51	131.04	2485.64	2787.58	133.64	133.50	rcp-int
19	18	127.3	1.78	66.86	0.50	0.89	33.43	7.0	45.1	3.6	121.2	5.74	68.58	18	0.30	131.14	131.52	2834.69	3004.27	133.50	134.79	rcp-int
20	19	205.4	65.08	65.08	0.50	32.54	32.54	45.0	45.0	3.6	118.0	5.77	66.80	18	0.30	131.62	132.24	3089.79	3349.36	134.79	135.59	rcp-int
21	1	9.3	2.08	2.08	0.50	1.04	1.04	5.0	5.0	8.3	8.64	3.67	7.04	15	0.32	123.41	123.44	144.67	144.84	127.07	127.07	rcp-int

Existing System #1 | Number of lines: 42 | Run Date: 07-21-2009

NOTES: Intensity = 121.63 / (Inlet time + 19.00) ^ 0.84; Return period = 25 Yrs. ; c = cir e = ellip b = box

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line		Incr	Total		Incr	Total	Inlet	Syst					Size	Slope	Dn	Up	Dn	Up	Dn	Up	
		(ft)	(ac)	(ac)	(C)			(min)	(min)	(in/hr)	(cfs)	(cfs)	(ft/s)	(in)	(%)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	
22	7	99.2	0.26	6.23	0.50	0.13	3.12	5.0	6.3	7.9	24.75	5.78	14.01	18	0.30	125.47	125.77	283.93	289.44	128.28	127.76	rcp-int
23	22	70.1	0.00	5.97	0.00	0.00	2.99	0.0	6.2	8.0	23.79	5.75	13.46	18	0.30	125.87	126.08	290.97	294.56	127.76	127.50	rcp-int
24	23	18.7	0.00	5.97	0.00	0.00	2.99	0.0	6.2	8.0	23.80	0.00	13.47	18 x 18 e	-0.64	127.71	127.59	297.80	304.77	127.50	127.50	open channel
25	24	23.3	0.00	5.97	0.00	0.00	2.99	0.0	6.2	8.0	23.82	1.28	30.33	12	0.13	127.65	127.68	305.19	315.63	127.50	128.35	culvert-int
26	25	2.9	0.00	5.97	0.00	0.00	2.99	0.0	6.2	8.0	23.82	3.23	13.48	18 x 18 e	0.69	127.75	127.77	334.79	335.87	128.35	128.35	open channel
27	26	2.6	0.00	3.34	0.00	0.00	1.67	0.0	5.1	8.3	13.81	3.43	7.81	18 x 18 e	0.77	127.77	127.79	341.41	341.74	128.35	128.35	open channel
28	27	132.1	3.34	3.34	0.50	1.67	1.67	5.0	5.0	8.3	13.87	1.96	17.66	12	0.30	127.90	128.30	341.88	361.91	128.35	130.02	rcp-int
29	26	43.0	0.00	2.63	0.00	0.00	1.32	0.0	6.0	8.0	10.54	4.29	5.96	18 x 18 e	1.21	127.77	128.29	341.41	344.55	128.35	128.41	open channel
30	29	34.1	2.63	2.63	0.50	1.32	1.32	6.0	6.0	8.0	10.55	1.93	13.43	12	0.29	128.40	128.50	344.63	347.63	128.41	128.00	culvert
31	9	60.0	0.34	18.30	0.50	0.17	9.15	5.0	24.0	5.1	46.39	4.64	37.81	15	0.52	126.30	126.61	422.58	453.57	130.28	129.43	rcp-int
32	31	99.9	16.94	17.96	0.50	8.47	8.98	24.0	24.0	5.1	45.57	4.09	37.14	15	0.40	126.71	127.11	464.68	514.44	129.43	130.07	rcp-int
33	32	5.5	0.00	1.02	0.00	0.00	0.51	0.0	7.2	7.7	3.93	0.00	2.22	18 x 18 e	-7.96	129.49	129.05	545.53	545.59	130.07	130.07	open channel
34	33	3.0	0.00	1.02	0.00	0.00	0.51	0.0	7.2	7.7	3.93	0.00	2.22	18 x 18 e	-9.09	129.05	128.78	545.74	545.77	130.07	130.07	open channel
35	34	40.9	1.02	1.02	0.50	0.51	0.51	7.0	7.0	7.8	3.96	1.43	3.23	15	0.05	128.78	128.80	545.78	545.94	130.07	128.80	culvert-int
36	13	16.4	0.12	0.12	0.50	0.06	0.06	5.0	5.0	8.3	0.50	4.51	0.41	15	0.49	129.56	129.64	1340.61	1340.61	132.47	132.47	rcp-int
37	14	567.5	1.65	9.06	0.50	0.83	4.53	7.0	17.2	5.9	26.57	0.00	8.46	24	-0.18	130.10	129.10	1438.68	1446.51	131.21	133.62	rcp
38	37	113.5	0.20	7.41	0.50	0.10	3.71	5.0	17.1	5.9	21.81	11.54	12.34	18	1.21	129.20	130.57	1447.95	1452.85	133.62	136.25	rcp-int
39	38	68.8	7.21	7.21	0.50	3.61	3.61	17.0	17.0	5.9	21.26	3.57	17.32	15	0.31	130.65	130.86	1454.03	1461.49	136.25	133.66	rcp-int
40	14	136.7	5.57	7.34	0.50	2.79	3.67	9.0	9.0	7.3	26.76	3.54	21.81	15	0.30	130.90	131.31	1438.68	1462.15	131.21	132.01	rcp-int
41	40	46.5	0.18	1.77	0.50	0.09	0.89	5.0	5.1	8.3	7.32	3.54	5.96	15	0.30	131.31	131.45	1465.85	1466.45	132.01	132.28	rcp-int

Existing System #1 | Number of lines: 42 | Run Date: 07-21-2009

NOTES: Intensity = 121.63 / (Inlet time + 19.00) ^ 0.84; Return period = 25 Yrs. ; c = cir e = ellip b = box

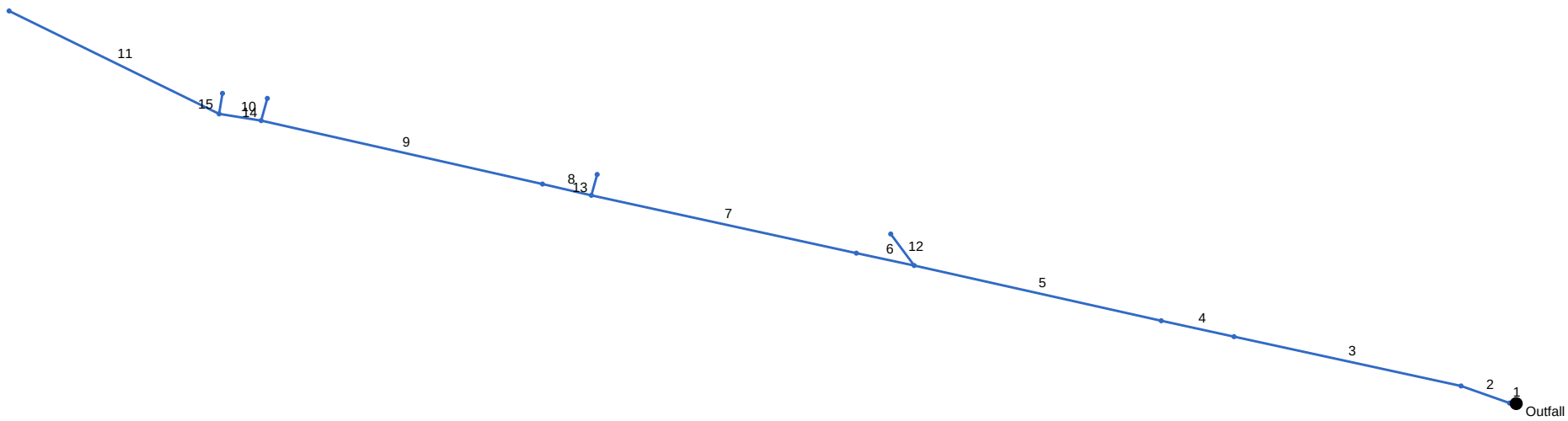
Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
42	41	40.4	1.59	1.59	0.50	0.80	0.80	5.0	5.0	8.3	6.60	3.52	5.38	15	0.30	131.45	131.57	1466.72	1467.15	132.28	131.98	rcp-int

Existing System #1 | Number of lines: 42 | Run Date: 07-21-2009

NOTES: Intensity = 121.63 / (Inlet time + 19.00) ^ 0.84; Return period = 25 Yrs. ; c = cir e = ellip b = box

Existing System #2



Project File: System 2.stm	Number of lines: 15	Date: 07-21-2009

Storm Sewer Inventory Report

Line No.	Alignment				Flow Data				Physical Data								Line ID
	Dnstr line No.	Line length (ft)	Defl angle (deg)	Junc type	Known Q (cfs)	Drng area (ac)	Runoff coeff (C)	Inlet time (min)	Invert El Dn (ft)	Line slope (%)	Invert El Up (ft)	Line size (in)	Line shape	N value (n)	J-loss coeff (K)	Inlet/ Rim El (ft)	
1	End	10.1	-175.1	Curb	0.00	2.25	0.50	5.0	117.31	3.08	117.62	24	Cir	0.013	0.50	118.36	rcp
2	1	76.5	14.5	Curb	0.00	1.50	0.50	5.0	117.72	0.78	118.32	24	Cir	0.013	0.50	124.32	rcp
3	2	346.5	-7.1	Curb	0.00	1.46	0.50	5.0	118.37	0.61	120.48	24	Cir	0.013	0.50	129.81	rcp
4	3	111.0	0.0	Curb	0.00	0.31	0.50	5.0	120.58	0.70	121.36	24	Cir	0.013	0.50	131.60	rcp
5	4	377.7	0.3	Curb	0.00	2.01	0.50	5.0	121.36	0.52	123.34	24	Cir	0.013	1.05	129.45	rcp
6	5	88.1	-0.4	Curb	0.00	3.34	0.50	5.0	124.79	0.50	125.23	18	Cir	0.013	0.50	130.02	rcp
7	6	404.7	0.1	Grate	0.00	3.71	0.50	8.0	125.33	0.50	127.35	18	Cir	0.013	1.50	133.14	rcp
8	7	74.9	0.7	Grate	0.00	0.58	0.50	5.0	127.45	0.49	127.82	18	Cir	0.013	0.50	133.49	rcp
9	8	430.0	-0.3	Grate	0.00	0.55	0.50	5.0	127.92	0.50	130.07	15	Cir	0.013	1.50	135.97	rcp
10	9	63.3	-3.4	Grate	0.00	0.41	0.50	5.0	130.17	0.51	130.49	15	Cir	0.013	1.50	136.02	rcp
11	10	348.9	16.8	Grate	0.00	2.38	0.50	8.0	130.59	0.50	132.33	15	Cir	0.013	1.00	133.88	rcp
12	5	58.7	40.8	Curb	0.00	2.64	0.50	5.0	132.43	0.49	132.72	15	Cir	0.013	1.00	129.53	rcp
13	7	32.3	93.5	Grate	0.00	0.69	0.50	5.0	132.82	0.49	132.98	12	Cir	0.013	1.00	132.16	rcp
14	9	34.6	92.7	Grate	0.00	0.97	0.50	5.0	133.08	0.49	133.25	12	Cir	0.013	1.00	136.07	rcp
15	10	31.0	90.0	Grate	0.00	0.47	0.50	5.0	133.35	0.52	133.51	12	Cir	0.013	1.00	136.27	rcp

Existing System #2 | Number of lines: 15 | Date: 07-21-2009

Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line size (in)	Line shape	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line slope (%)	HGL down (ft)	HGL up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns line No.	Junction Type
1	rcp	69.25	24	Cir	10.1	117.31	117.62	3.085	119.31*	120.26*	3.78	124.03	End	Curb-Horiz
2	rcp	62.70	24	Cir	76.5	117.72	118.32	0.785	124.03*	129.91*	3.10	133.01	1	Curb-Horiz
3	rcp	58.88	24	Cir	346.5	118.37	120.48	0.609	133.01*	156.50*	2.73	159.23	2	Curb-Horiz
4	rcp	54.69	24	Cir	111.0	120.58	121.36	0.703	159.23*	165.72*	2.36	168.08	3	Curb-Horiz
5	rcp	54.44	24	Cir	377.7	121.36	123.34	0.524	168.08*	189.97*	4.90	194.87	4	Curb-Horiz
6	rcp	40.27	18	Cir	88.1	124.79	125.23	0.499	194.87*	207.83*	4.04	211.86	5	Curb-Horiz
7	rcp	30.40	18	Cir	404.7	125.33	127.35	0.499	211.86*	245.80*	6.90	252.70	6	Grate
8	rcp	16.77	18	Cir	74.9	127.45	127.82	0.494	252.70*	254.61*	0.70	255.31	7	Grate
9	rcp	15.24	15	Cir	430.0	127.92	130.07	0.500	255.31*	279.28*	3.60	282.87	8	Grate
10	rcp	10.44	15	Cir	63.3	130.17	130.49	0.506	282.87*	284.53*	1.69	286.21	9	Grate
11	rcp	7.85	15	Cir	348.9	130.59	132.33	0.499	286.21*	291.37*	0.64	292.01	10	Grate
12	rcp	9.68	15	Cir	58.7	132.43	132.72	0.494	194.87*	196.19*	0.97	197.15	5	Curb-Horiz
13	rcp	2.53	12	Cir	32.3	132.82	132.98	0.495	252.70*	252.86*	0.16	253.02	7	Grate
14	rcp	3.56	12	Cir	34.6	133.08	133.25	0.491	282.87*	283.22*	0.32	283.54	9	Grate
15	rcp	1.72	12	Cir	31.0	133.35	133.51	0.516	286.21*	286.29*	0.07	286.36	10	Grate

Existing System #2 | Number of lines: 15 | Run Date: 07-21-2009

NOTES: Return period = 10 Yrs. ; *Surcharged (HGL above crown).

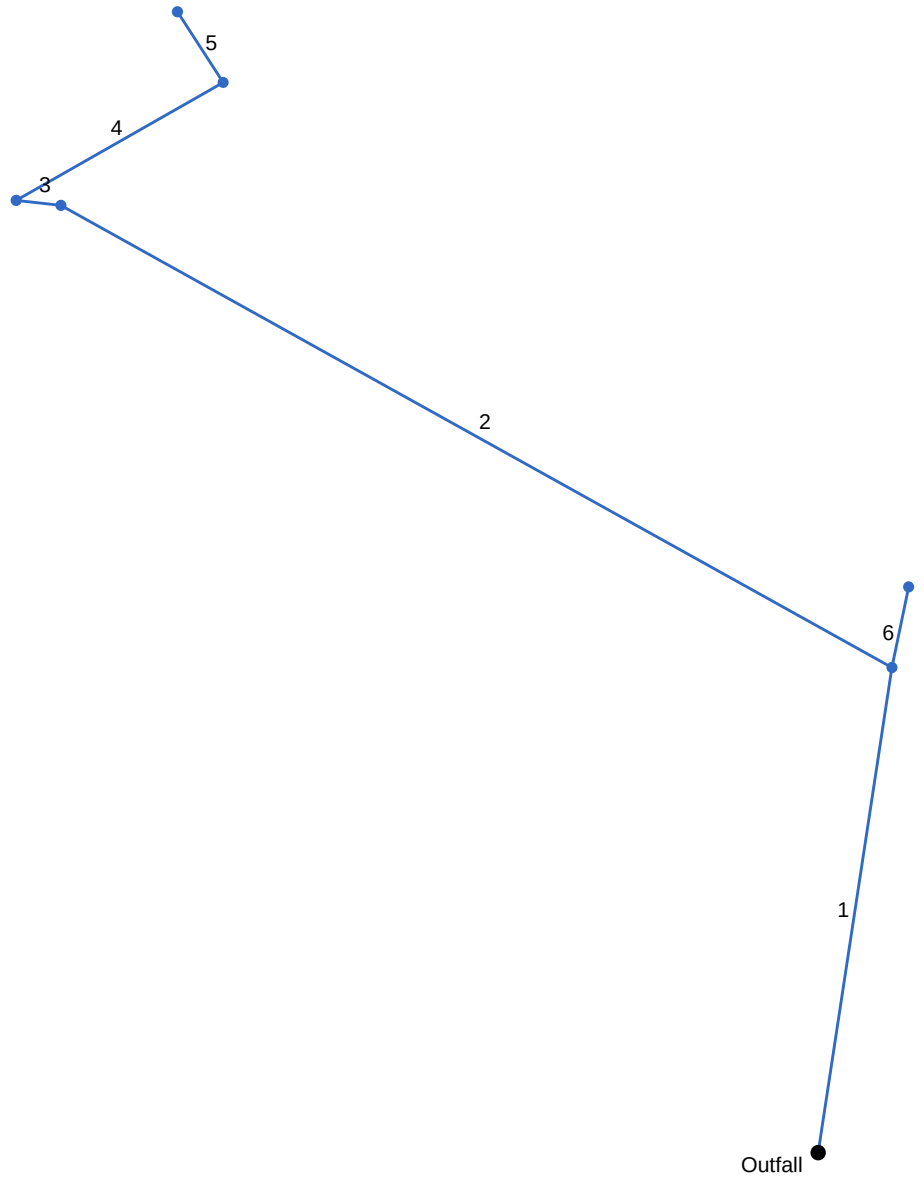
Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line		Incr	Total		Incr	Total	Inlet	Syst					Size	Slope	Dn	Up	Dn	Up	Dn	Up	
		(ft)	(ac)	(ac)	(C)			(min)	(min)	(in/hr)	(cfs)	(cfs)	(ft/s)	(in)	(%)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	
1	End	10.1	2.25	23.27	0.50	1.13	11.64	5.0	11.3	6.0	69.25	39.72	22.04	24	3.08	117.31	117.62	119.31	120.26	118.36	118.36	rcp
2	1	76.5	1.50	21.02	0.50	0.75	10.51	5.0	11.2	6.0	62.70	20.04	19.96	24	0.78	117.72	118.32	124.03	129.91	118.36	124.32	rcp
3	2	346.5	1.46	19.52	0.50	0.73	9.76	5.0	10.8	6.0	58.88	17.65	18.74	24	0.61	118.37	120.48	133.01	156.50	124.32	129.81	rcp
4	3	111.0	0.31	18.06	0.50	0.16	9.03	5.0	10.7	6.1	54.69	18.96	17.41	24	0.70	120.58	121.36	159.23	165.72	129.81	131.60	rcp
5	4	377.7	2.01	17.75	0.50	1.01	8.88	5.0	10.3	6.1	54.44	16.38	17.33	24	0.52	121.36	123.34	168.08	189.97	131.60	129.45	rcp
6	5	88.1	3.34	13.10	0.50	1.67	6.55	5.0	10.2	6.1	40.27	7.42	22.79	18	0.50	124.79	125.23	194.87	207.83	129.45	130.02	rcp
7	6	404.7	3.71	9.76	0.50	1.86	4.88	8.0	9.8	6.2	30.40	7.42	17.21	18	0.50	125.33	127.35	211.86	245.80	130.02	133.14	rcp
8	7	74.9	0.58	5.36	0.50	0.29	2.68	5.0	9.6	6.3	16.77	7.38	9.49	18	0.49	127.45	127.82	252.70	254.61	133.14	133.49	rcp
9	8	430.0	0.55	4.78	0.50	0.28	2.39	5.0	9.0	6.4	15.24	4.57	12.42	15	0.50	127.92	130.07	255.31	279.28	133.49	135.97	rcp
10	9	63.3	0.41	3.26	0.50	0.21	1.63	5.0	8.9	6.4	10.44	4.59	8.51	15	0.51	130.17	130.49	282.87	284.53	135.97	136.02	rcp
11	10	348.9	2.38	2.38	0.50	1.19	1.19	8.0	8.0	6.6	7.85	4.56	6.40	15	0.50	130.59	132.33	286.21	291.37	136.02	133.88	rcp
12	5	58.7	2.64	2.64	0.50	1.32	1.32	5.0	5.0	7.3	9.68	4.54	7.89	15	0.49	132.43	132.72	194.87	196.19	129.45	129.53	rcp
13	7	32.3	0.69	0.69	0.50	0.35	0.35	5.0	5.0	7.3	2.53	2.51	3.22	12	0.49	132.82	132.98	252.70	252.86	133.14	132.16	rcp
14	9	34.6	0.97	0.97	0.50	0.49	0.49	5.0	5.0	7.3	3.56	2.50	4.53	12	0.49	133.08	133.25	282.87	283.22	135.97	136.07	rcp
15	10	31.0	0.47	0.47	0.50	0.24	0.24	5.0	5.0	7.3	1.72	2.56	2.19	12	0.52	133.35	133.51	286.21	286.29	136.02	136.27	rcp

Existing System #2 | Number of lines: 15 | Run Date: 07-21-2009

NOTES: Intensity = 103.01 / (Inlet time + 17.60) ^ 0.85; Return period = 10 Yrs. ; c = cir e = ellip b = box

Existing System #3



Project File: System 3.stm	Number of lines: 6	Date: 07-21-2009

Storm Sewer Inventory Report

Line No.	Alignment				Flow Data				Physical Data								Line ID
	Dnstr line No.	Line length (ft)	Defl angle (deg)	Junc type	Known Q (cfs)	Drng area (ac)	Runoff coeff (C)	Inlet time (min)	Invert El Dn (ft)	Line slope (%)	Invert El Up (ft)	Line size (in)	Line shape	N value (n)	J-loss coeff (K)	Inlet/ Rim El (ft)	
1	End	236.1	-81.4	MH	0.00	1.88	0.50	5.0	123.93	0.74	125.67	24	Cir	0.013	0.95	128.89	rcp
2	1	457.4	-69.5	MH	0.00	0.00	0.00	0.0	125.71	0.50	128.00	18	Cir	0.013	0.45	131.62	rcp
3	2	21.7	-23.0	Grate	0.00	0.93	0.50	7.0	128.10	0.92	128.30	18	Cir	0.013	1.50	132.02	rcp
4	3	114.7	144.2	Grate	0.00	1.62	0.50	7.0	128.40	0.50	128.97	15	Cir	0.013	1.50	129.88	rcp
5	4	40.5	-93.2	Grate	0.00	7.34	0.50	6.0	129.05	0.49	129.25	15	Cir	0.013	1.00	130.12	rcp
6	1	39.6	3.0	Grate	0.00	3.93	0.50	5.0	129.70	0.50	129.90	12	Cir	0.013	1.00	129.65	rcp

Existing System #3 | Number of lines: 6 | Date: 07-21-2009

Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line size (in)	Line shape	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line slope (%)	HGL down (ft)	HGL up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns line No.	Junction Type
1	rcp	53.01	24	Cir	236.1	123.93	125.67	0.737	125.93*	138.90*	4.20	143.11	End	Manhole
2	rcp	33.93	18	Cir	457.4	125.71	128.00	0.501	143.11*	190.87*	2.58	193.45	1	Manhole
3	rcp	33.96	18	Cir	21.7	128.10	128.30	0.924	193.45*	195.72*	8.61	204.33	2	Grate
4	rcp	30.86	15	Cir	114.7	128.40	128.97	0.497	204.33*	230.52*	14.75	245.27	3	Grate
5	rcp	26.34	15	Cir	40.5	129.05	129.25	0.493	245.27*	252.02*	7.16	259.18	4	Grate
6	rcp	14.73	12	Cir	39.6	129.70	129.90	0.505	143.11*	149.89*	5.47	155.35	1	Grate

Existing System #3 | Number of lines: 6 | Run Date: 07-21-2009

NOTES: Return period = 10 Yrs. ; *Surcharged (HGL above crown).

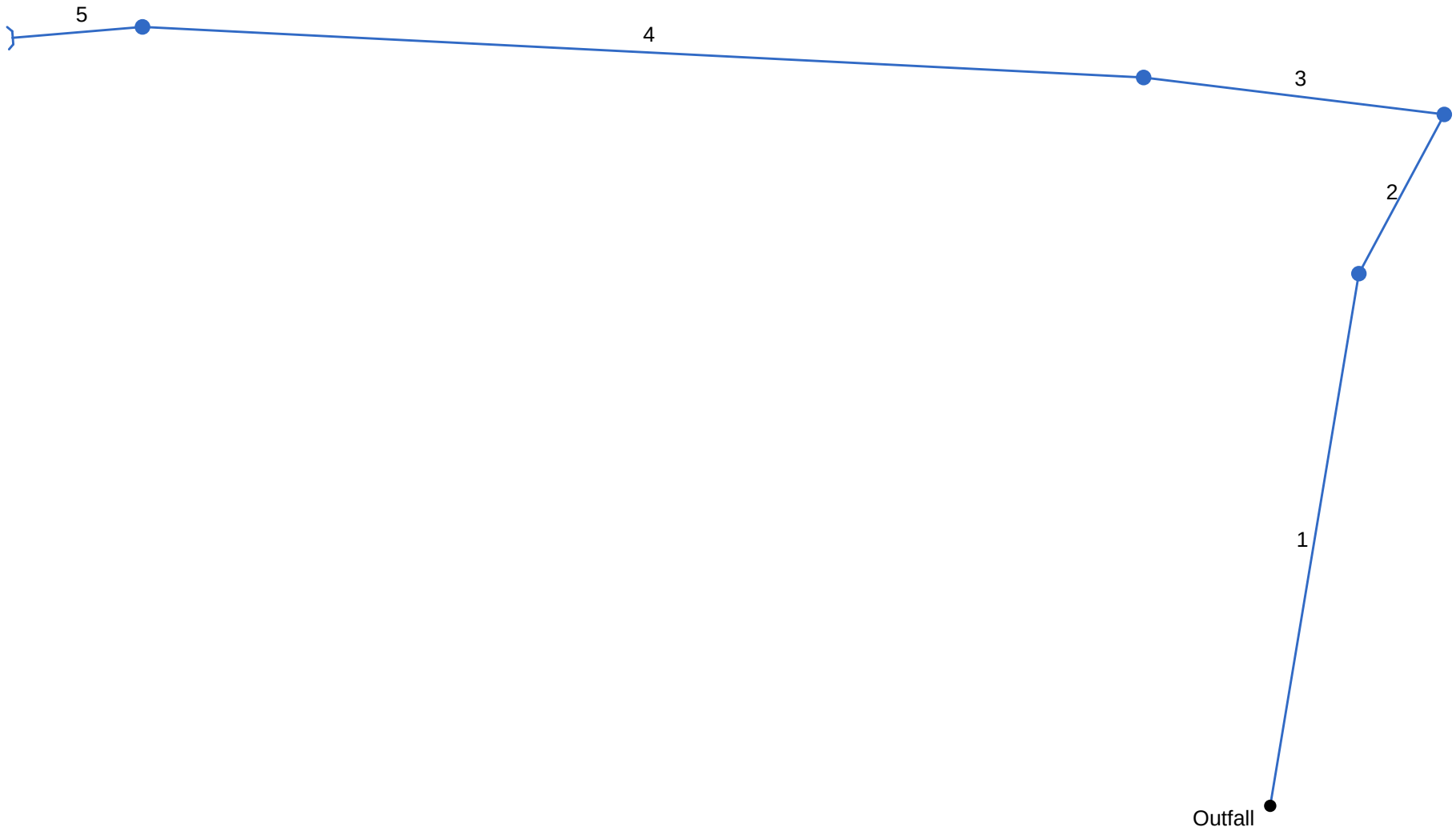
Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	236.1	1.88	15.70	0.50	0.94	7.85	5.0	7.5	6.8	53.01	19.42	16.87	24	0.74	123.93	125.67	125.93	138.90	127.51	128.89	rcp
2	1	457.4	0.00	9.89	0.00	0.00	4.95	0.0	7.1	6.9	33.93	7.43	19.20	18	0.50	125.71	128.00	143.11	190.87	128.89	131.62	rcp
3	2	21.7	0.93	9.89	0.50	0.47	4.95	7.0	7.1	6.9	33.96	10.09	19.22	18	0.92	128.10	128.30	193.45	195.72	131.62	132.02	rcp
4	3	114.7	1.62	8.96	0.50	0.81	4.48	7.0	7.0	6.9	30.86	4.55	25.15	15	0.50	128.40	128.97	204.33	230.52	132.02	129.88	rcp
5	4	40.5	7.34	7.34	0.50	3.67	3.67	6.0	6.0	7.2	26.34	4.54	21.47	15	0.49	129.05	129.25	245.27	252.02	129.88	130.12	rcp
6	1	39.6	3.93	3.93	0.50	1.97	1.97	5.0	5.0	7.5	14.73	2.53	18.75	12	0.50	129.70	129.90	143.11	149.89	128.89	129.65	rcp

Existing System #3 | Number of lines: 6 | Run Date: 07-21-2009

NOTES: Intensity = 82.60 / (Inlet time + 13.50) ^ 0.82; Return period = 10 Yrs. ; c = cir e = ellip b = box

Existing System #4



Project File: System 4.stm	Number of lines: 5	Date: 07-21-2009

Hydraflow Storm Sewers Extension v6.052

Storm Sewer Inventory Report

Line No.	Alignment				Flow Data				Physical Data								Line ID
	Dnstr line No.	Line length (ft)	Defl angle (deg)	Junc type	Known Q (cfs)	Drng area (ac)	Runoff coeff (C)	Inlet time (min)	Invert El Dn (ft)	Line slope (%)	Invert El Up (ft)	Line size (in)	Line shape	N value (n)	J-loss coeff (K)	Inlet/ Rim El (ft)	
1	End	164.1	-80.5	Curb	0.00	1.06	0.50	7.0	119.68	0.58	120.64	24	Cir	0.013	0.56	124.91	rcp
2	1	55.0	18.7	Curb	0.00	7.49	0.50	10.0	120.83	0.49	121.10	18	Cir	0.013	1.50	125.92	rcp
3	2	92.1	-111.2	Curb	0.00	1.87	0.50	6.0	121.20	0.50	121.66	18	Cir	0.013	0.50	124.71	rcp
4	3	305.0	-4.1	MH	0.00	1.50	0.50	6.0	121.80	0.50	123.32	18	Cir	0.035	0.16	127.52	open channel
5	4	39.6	-7.7	Hdwl	0.00	1.90	0.50	6.0	123.50	0.50	123.70	15	Cir	0.013	1.00	127.09	culvert

Existing System #4 | Number of lines: 5 | Date: 07-21-2009

Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line size (in)	Line shape	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line slope (%)	HGL down (ft)	HGL up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns line No.	Junction Type
1	rcp	42.48	24	Cir	164.1	119.68	120.64	0.585	121.68*	127.47*	1.59	129.06	End	Curb-Horiz
2	rcp	39.28	18	Cir	55.0	120.83	121.10	0.491	129.06*	136.76*	11.52	148.28	1	Curb-Horiz
3	rcp	18.25	18	Cir	92.1	121.20	121.66	0.499	148.28*	151.06*	0.83	151.89	2	Curb-Horiz
4	open channel	12.14	18	Cir	305.0	121.80	123.32	0.498	151.89*	181.45*	0.12	181.57	3	Manhole
5	culvert	6.82	15	Cir	39.6	123.50	123.70	0.505	181.57*	182.01*	0.48	182.49	4	OpenHeadwall

Existing System #4 | Number of lines: 5 | Run Date: 07-21-2009

NOTES: Return period = 10 Yrs. ; *Surcharged (HGL above crown).

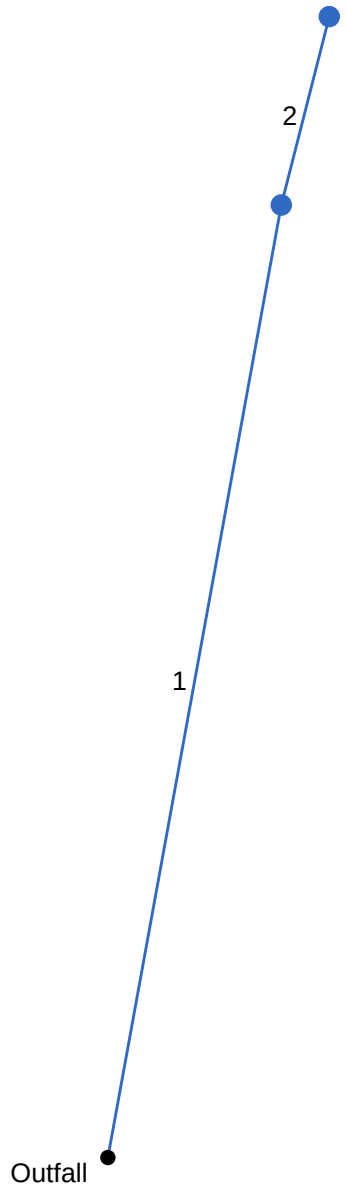
Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	164.1	1.06	13.82	0.50	0.53	6.91	7.0	10.0	6.1	42.48	17.30	13.52	24	0.58	119.68	120.64	121.68	127.47	120.90	124.91	rcp
2	1	55.0	7.49	12.76	0.50	3.75	6.38	10.0	10.0	6.2	39.28	7.36	22.23	18	0.49	120.83	121.10	129.06	136.76	124.91	125.92	rcp
3	2	92.1	1.87	5.27	0.50	0.94	2.64	6.0	6.9	6.9	18.25	7.42	10.33	18	0.50	121.20	121.66	148.28	151.06	125.92	124.71	rcp
4	3	305.0	1.50	3.40	0.50	0.75	1.70	6.0	6.1	7.1	12.14	2.75	6.87	18	0.50	121.80	123.32	151.89	181.45	124.71	127.52	open channel
5	4	39.6	1.90	1.90	0.50	0.95	0.95	6.0	6.0	7.2	6.82	4.59	5.56	15	0.50	123.50	123.70	181.57	182.01	127.52	127.09	culvert

Existing System #4 | Number of lines: 5 | Run Date: 07-21-2009

NOTES: Intensity = 82.60 / (Inlet time + 13.50) ^ 0.82; Return period = 10 Yrs. ; c = cir e = ellip b = box

Existing System #5



Project File: System 5.stm	Number of lines: 2	Date: 07-21-2009

Storm Sewer Inventory Report

Line No.	Alignment				Flow Data				Physical Data								Line ID
	Dnstr line No.	Line length (ft)	Defl angle (deg)	Junc type	Known Q (cfs)	Drng area (ac)	Runoff coeff (C)	Inlet time (min)	Invert El Dn (ft)	Line slope (%)	Invert El Up (ft)	Line size (in)	Line shape	N value (n)	J-loss coeff (K)	Inlet/ Rim El (ft)	
1	End	206.9	-79.7	Grate	0.00	0.00	0.00	0.0	116.01	3.00	122.22	18	Cir	0.013	0.50	124.52	
2	1	41.5	4.1	MH	0.00	2.19	0.50	5.0	122.40	1.01	122.82	15	Cir	0.013	1.00	124.62	

Existing System #5 | Number of lines: 2 | Date: 07-21-2009

Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line size (in)	Line shape	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line slope (%)	HGL down (ft)	HGL up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns line No.	Junction Type
1		10.61	18	Cir	206.9	116.01	122.22	3.002	117.26	123.46	n/a	123.46 j	End	Grate
2		10.64	15	Cir	41.5	122.40	122.82	1.011	123.65*	124.78*	1.17	125.95	1	Manhole

Existing System #5 | Number of lines: 2 | Run Date: 07-21-2009

NOTES: Return period = 100 Yrs. ; *Surcharged (HGL above crown). ; j - Line contains hyd. jump.

Storm Sewer Tabulation

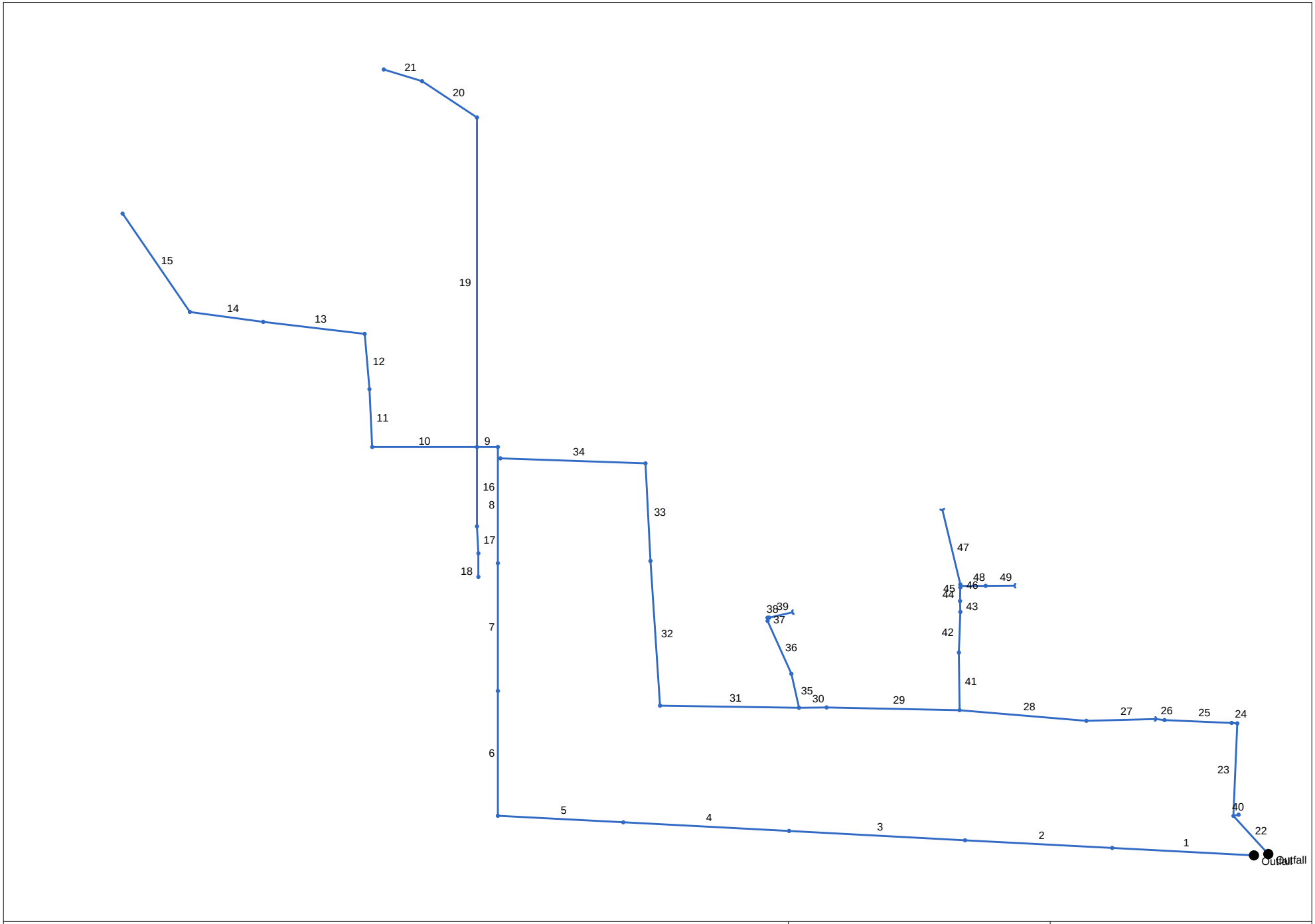
Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	206.9	0.00	2.19	0.00	0.00	1.10	0.0	5.1	9.7	10.61	18.19	6.76	18	3.00	116.01	122.22	117.26	123.46	116.68	124.52	
2	1	41.5	2.19	2.19	0.50	1.10	1.10	5.0	5.0	9.7	10.64	6.49	8.67	15	1.01	122.40	122.82	123.65	124.78	124.52	124.62	

Existing System #5 | Number of lines: 2 | Run Date: 07-21-2009

NOTES: Intensity = 157.18 / (Inlet time + 19.60) ^ 0.87; Return period = 100 Yrs. ; c = cir e = ellip b = box

PROPOSED CLOSED SYSTEMS

Proposed System #1 - Alt #1



Project File: Proposed System 1 - street alternate-4.stm	Number of lines: 49	Date: 07-21-2009

Hydraflow Storm Sewers Extension v6.052

Storm Sewer Inventory Report

Line No.	Alignment				Flow Data				Physical Data								Line ID
	Dnstr line No.	Line length (ft)	Defl angle (deg)	Junc type	Known Q (cfs)	Drng area (ac)	Runoff coeff (C)	Inlet time (min)	Invert El Dn (ft)	Line slope (%)	Invert El Up (ft)	Line size (in)	Line shape	N value (n)	J-loss coeff (K)	Inlet/ Rim El (ft)	
1	End	244.0	-177.0	Genr	0.00	0.90	0.50	6.0	119.50	0.25	120.11	60	Cir	0.013	0.00	129.00	Proposed pipe
2	1	254.0	0.0	Genr	0.00	0.94	0.50	5.0	120.44	0.25	121.08	60	Cir	0.013	0.00	129.80	Proposed pipe
3	2	303.0	0.0	Genr	0.00	2.13	0.50	5.0	121.28	0.25	122.04	60	Cir	0.013	0.00	130.20	Proposed pipe
4	3	286.0	0.0	Genr	0.00	1.59	0.50	5.0	122.24	0.25	122.96	60	Cir	0.013	0.00	133.80	Proposed pipe
5	4	216.0	0.0	Genr	0.00	1.67	0.50	6.0	123.16	0.25	123.70	60	Cir	0.013	1.00	137.80	Proposed pipe
6	5	215.0	87.0	Genr	0.00	1.03	0.50	5.0	124.00	0.25	124.54	60	Cir	0.013	0.00	134.60	Proposed pipe
7	6	220.0	0.0	Genr	0.00	0.00	0.50	0.0	124.84	0.25	125.39	60	Cir	0.013	0.00	132.50	Proposed pipe
8	7	200.0	0.0	Genr	0.00	3.22	0.50	9.0	125.59	0.25	126.09	60	Cir	0.013	1.00	132.30	Proposed pipe
9	8	35.9	-90.0	Genr	0.00	1.48	0.50	9.0	126.09	0.25	126.18	60	Cir	0.013	2.25	131.21	Proposed pipe
10	9	180.5	0.0	Grate	0.00	2.87	0.50	8.0	126.28	0.25	126.73	60	Cir	0.013	1.50	133.10	rcp-int
11	10	99.7	87.3	Grate	0.00	0.67	0.50	5.0	126.93	0.25	127.18	60	Cir	0.013	0.50	132.76	rcp-int
12	11	95.6	-2.2	Grate	0.00	1.13	0.50	6.0	127.18	0.25	127.42	54	Cir	0.013	1.47	133.64	rcp-int
13	12	175.9	-78.3	Grate	0.00	9.08	0.50	9.0	127.62	0.25	128.06	54	Cir	0.013	0.50	133.50	rcp-int
14	13	127.3	0.9	Grate	0.00	1.78	0.50	7.0	128.26	0.25	128.58	54	Cir	0.013	1.17	134.79	rcp-int
15	14	205.4	47.9	Genr	0.00	65.08	0.30	45.0	128.88	0.25	129.39	54	Cir	0.013	1.00	135.59	rcp-int
16	9	136.7	-90.0	Grate	0.00	5.57	0.50	9.0	130.90	0.30	131.31	15	Cir	0.013	0.50	132.01	rcp-int
17	16	46.5	-3.0	Grate	0.00	0.18	0.50	5.0	131.31	0.30	131.45	15	Cir	0.013	0.50	132.28	rcp-int
18	17	40.4	3.2	Grate	0.00	1.59	0.50	5.0	131.45	0.30	131.57	15	Cir	0.013	1.00	131.98	rcp-int
19	9	567.5	90.0	Curb	0.00	1.65	0.50	7.0	130.10	-0.18	129.10	24	Cir	0.013	1.29	133.62	rcp
20	19	113.5	-56.6	Curb	0.00	0.20	0.50	5.0	129.20	1.21	130.57	18	Cir	0.013	0.50	136.25	rcp-int
21	20	68.8	-16.4	Curb	0.00	7.21	0.50	17.0	130.65	0.31	130.86	15	Cir	0.013	1.00	133.66	rcp-int
22	End	89.0	-132.4	MH	0.00	0.00	0.00	0.0	122.92	0.04	122.96	36x58	Ell	0.024	1.00	127.07	cmp
23	22	159.6	44.8	MH	0.00	0.00	0.00	0.0	123.06	0.51	123.88	36	Cir	0.013	1.00	126.79	rcp

Proposed System #1 - Alt #1 | Number of lines: 49 | Date: 07-21-2009

Storm Sewer Inventory Report

Line No.	Alignment				Flow Data				Physical Data								Line ID
	Dnstr line No.	Line length (ft)	Defl angle (deg)	Junc type	Known Q (cfs)	Drng area (ac)	Runoff coeff (C)	Inlet time (min)	Invert El Dn (ft)	Line slope (%)	Invert El Up (ft)	Line size (in)	Line shape	N value (n)	J-loss coeff (K)	Inlet/ Rim El (ft)	
24	23	9.7	-88.0	Genr	0.00	0.53	0.50	5.0	123.93	0.31	123.96	36	Cir	0.024	0.50	129.63	cmp
25	24	115.6	-2.0	Genr	0.00	0.00	0.00	0.0	123.96	0.21	124.20	48x144	Ell	0.035	0.50	129.46	open channel
26	25	15.2	4.4	Hdwl	0.00	0.54	0.50	5.0	124.20	-0.26	124.16	35x58	Ell	0.013	0.50	129.46	culvert
27	26	119.3	-8.3	Genr	0.00	1.32	0.50	5.0	124.16	0.18	124.38	48x144	Ell	0.035	0.50	127.62	open channel
28	27	219.2	6.3	Grate	0.00	0.81	0.50	5.0	124.38	0.22	124.87	36	Cir	0.013	1.49	128.28	rcp
29	28	229.1	-3.6	Grate	0.00	0.27	0.50	5.0	124.87	0.22	125.38	36	Cir	0.024	0.50	129.79	cmp
30	29	47.3	-2.1	Grate	0.00	0.01	0.50	5.0	125.38	0.15	125.45	36	Cir	0.024	1.47	130.28	cmp
31	30	239.0	1.8	Grate	0.00	0.62	0.50	5.0	125.65	0.27	126.29	24	Cir	0.013	1.50	131.80	Inserted Line
32	31	249.6	85.3	Grate	0.00	1.33	0.50	5.0	126.53	0.53	127.86	24	Cir	0.013	0.50	132.05	Inserted Line
33	32	168.4	0.8	Grate	0.00	1.80	0.50	7.0	127.88	0.46	128.65	24	Cir	0.013	1.50	132.05	Inserted Line
34	33	250.0	-85.0	Curb	0.00	0.01	0.50	5.0	128.85	0.06	129.00	24	Cir	0.013	1.00	132.47	Inserted Line
35	30	60.0	78.3	Grate	0.00	0.34	0.50	5.0	126.30	0.52	126.61	15	Cir	0.013	0.50	129.43	Inserted Line
36	35	99.9	-11.7	Genr	0.00	16.94	0.50	24.0	126.71	0.40	127.11	15	Cir	0.013	0.67	130.07	Inserted Line
37	36	5.5	23.0	MH	0.00	0.00	0.00	0.0	129.49	-8.00	129.05	18	Cir	0.035	1.00	130.07	Inserted Line
38	37	3.0	85.5	MH	0.00	0.00	0.00	0.0	129.05	-9.00	128.78	18	Cir	0.035	0.15	130.07	Inserted Line
39	38	40.9	-7.0	Hdwl	0.00	1.02	0.50	7.0	128.78	0.05	128.80	15	Cir	0.035	1.00	128.80	Inserted Line
40	22	9.3	119.5	Curb	0.00	2.08	0.50	5.0	123.41	0.32	123.44	15	Cir	0.013	1.00	127.07	rcp-int
41	28	99.2	84.5	Grate	0.00	0.26	0.50	5.0	125.47	0.30	125.77	18	Cir	0.013	0.50	127.76	rcp-int
42	41	70.1	2.8	MH	0.00	0.00	0.00	0.0	125.87	0.30	126.08	18	Cir	0.013	0.15	127.50	rcp-int
43	42	18.7	-3.9	MH	0.00	0.00	0.00	0.0	127.71	-0.64	127.59	18x18	Ell	0.035	0.15	127.50	open channel
44	43	23.3	2.3	MH	0.00	0.00	0.00	0.0	127.65	0.13	127.68	12	Cir	0.013	0.34	128.35	culvert-int
45	44	2.9	17.0	MH	0.00	0.00	0.00	0.0	127.75	0.69	127.77	18x18	Ell	0.035	0.96	128.35	open channel
46	45	2.6	-28.4	MH	0.00	0.00	0.00	0.0	127.77	0.77	127.79	18x18	Ell	0.035	0.15	128.35	open channel

Proposed System #1 - Alt #1 | Number of lines: 49 | Date: 07-21-2009

Storm Sewer Inventory Report

Line No.	Alignment				Flow Data				Physical Data								Line ID
	Dnstr line No.	Line length (ft)	Defl angle (deg)	Junc type	Known Q (cfs)	Drng area (ac)	Runoff coeff (C)	Inlet time (min)	Invert El Dn (ft)	Line slope (%)	Invert El Up (ft)	Line size (in)	Line shape	N value (n)	J-loss coeff (K)	Inlet/ Rim El (ft)	
47	46	132.1	-2.6	Hdwl	0.00	3.34	0.50	5.0	127.90	0.30	128.30	12	Cir	0.013	1.00	130.02	rcp-int
48	45	43.0	72.4	MH	0.00	0.00	0.00	0.0	127.77	1.21	128.29	18x18	Ell	0.035	0.15	128.41	open channel
49	48	50.0	-0.2	Hdwl	0.00	2.63	0.50	6.0	128.40	0.20	128.50	12	Cir	0.013	1.00	128.00	culvert

Proposed System #1 - Alt #1 | Number of lines: 49 | Date: 07-21-2009

Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line size (in)	Line shape	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line slope (%)	HGL down (ft)	HGL up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns line No.	Junction Type
1	Proposed pipe	116.1	60	Cir	244.0	119.50	120.11	0.250	123.18	123.79	0.00	123.79	End	Generic
2	Proposed pipe	115.9	60	Cir	254.0	120.44	121.08	0.252	124.10	124.74	0.00	124.74	1	Generic
3	Proposed pipe	115.8	60	Cir	303.0	121.28	122.04	0.251	124.95	125.71	0.00	125.71	2	Generic
4	Proposed pipe	114.0	60	Cir	286.0	122.24	122.96	0.252	125.86	126.58	0.00	126.58	3	Generic
5	Proposed pipe	112.7	60	Cir	216.0	123.16	123.70	0.250	126.75	127.29	0.87	128.16	4	Generic
6	Proposed pipe	111.2	60	Cir	215.0	124.00	124.54	0.251	128.16	128.50	0.00	128.50	5	Generic
7	Proposed pipe	110.6	60	Cir	220.0	124.84	125.39	0.250	128.50	128.99	0.00	128.99	6	Generic
8	Proposed pipe	111.4	60	Cir	200.0	125.59	126.09	0.250	129.15	129.65	0.86	130.52	7	Generic
9	Proposed pipe	106.9	60	Cir	35.9	126.09	126.18	0.251	130.52	130.56	1.20	131.76	8	Generic
10	rcp-int	81.25	60	Cir	180.5	126.28	126.73	0.249	131.76*	131.94*	0.40	132.34	9	Grate
11	rcp-int	77.41	60	Cir	99.7	126.93	127.18	0.251	132.34*	132.42*	0.12	132.54	10	Grate
12	rcp-int	76.74	54	Cir	95.6	127.18	127.42	0.251	132.54*	132.69*	0.53	133.22	11	Grate
13	rcp-int	75.66	54	Cir	175.9	127.62	128.06	0.250	133.22*	133.48*	0.18	133.66	12	Grate
14	rcp-int	62.34	54	Cir	127.3	128.26	128.58	0.251	133.66*	133.79*	0.28	134.07	13	Grate
15	rcp-int	60.35	54	Cir	205.4	128.88	129.39	0.248	134.07*	134.26*	0.22	134.48	14	Generic
16	rcp-int	23.43	15	Cir	136.7	130.90	131.31	0.300	132.15*	150.16*	2.83	152.99	9	Grate
17	rcp-int	6.45	15	Cir	46.5	131.31	131.45	0.301	152.99*	153.46*	0.21	153.67	16	Grate
18	rcp-int	5.83	15	Cir	40.4	131.45	131.57	0.297	153.67*	154.00*	0.35	154.35	17	Grate
19	rcp	23.00	24	Cir	567.5	130.10	129.10	-0.176	132.10*	137.97*	1.08	139.05	9	Curb-Horiz
20	rcp-int	18.89	18	Cir	113.5	129.20	130.57	1.207	139.05*	142.72*	0.89	143.61	19	Curb-Horiz
21	rcp-int	18.42	15	Cir	68.8	130.65	130.86	0.305	143.61*	149.21*	3.50	152.72	20	Curb-Horiz
22	cmp	11.16	36x58	Ell	89.0	122.92	122.96	0.045	125.17	125.21	0.02	125.23	End	Manhole
23	rcp	10.48	36	Cir	159.6	123.06	123.88	0.514	125.23	125.25	0.17	125.42	22	Manhole
24	cmp	10.48	36	Cir	9.7	123.93	123.96	0.309	125.47	125.50	0.06	125.57	23	Generic

Proposed System #1 - Alt #1 | Number of lines: 49 | Run Date: 07-21-2009

NOTES: Return period = 10 Yrs. ; *Surcharged (HGL above crown).

Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line size (in)	Line shape	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line slope (%)	HGL down (ft)	HGL up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns line No.	Junction Type
25	open channel	10.34	48x144	Ell	115.6	123.96	124.20	0.208	125.69	125.80	0.00	125.80	24	Generic
26	culvert	10.34	35x58	Ell	15.2	124.20	124.16	-0.264	127.12*	127.12*	0.01	127.12	25	OpenHeadwall
27	open channel	10.19	48x144	Ell	119.3	124.16	124.38	0.184	127.14	127.18	0.00	127.18	26	Generic
28	rcp	9.76	36	Cir	219.2	124.38	124.87	0.224	127.18	127.21	0.06	127.28	27	Grate
29	cmp	7.43	36	Cir	229.1	124.87	125.38	0.223	127.28	127.40	0.02	127.41	28	Grate
30	cmp	7.34	36	Cir	47.3	125.38	125.45	0.148	127.41	127.44	0.05	127.49	29	Grate
31	Inserted Line	1.25	24	Cir	239.0	125.65	126.29	0.268	127.49	127.50	0.01	127.51	30	Grate
32	Inserted Line	1.05	24	Cir	249.6	126.53	127.86	0.533	127.51	128.22	n/a	128.22 j	31	Grate
33	Inserted Line	0.61	24	Cir	168.4	127.88	128.65	0.457	128.22	128.93	0.13	128.93	32	Grate
34	Inserted Line	0.04	24	Cir	250.0	128.85	129.00	0.060	128.97	129.12	0.00	129.12	33	Curb-Horiz
35	Inserted Line	39.95	15	Cir	60.0	126.30	126.61	0.517	127.55*	150.52*	8.24	158.76	30	Grate
36	Inserted Line	39.25	15	Cir	99.9	126.71	127.11	0.400	158.76*	195.68*	10.65	206.34	35	Generic
37	Inserted Line	3.45	18	Cir	5.5	129.49	129.05	-8.000	206.34*	206.38*	0.06	206.44	36	Manhole
38	Inserted Line	3.45	18	Cir	3.0	129.05	128.78	-9.000	206.44*	206.46*	0.01	206.47	37	Manhole
39	Inserted Line	3.48	15	Cir	40.9	128.78	128.80	0.049	206.47*	207.33*	0.12	207.46	38	OpenHeadwall
40	rcp-int	7.62	15	Cir	9.3	123.41	123.44	0.322	125.23*	125.36*	0.60	125.96	22	Curb-Horiz
41	rcp-int	21.74	18	Cir	99.2	125.47	125.77	0.302	127.28*	131.53*	1.18	132.70	28	Grate
42	rcp-int	20.90	18	Cir	70.1	125.87	126.08	0.300	132.70*	135.48*	0.33	135.81	41	Manhole
43	open channel	20.92	18x18	Ell	18.7	127.71	127.59	-0.642	137.98*	143.37*	n/a	143.69	42	Manhole
44	culvert-int	20.93	12	Cir	23.3	127.65	127.68	0.129	143.69*	151.76*	3.76	155.52	43	Manhole
45	open channel	20.94	18x18	Ell	2.9	127.75	127.77	0.687	166.56*	167.40*	n/a	169.49	44	Manhole
46	open channel	12.18	18x18	Ell	2.6	127.77	127.79	0.772	171.68*	171.93*	0.11	172.04	45	Manhole
47	rcp-int	12.24	12	Cir	132.1	127.90	128.30	0.303	172.04*	187.65*	3.78	191.43	46	OpenHeadwall
48	open channel	9.27	18x18	Ell	43.0	127.77	128.29	1.210	171.68*	174.10*	0.06	174.17	45	Manhole

Proposed System #1 - Alt #1 | Number of lines: 49 | Run Date: 07-21-2009

NOTES: Return period = 10 Yrs. ; *Surcharged (HGL above crown). ; j - Line contains hyd. jump.

Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line size (in)	Line shape	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line slope (%)	HGL down (ft)	HGL up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns line No.	Junction Type
49	culvert	9.29	12	Cir	50.0	128.40	128.50	0.200	174.17*	177.57*	2.18	179.75	48	OpenHeadwall

Proposed System #1 - Alt #1 | Number of lines: 49 | Run Date: 07-21-2009

NOTES: Return period = 10 Yrs. ; *Surcharged (HGL above crown). ; j - Line contains hyd. jump.

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	244.0	0.90	110.0	0.50	0.45	41.97	6.0	53.8	2.8	116.1	130.2	7.50	60	0.25	119.50	120.11	123.18	123.79	126.00	129.00	Proposed pipe
2	1	254.0	0.94	109.1	0.50	0.47	41.52	5.0	53.0	2.8	115.9	130.7	7.52	60	0.25	120.44	121.08	124.10	124.74	129.00	129.80	Proposed pipe
3	2	303.0	2.13	108.1	0.50	1.07	41.05	5.0	52.1	2.8	115.8	130.4	7.50	60	0.25	121.28	122.04	124.95	125.71	129.80	130.20	Proposed pipe
4	3	286.0	1.59	106.0	0.50	0.80	39.98	5.0	51.2	2.9	114.0	130.7	7.50	60	0.25	122.24	122.96	125.86	126.58	130.20	133.80	Proposed pipe
5	4	216.0	1.67	104.4	0.50	0.84	39.19	6.0	50.6	2.9	112.7	130.2	7.47	60	0.25	123.16	123.70	126.75	127.29	133.80	137.80	Proposed pipe
6	5	215.0	1.03	102.7	0.50	0.52	38.35	5.0	49.9	2.9	111.2	130.5	6.52	60	0.25	124.00	124.54	128.16	128.50	137.80	134.60	Proposed pipe
7	6	220.0	0.00	101.7	0.50	0.00	37.84	0.0	49.3	2.9	110.6	130.2	7.25	60	0.25	124.84	125.39	128.50	128.99	134.60	132.50	Proposed pipe
8	7	200.0	3.22	101.7	0.50	1.61	37.84	9.0	48.7	2.9	111.4	130.2	7.45	60	0.25	125.59	126.09	129.15	129.65	132.50	132.30	Proposed pipe
9	8	35.9	1.48	98.49	0.50	0.74	36.23	9.0	48.6	2.9	106.9	130.4	5.84	60	0.25	126.09	126.18	130.52	130.56	132.30	131.21	Proposed pipe
10	9	180.5	2.87	80.61	0.50	1.44	27.29	8.0	47.8	3.0	81.25	130.1	4.14	60	0.25	126.28	126.73	131.76	131.94	131.21	133.10	rcp-int
11	10	99.7	0.67	77.74	0.50	0.34	25.85	5.0	47.4	3.0	77.41	130.4	3.94	60	0.25	126.93	127.18	132.34	132.42	133.10	132.76	rcp-int
12	11	95.6	1.13	77.07	0.50	0.57	25.52	6.0	47.1	3.0	76.74	98.56	4.83	54	0.25	127.18	127.42	132.54	132.69	132.76	133.64	rcp-int
13	12	175.9	9.08	75.94	0.50	4.54	24.95	9.0	46.4	3.0	75.66	98.37	4.76	54	0.25	127.62	128.06	133.22	133.48	133.64	133.50	rcp-int
14	13	127.3	1.78	66.86	0.50	0.89	20.41	7.0	45.9	3.1	62.34	98.60	3.92	54	0.25	128.26	128.58	133.66	133.79	133.50	134.79	rcp-int
15	14	205.4	65.08	65.08	0.30	19.52	19.52	45.0	45.0	3.1	60.35	97.99	3.79	54	0.25	128.88	129.39	134.07	134.26	134.79	135.59	rcp-int
16	9	136.7	5.57	7.34	0.50	2.79	3.67	9.0	9.0	6.4	23.43	3.54	19.10	15	0.30	130.90	131.31	132.15	150.16	131.21	132.01	rcp-int
17	16	46.5	0.18	1.77	0.50	0.09	0.89	5.0	5.1	7.3	6.45	3.54	5.26	15	0.30	131.31	131.45	152.99	153.46	132.01	132.28	rcp-int
18	17	40.4	1.59	1.59	0.50	0.80	0.80	5.0	5.0	7.3	5.83	3.52	4.75	15	0.30	131.45	131.57	153.67	154.00	132.28	131.98	rcp-int
19	9	567.5	1.65	9.06	0.50	0.83	4.53	7.0	17.3	5.1	23.00	0.00	7.32	24	-0.18	130.10	129.10	132.10	137.97	131.21	133.62	rcp
20	19	113.5	0.20	7.41	0.50	0.10	3.71	5.0	17.1	5.1	18.89	11.54	10.69	18	1.21	129.20	130.57	139.05	142.72	133.62	136.25	rcp-int
21	20	68.8	7.21	7.21	0.50	3.61	3.61	17.0	17.0	5.1	18.42	3.57	15.01	15	0.31	130.65	130.86	143.61	149.21	136.25	133.66	rcp-int
22	End	89.0	0.00	33.85	0.00	0.00	16.93	0.0	369.7	0.7	11.16	14.20	1.23	36 x 58 e	0.04	122.92	122.96	125.17	125.21	122.92	127.07	cmp

Proposed System #1 - Alt #1 | Number of lines: 49 | Run Date: 07-21-2009

NOTES: Intensity = 103.01 / (Inlet time + 17.60) ^ 0.85; Return period = 10 Yrs. ; c = cir e = ellip b = box

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
23	22	159.6	0.00	31.77	0.00	0.00	15.89	0.0	369.4	0.7	10.48	47.80	2.62	36	0.51	123.06	123.88	125.23	125.25	127.07	126.79	rcp
24	23	9.7	0.53	31.77	0.50	0.27	15.89	5.0	369.4	0.7	10.48	20.08	2.87	36	0.31	123.93	123.96	125.47	125.50	126.79	129.63	cmp
25	24	115.6	0.00	31.24	0.00	0.00	15.62	0.0	368.2	0.7	10.34	95.57	0.68	48 x 144 e	0.21	123.96	124.20	125.69	125.80	129.63	129.46	open channel
26	25	15.2	0.54	31.24	0.50	0.27	15.62	5.0	368.2	0.7	10.34	0.00	0.93	35 x 58 e	-0.26	124.20	124.16	127.12	127.12	129.46	129.46	culvert
27	26	119.3	1.32	30.70	0.50	0.66	15.35	5.0	367.0	0.7	10.19	90.07	0.35	48 x 144 e	0.18	124.16	124.38	127.14	127.18	129.46	127.62	open channel
28	27	219.2	0.81	29.38	0.50	0.41	14.69	5.0	366.6	0.7	9.76	31.53	1.53	36	0.22	124.38	124.87	127.18	127.21	127.62	128.28	rcp
29	28	229.1	0.27	22.34	0.50	0.14	11.17	5.0	366.0	0.7	7.43	17.04	1.35	36	0.22	124.87	125.38	127.28	127.40	128.28	129.79	cmp
30	29	47.3	0.01	22.07	0.50	0.01	11.04	5.0	365.9	0.7	7.34	13.90	1.46	36	0.15	125.38	125.45	127.41	127.44	129.79	130.28	cmp
31	30	239.0	0.62	3.76	0.50	0.31	1.88	5.0	364.8	0.7	1.25	11.70	0.52	24	0.27	125.65	126.29	127.49	127.50	130.28	131.80	Inserted Line
32	31	249.6	1.33	3.14	0.50	0.67	1.57	5.0	363.6	0.7	1.05	16.51	1.69	24	0.53	126.53	127.86	127.51	128.22	131.80	132.05	Inserted Line
33	32	168.4	1.80	1.81	0.50	0.90	0.91	7.0	362.1	0.7	0.61	15.29	2.01	24	0.46	127.88	128.65	128.22	128.93	132.05	132.05	Inserted Line
34	33	250.0	0.01	0.01	0.50	0.01	0.01	5.0	5.0	7.3	0.04	5.54	0.50	24	0.06	128.85	129.00	128.97	129.12	132.05	132.47	Inserted Line
35	30	60.0	0.34	18.30	0.50	0.17	9.15	5.0	24.1	4.4	39.95	4.64	32.56	15	0.52	126.30	126.61	127.55	150.52	130.28	129.43	Inserted Line
36	35	99.9	16.94	17.96	0.50	8.47	8.98	24.0	24.0	4.4	39.25	4.09	31.99	15	0.40	126.71	127.11	158.76	195.68	129.43	130.07	Inserted Line
37	36	5.5	0.00	1.02	0.00	0.00	0.51	0.0	7.3	6.8	3.45	0.00	1.95	18	-8.00	129.49	129.05	206.34	206.38	130.07	130.07	Inserted Line
38	37	3.0	0.00	1.02	0.00	0.00	0.51	0.0	7.2	6.8	3.45	0.00	1.95	18	-9.00	129.05	128.78	206.44	206.46	130.07	130.07	Inserted Line
39	38	40.9	1.02	1.02	0.50	0.51	0.51	7.0	7.0	6.8	3.48	0.53	2.84	15	0.05	128.78	128.80	206.47	207.33	130.07	128.80	Inserted Line
40	22	9.3	2.08	2.08	0.50	1.04	1.04	5.0	5.0	7.3	7.62	3.67	6.21	15	0.32	123.41	123.44	125.23	125.36	127.07	127.07	rcp-int
41	28	99.2	0.26	6.23	0.50	0.13	3.12	5.0	6.4	7.0	21.74	5.78	12.30	18	0.30	125.47	125.77	127.28	131.53	128.28	127.76	rcp-int
42	41	70.1	0.00	5.97	0.00	0.00	2.99	0.0	6.3	7.0	20.90	5.75	11.83	18	0.30	125.87	126.08	132.70	135.48	127.76	127.50	rcp-int
43	42	18.7	0.00	5.97	0.00	0.00	2.99	0.0	6.2	7.0	20.92	0.00	11.84	18 x 18 e	-0.64	127.71	127.59	137.98	143.37	127.50	127.50	open channel

Proposed System #1 - Alt #1 | Number of lines: 49 | Run Date: 07-21-2009

NOTES: Intensity = 103.01 / (Inlet time + 17.60) ^ 0.85; Return period = 10 Yrs. ; c = cir e = ellip b = box

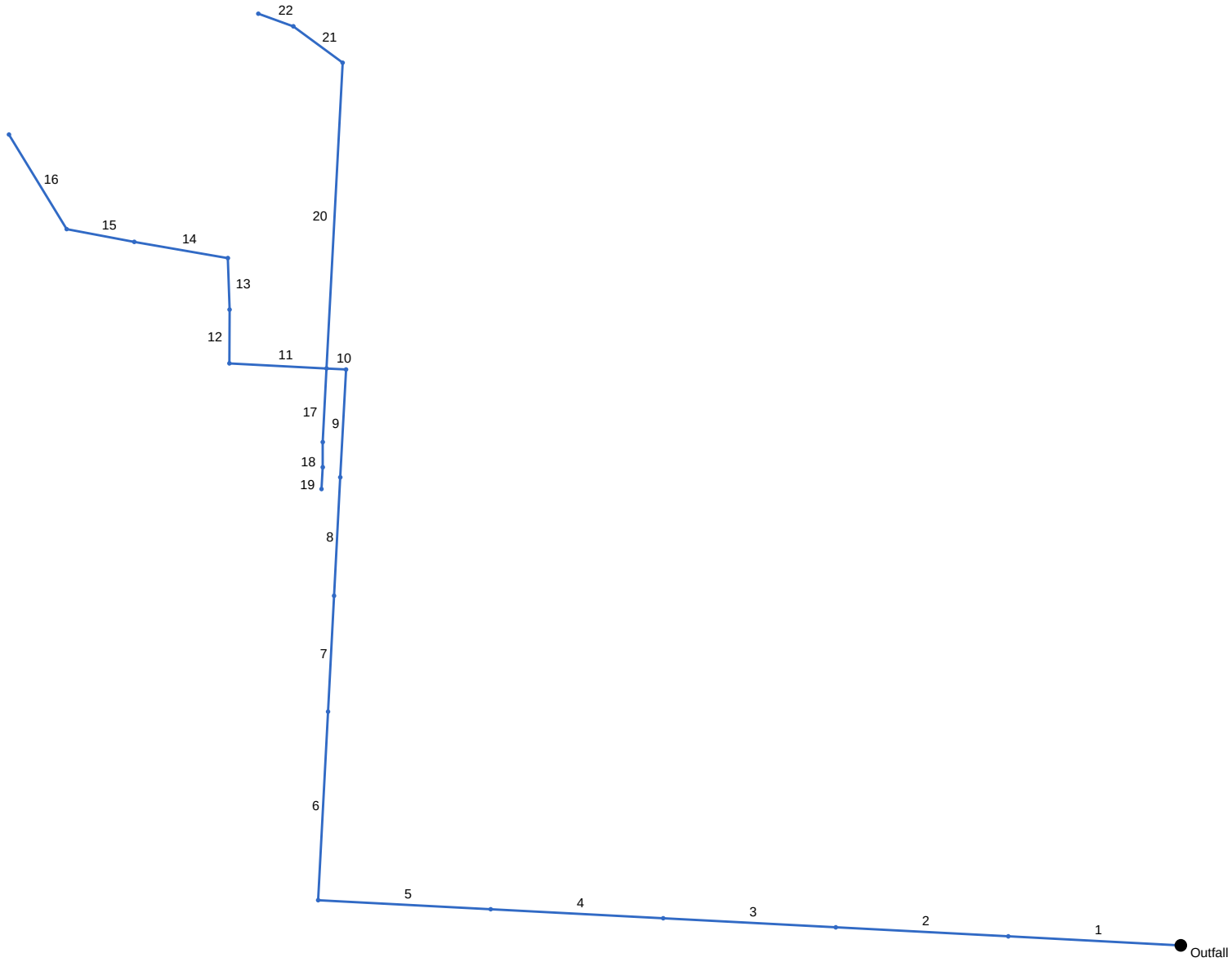
Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line		Incr	Total		Incr	Total	Inlet	Syst					Size	Slope	Dn	Up	Dn	Up	Dn	Up	
		(ft)	(ac)	(ac)	(C)			(min)	(min)	(in/hr)	(cfs)	(cfs)	(ft/s)	(in)	(%)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	
44	43	23.3	0.00	5.97	0.00	0.00	2.99	0.0	6.2	7.0	20.93	1.28	26.66	12	0.13	127.65	127.68	143.69	151.76	127.50	128.35	culvert-int
45	44	2.9	0.00	5.97	0.00	0.00	2.99	0.0	6.2	7.0	20.94	3.23	11.85	18 x 18 e	0.69	127.75	127.77	166.56	167.40	128.35	128.35	open channel
46	45	2.6	0.00	3.34	0.00	0.00	1.67	0.0	5.1	7.3	12.18	3.43	6.89	18 x 18 e	0.77	127.77	127.79	171.68	171.93	128.35	128.35	open channel
47	46	132.1	3.34	3.34	0.50	1.67	1.67	5.0	5.0	7.3	12.24	1.96	15.59	12	0.30	127.90	128.30	172.04	187.65	128.35	130.02	rcp-int
48	45	43.0	0.00	2.63	0.00	0.00	1.32	0.0	6.1	7.0	9.27	4.29	5.25	18 x 18 e	1.21	127.77	128.29	171.68	174.10	128.35	128.41	open channel
49	48	50.0	2.63	2.63	0.50	1.32	1.32	6.0	6.0	7.1	9.29	1.59	11.83	12	0.20	128.40	128.50	174.17	177.57	128.41	128.00	culvert

Proposed System #1 - Alt #1 | Number of lines: 49 | Run Date: 07-21-2009

NOTES: Intensity = 103.01 / (Inlet time + 17.60) ^ 0.85; Return period = 10 Yrs. ; c = cir e = ellip b = box

Proposed System #1 - Alt #2



Project File: Proposed System 1 - street alternate-6 to RR.stm	Number of lines: 22	Date: 07-21-2009

Hydraflow Storm Sewers Extension v6.052

Storm Sewer Inventory Report

Line No.	Alignment				Flow Data				Physical Data								Line ID
	Dnstr line No.	Line length (ft)	Defl angle (deg)	Junc type	Known Q (cfs)	Drng area (ac)	Runoff coeff (C)	Inlet time (min)	Invert El Dn (ft)	Line slope (%)	Invert El Up (ft)	Line size (in)	Line shape	N value (n)	J-loss coeff (K)	Inlet/ Rim El (ft)	
1	End	320.0	-177.0	Genr	0.00	1.80	0.50	5.0	116.92	0.25	117.72	66	Cir	0.013	0.00	132.00	Proposed pipe
2	1	320.0	0.0	Genr	0.00	1.80	0.50	5.0	117.84	0.25	118.64	66	Cir	0.013	0.00	132.00	Proposed pipe
3	2	320.0	0.0	Genr	0.00	1.80	0.50	5.0	118.98	0.25	119.78	66	Cir	0.013	0.00	132.00	Proposed pipe
4	3	320.0	0.0	Genr	0.00	1.80	0.50	5.0	120.24	0.25	121.04	66	Cir	0.013	0.00	134.00	Proposed pipe
5	4	320.0	0.0	Genr	0.00	1.80	0.50	5.0	121.36	0.25	122.16	66	Cir	0.013	1.00	137.00	Proposed pipe
6	5	350.0	90.0	Genr	0.00	1.80	0.50	6.0	122.23	0.25	123.11	60	Cir	0.013	0.00	137.80	Proposed pipe(2)
7	6	215.0	0.0	Genr	0.00	1.03	0.50	5.0	123.30	0.25	123.84	60	Cir	0.013	0.00	134.60	Proposed pipe
8	7	220.0	0.0	MH	0.00	0.00	0.00	0.0	123.64	0.25	124.19	60	Cir	0.013	0.00	132.50	Proposed pipe
9	8	200.0	0.0	Genr	0.00	3.22	0.50	9.0	124.09	0.25	124.59	60	Cir	0.013	1.00	132.30	Proposed pipe
10	9	35.9	-90.0	Genr	0.00	1.48	0.50	9.0	124.93	0.25	125.02	60	Cir	0.013	2.25	131.21	Proposed pipe
11	10	180.5	0.0	Grate	0.00	2.87	0.50	8.0	125.18	0.25	125.63	60	Cir	0.013	1.50	133.10	rcp-int
12	11	99.7	87.3	Grate	0.00	0.67	0.50	5.0	125.72	0.25	125.97	54	Cir	0.013	0.50	132.76	rcp-int
13	12	95.6	-2.2	Grate	0.00	1.14	0.50	6.0	126.22	0.25	126.46	54	Cir	0.013	1.47	133.64	rcp-int
14	13	175.9	-78.3	Grate	0.00	9.08	0.50	9.0	126.81	0.25	127.25	54	Cir	0.013	0.50	133.50	rcp-int
15	14	127.3	0.9	Grate	0.00	1.78	0.50	7.0	127.54	0.25	127.86	48	Cir	0.013	1.17	134.79	rcp-int
16	15	205.4	47.9	Genr	0.00	65.08	0.30	45.0	128.02	0.25	128.53	42	Cir	0.013	1.00	135.59	rcp-int
17	10	136.7	-90.0	Grate	0.00	5.57	0.50	9.0	125.30	0.25	125.64	42	Cir	0.013	0.50	132.01	rcp-int
18	17	46.5	-3.0	Grate	0.00	0.18	0.50	5.0	126.01	0.26	126.13	24	Cir	0.013	0.50	132.28	rcp-int
19	18	40.4	3.2	Grate	0.00	1.59	0.50	5.0	126.25	0.25	126.35	24	Cir	0.013	1.00	131.98	rcp-int
20	10	567.5	90.0	Curb	0.00	1.65	0.50	7.0	125.60	0.25	127.02	42	Cir	0.013	1.29	133.62	rcp
21	20	113.5	-56.6	Curb	0.00	0.20	0.50	5.0	127.80	0.25	128.08	30	Cir	0.013	0.50	136.25	rcp-int
22	21	68.8	-16.4	Curb	0.00	7.21	0.50	17.0	128.35	0.25	128.52	24	Cir	0.013	1.00	133.66	rcp-int

Proposed System #1 - Alt #2 | Number of lines: 22 | Date: 07-21-2009

Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line size (in)	Line shape	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line slope (%)	HGL down (ft)	HGL up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns line No.	Junction Type
1	Proposed pipe	118.3	66	Cir	320.0	116.92	117.72	0.250	121.21	121.57	0.00	121.57	End	Generic
2	Proposed pipe	117.4	66	Cir	320.0	117.84	118.64	0.250	121.57	122.12	0.00	122.12	1	Generic
3	Proposed pipe	116.5	66	Cir	320.0	118.98	119.78	0.250	122.35	123.15	0.00	123.15	2	Generic
4	Proposed pipe	115.6	66	Cir	320.0	120.24	121.04	0.250	123.59	124.39	0.00	124.39	3	Generic
5	Proposed pipe	114.7	66	Cir	320.0	121.36	122.16	0.250	124.70	125.50	0.90	126.40	4	Generic
6	Proposed pipe(2)	113.6	60	Cir	350.0	122.23	123.11	0.251	126.40	127.00	0.00	127.00	5	Generic
7	Proposed pipe	112.0	60	Cir	215.0	123.30	123.84	0.251	127.00	127.48	0.00	127.48	6	Generic
8	Proposed pipe	111.4	60	Cir	220.0	123.64	124.19	0.250	127.48	127.90	0.00	127.90	7	Manhole
9	Proposed pipe	112.3	60	Cir	200.0	124.09	124.59	0.250	127.90	128.30	0.80	129.10	8	Generic
10	Proposed pipe	107.6	60	Cir	35.9	124.93	125.02	0.251	129.10	129.15	1.35	130.50	9	Generic
11	rcp-int	81.86	60	Cir	180.5	125.18	125.63	0.249	130.50	130.63	0.41	131.04	10	Grate
12	rcp-int	77.90	54	Cir	99.7	125.72	125.97	0.251	131.04*	131.19*	0.19	131.38	11	Grate
13	rcp-int	77.23	54	Cir	95.6	126.22	126.46	0.251	131.38*	131.53*	0.54	132.06	12	Grate
14	rcp-int	76.13	54	Cir	175.9	126.81	127.25	0.250	132.06*	132.33*	0.18	132.51	13	Grate
15	rcp-int	62.64	48	Cir	127.3	127.54	127.86	0.251	132.51*	132.75*	0.45	133.20	14	Grate
16	rcp-int	60.35	42	Cir	205.4	128.02	128.53	0.248	133.20*	133.94*	0.61	134.55	15	Generic
17	rcp-int	23.43	42	Cir	136.7	125.30	125.64	0.249	130.50*	130.57*	0.05	130.62	10	Grate
18	rcp-int	6.40	24	Cir	46.5	126.01	126.13	0.258	130.62*	130.65*	0.03	130.69	17	Grate
19	rcp-int	5.83	24	Cir	40.4	126.25	126.35	0.248	130.69*	130.71*	0.05	130.77	18	Grate
20	rcp	22.76	42	Cir	567.5	125.60	127.02	0.250	130.50*	130.79*	0.11	130.90	10	Curb-Horiz
21	rcp-int	18.84	30	Cir	113.5	127.80	128.08	0.247	130.90*	131.14*	0.11	131.25	20	Curb-Horiz
22	rcp-int	18.42	24	Cir	68.8	128.35	128.52	0.247	131.25*	131.71*	0.53	132.24	21	Curb-Horiz

Proposed System #1 - Alt #2 | Number of lines: 22 | Run Date: 07-21-2009

NOTES: Return period = 10 Yrs. ; *Surcharged (HGL above crown).

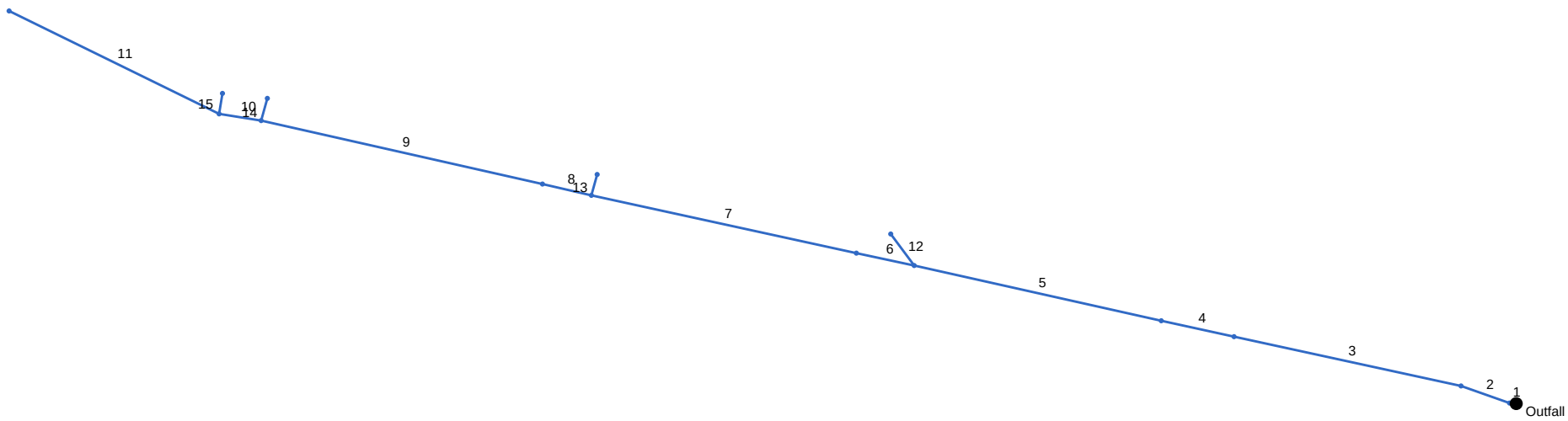
Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line		Incr	Total		Incr	Total	Inlet	Syst					Size	Slope	Dn	Up	Dn	Up	Dn	Up	
		(ft)	(ac)	(ac)	(C)			(min)	(min)	(in/hr)	(cfs)	(cfs)	(ft/s)	(in)	(%)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	
1	End	320.0	1.80	113.6	0.50	0.90	43.76	5.0	55.7	2.7	118.3	167.9	6.30	66	0.25	116.92	117.72	121.21	121.57	126.00	132.00	Proposed pipe
2	1	320.0	1.80	111.8	0.50	0.90	42.86	5.0	54.6	2.7	117.4	167.9	7.13	66	0.25	117.84	118.64	121.57	122.12	132.00	132.00	Proposed pipe
3	2	320.0	1.80	110.0	0.50	0.90	41.96	5.0	53.4	2.8	116.5	167.9	7.63	66	0.25	118.98	119.78	122.35	123.15	132.00	132.00	Proposed pipe
4	3	320.0	1.80	108.2	0.50	0.90	41.06	5.0	52.3	2.8	115.6	167.9	7.63	66	0.25	120.24	121.04	123.59	124.39	132.00	134.00	Proposed pipe
5	4	320.0	1.80	106.4	0.50	0.90	40.16	5.0	51.1	2.9	114.7	167.9	7.61	66	0.25	121.36	122.16	124.70	125.50	134.00	137.00	Proposed pipe
6	5	350.0	1.80	104.6	0.50	0.90	39.26	6.0	50.0	2.9	113.6	130.6	6.71	60	0.25	122.23	123.11	126.40	127.00	137.00	137.80	Proposed pipe(2)
7	6	215.0	1.03	102.8	0.50	0.52	38.36	5.0	49.4	2.9	112.0	130.5	7.25	60	0.25	123.30	123.84	127.00	127.48	137.80	134.60	Proposed pipe
8	7	220.0	0.00	101.7	0.00	0.00	37.84	0.0	48.7	2.9	111.4	130.2	7.01	60	0.25	123.64	124.19	127.48	127.90	134.60	132.50	Proposed pipe
9	8	200.0	3.22	101.7	0.50	1.61	37.84	9.0	48.1	3.0	112.3	130.2	7.09	60	0.25	124.09	124.59	127.90	128.30	132.50	132.30	Proposed pipe
10	9	35.9	1.48	98.50	0.50	0.74	36.23	9.0	48.0	3.0	107.6	130.4	6.18	60	0.25	124.93	125.02	129.10	129.15	132.30	131.21	Proposed pipe
11	10	180.5	2.87	80.62	0.50	1.44	27.29	8.0	47.3	3.0	81.86	130.1	4.17	60	0.25	125.18	125.63	130.50	130.63	131.21	133.10	rcp-int
12	11	99.7	0.67	77.75	0.50	0.34	25.86	5.0	46.9	3.0	77.90	98.49	4.90	54	0.25	125.72	125.97	131.04	131.19	133.10	132.76	rcp-int
13	12	95.6	1.14	77.08	0.50	0.57	25.52	6.0	46.6	3.0	77.23	98.56	4.86	54	0.25	126.22	126.46	131.38	131.53	132.76	133.64	rcp-int
14	13	175.9	9.08	75.94	0.50	4.54	24.95	9.0	46.0	3.1	76.13	98.37	4.79	54	0.25	126.81	127.25	132.06	132.33	133.64	133.50	rcp-int
15	14	127.3	1.78	66.86	0.50	0.89	20.41	7.0	45.5	3.1	62.64	72.02	4.99	48	0.25	127.54	127.86	132.51	132.75	133.50	134.79	rcp-int
16	15	205.4	65.08	65.08	0.30	19.52	19.52	45.0	45.0	3.1	60.35	50.13	6.27	42	0.25	128.02	128.53	133.20	133.94	134.79	135.59	rcp-int
17	10	136.7	5.57	7.34	0.50	2.79	3.67	9.0	9.0	6.4	23.43	50.17	2.44	42	0.25	125.30	125.64	130.50	130.57	131.21	132.01	rcp-int
18	17	46.5	0.18	1.77	0.50	0.09	0.89	5.0	5.4	7.2	6.40	11.49	2.04	24	0.26	126.01	126.13	130.62	130.65	132.01	132.28	rcp-int
19	18	40.4	1.59	1.59	0.50	0.80	0.80	5.0	5.0	7.3	5.83	11.25	1.86	24	0.25	126.25	126.35	130.69	130.71	132.28	131.98	rcp-int
20	10	567.5	1.65	9.06	0.50	0.83	4.53	7.0	17.7	5.0	22.76	50.32	2.37	42	0.25	125.60	127.02	130.50	130.79	131.21	133.62	rcp
21	20	113.5	0.20	7.41	0.50	0.10	3.71	5.0	17.2	5.1	18.84	20.37	3.84	30	0.25	127.80	128.08	130.90	131.14	133.62	136.25	rcp-int
22	21	68.8	7.21	7.21	0.50	3.61	3.61	17.0	17.0	5.1	18.42	11.24	5.86	24	0.25	128.35	128.52	131.25	131.71	136.25	133.66	rcp-int

Proposed System #1 - Alt #2 | Number of lines: 22 | Run Date: 07-21-2009

NOTES: Intensity = 103.01 / (Inlet time + 17.60) ^ 0.85; Return period = 10 Yrs. ; c = cir e = ellip b = box

Proposed System #2



Project File: Proposed System 2.stm	Number of lines: 15	Date: 07-21-2009

Storm Sewer Inventory Report

Line No.	Alignment				Flow Data				Physical Data								Line ID
	Dnstr line No.	Line length (ft)	Defl angle (deg)	Junc type	Known Q (cfs)	Drng area (ac)	Runoff coeff (C)	Inlet time (min)	Invert El Dn (ft)	Line slope (%)	Invert El Up (ft)	Line size (in)	Line shape	N value (n)	J-loss coeff (K)	Inlet/ Rim El (ft)	
1	End	10.1	-175.1	Curb	0.00	2.25	0.50	5.0	117.31	3.08	117.62	36	Cir	0.013	0.50	118.36	rcp
2	1	76.5	14.5	Curb	0.00	1.50	0.50	5.0	117.72	0.78	118.32	36	Cir	0.013	0.50	124.32	rcp
3	2	346.5	-7.1	Curb	0.00	1.46	0.50	5.0	118.37	0.61	120.48	36	Cir	0.013	0.50	129.81	rcp
4	3	111.0	0.0	Curb	0.00	0.31	0.50	5.0	120.58	0.70	121.36	36	Cir	0.013	0.50	131.60	rcp
5	4	377.7	0.3	Curb	0.00	2.01	0.50	5.0	121.36	0.52	123.34	36	Cir	0.013	1.05	129.45	rcp
6	5	88.1	-0.4	Curb	0.00	3.34	0.50	5.0	123.79	0.50	124.23	36	Cir	0.013	0.50	130.02	rcp
7	6	404.7	0.1	Grate	0.00	3.71	0.50	8.0	124.33	0.50	126.35	36	Cir	0.013	1.50	133.14	rcp
8	7	74.9	0.7	Grate	0.00	0.58	0.50	5.0	126.45	0.49	126.82	24	Cir	0.013	0.50	133.49	rcp
9	8	430.0	-0.3	Grate	0.00	0.55	0.50	5.0	126.92	0.50	129.07	24	Cir	0.013	1.50	135.97	rcp
10	9	63.3	-3.4	Grate	0.00	0.41	0.50	5.0	129.17	0.51	129.49	24	Cir	0.013	1.50	136.02	rcp
11	10	348.9	16.8	Grate	0.00	2.38	0.50	8.4	129.59	0.50	131.33	24	Cir	0.013	1.00	133.88	rcp
12	5	58.7	40.8	Curb	0.00	2.67	0.50	5.0	125.00	0.49	125.29	18	Cir	0.013	1.00	129.53	rcp
13	7	32.3	93.5	Grate	0.00	0.69	0.50	5.0	127.50	0.49	127.66	12	Cir	0.013	1.00	132.16	rcp
14	9	34.6	92.7	Grate	0.00	0.97	0.50	5.0	133.08	0.49	133.25	12	Cir	0.013	1.00	136.07	rcp
15	10	31.0	90.0	Grate	0.00	0.47	0.50	5.0	133.35	0.52	133.51	12	Cir	0.013	1.00	136.27	rcp

Proposed System #2 | Number of lines: 15 | Date: 07-21-2009

Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line size (in)	Line shape	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line slope (%)	HGL down (ft)	HGL up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns line No.	Junction Type
1	rcp	59.19	36	Cir	10.1	117.31	117.62	3.085	119.76	120.07	0.71	120.07	End	Curb-Horiz
2	rcp	53.71	36	Cir	76.5	117.72	118.32	0.785	120.07	120.66	n/a	120.66	1	Curb-Horiz
3	rcp	50.95	36	Cir	346.5	118.37	120.48	0.609	120.77	122.89	0.55	123.43	2	Curb-Horiz
4	rcp	47.50	36	Cir	111.0	120.58	121.36	0.703	123.43	123.73	0.49	124.22	3	Curb-Horiz
5	rcp	47.85	36	Cir	377.7	121.36	123.34	0.524	124.22	125.85	0.94	126.79	4	Curb-Horiz
6	rcp	35.53	36	Cir	88.1	123.79	124.23	0.499	126.79	126.98	0.21	127.19	5	Curb-Horiz
7	rcp	27.75	36	Cir	404.7	124.33	126.35	0.499	127.19	128.03	n/a	128.03 j	6	Grate
8	rcp	15.35	24	Cir	74.9	126.45	126.82	0.494	128.03	128.40	0.26	128.66	7	Grate
9	rcp	14.32	24	Cir	430.0	126.92	129.07	0.500	128.66	130.47	0.87	131.34	8	Grate
10	rcp	9.86	24	Cir	63.3	129.17	129.49	0.506	131.34	131.45	0.23	131.68	9	Grate
11	rcp	7.75	24	Cir	348.9	129.59	131.33	0.499	131.68	132.37	0.35	132.71	10	Grate
12	rcp	9.79	18	Cir	58.7	125.00	125.29	0.494	126.79*	127.30*	0.48	127.77	5	Curb-Horiz
13	rcp	2.53	12	Cir	32.3	127.50	127.66	0.495	128.33	128.49	0.21	128.69	7	Grate
14	rcp	3.56	12	Cir	34.6	133.08	133.25	0.491	134.08*	134.43*	0.32	134.74	9	Grate
15	rcp	1.72	12	Cir	31.0	133.35	133.51	0.516	133.95	134.11	0.19	134.30	10	Grate

Proposed System #2 | Number of lines: 15 | Run Date: 07-21-2009

NOTES: Return period = 10 Yrs. ; *Surcharged (HGL above crown). ; j - Line contains hyd. jump.

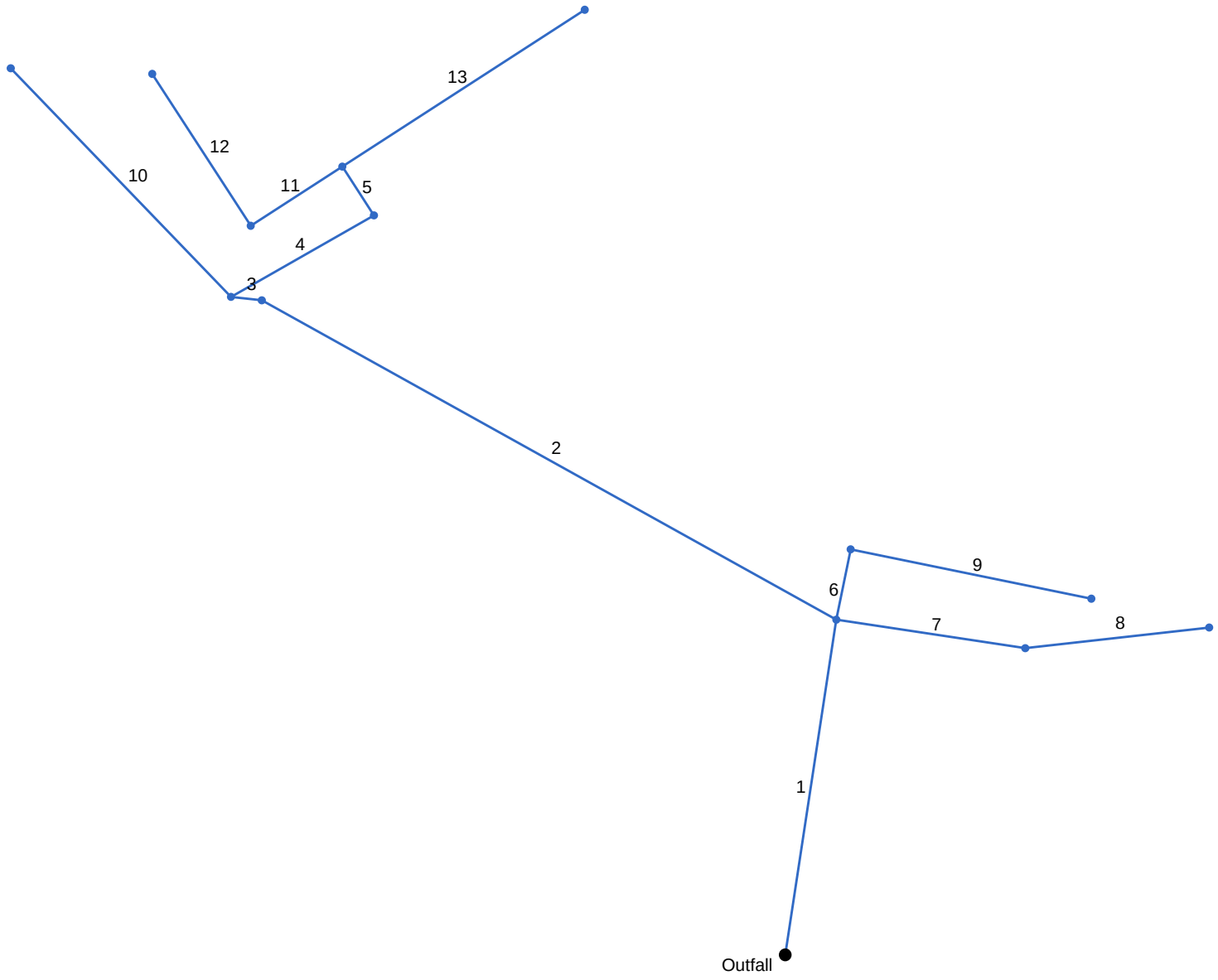
Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line		Incr	Total		Incr	Total	Inlet	Syst					Size	Slope	Dn	Up	Dn	Up	Dn	Up	
		(ft)	(ac)	(ac)	(C)			(min)	(min)	(in/hr)	(cfs)	(cfs)	(ft/s)	(in)	(%)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	
1	End	10.1	2.25	23.30	0.50	1.13	11.65	5.0	17.2	5.1	59.19	117.1	9.57	36	3.08	117.31	117.62	119.76	120.07	118.36	118.36	rcp
2	1	76.5	1.50	21.05	0.50	0.75	10.53	5.0	17.0	5.1	53.71	59.08	9.06	36	0.78	117.72	118.32	120.07	120.66	118.36	124.32	rcp
3	2	346.5	1.46	19.55	0.50	0.73	9.78	5.0	16.2	5.2	50.95	52.05	8.39	36	0.61	118.37	120.48	120.77	122.89	124.32	129.81	rcp
4	3	111.0	0.31	18.09	0.50	0.16	9.04	5.0	15.9	5.3	47.50	55.91	7.39	36	0.70	120.58	121.36	123.43	123.73	129.81	131.60	rcp
5	4	377.7	2.01	17.78	0.50	1.01	8.89	5.0	14.9	5.4	47.85	48.29	7.24	36	0.52	121.36	123.34	124.22	125.85	131.60	129.45	rcp
6	5	88.1	3.34	13.10	0.50	1.67	6.55	5.0	14.6	5.4	35.53	47.14	5.13	36	0.50	123.79	124.23	126.79	126.98	129.45	130.02	rcp
7	6	404.7	3.71	9.76	0.50	1.86	4.88	8.0	12.9	5.7	27.75	47.12	5.40	36	0.50	124.33	126.35	127.19	128.03	130.02	133.14	rcp
8	7	74.9	0.58	5.36	0.50	0.29	2.68	5.0	12.6	5.7	15.35	15.89	5.77	24	0.49	126.45	126.82	128.03	128.40	133.14	133.49	rcp
9	8	430.0	0.55	4.78	0.50	0.28	2.39	5.0	11.1	6.0	14.32	15.99	5.52	24	0.50	126.92	129.07	128.66	130.47	133.49	135.97	rcp
10	9	63.3	0.41	3.26	0.50	0.21	1.63	5.0	10.7	6.0	9.86	16.09	3.15	24	0.51	129.17	129.49	131.34	131.45	135.97	136.02	rcp
11	10	348.9	2.38	2.38	0.50	1.19	1.19	8.4	8.4	6.5	7.75	15.97	3.59	24	0.50	129.59	131.33	131.68	132.37	136.02	133.88	rcp
12	5	58.7	2.67	2.67	0.50	1.34	1.34	5.0	5.0	7.3	9.79	7.38	5.54	18	0.49	125.00	125.29	126.79	127.30	129.45	129.53	rcp
13	7	32.3	0.69	0.69	0.50	0.35	0.35	5.0	5.0	7.3	2.53	2.51	3.64	12	0.49	127.50	127.66	128.33	128.49	133.14	132.16	rcp
14	9	34.6	0.97	0.97	0.50	0.49	0.49	5.0	5.0	7.3	3.56	2.50	4.53	12	0.49	133.08	133.25	134.08	134.43	135.97	136.07	rcp
15	10	31.0	0.47	0.47	0.50	0.24	0.24	5.0	5.0	7.3	1.72	2.56	3.49	12	0.52	133.35	133.51	133.95	134.11	136.02	136.27	rcp

Proposed System #2 | Number of lines: 15 | Run Date: 07-21-2009

NOTES: Intensity = 103.01 / (Inlet time + 17.60) ^ 0.85; Return period = 10 Yrs. ; c = cir e = ellip b = box

Proposed System #3



Project File: Proposed System 3.stm	Number of lines: 13	Date: 07-21-2009

Storm Sewer Inventory Report

Line No.	Alignment				Flow Data				Physical Data								Line ID
	Dnstr line No.	Line length (ft)	Defl angle (deg)	Junc type	Known Q (cfs)	Drng area (ac)	Runoff coeff (C)	Inlet time (min)	Invert El Dn (ft)	Line slope (%)	Invert El Up (ft)	Line size (in)	Line shape	N value (n)	J-loss coeff (K)	Inlet/ Rim El (ft)	
1	End	236.1	-81.4	Grate	0.00	1.37	0.50	5.0	122.00	0.50	123.18	36	Cir	0.013	1.50	128.89	rcp
2	1	457.4	-69.5	MH	0.00	0.00	0.50	5.0	123.40	0.50	125.69	36	Cir	0.013	0.45	131.62	rcp
3	2	21.7	-23.0	Grate	0.00	0.85	0.50	5.0	125.90	0.51	126.01	36	Cir	0.013	1.56	132.02	rcp
4	3	114.7	144.2	Grate	0.00	1.37	0.50	5.0	126.21	0.50	126.78	36	Cir	0.013	1.50	131.80	rcp
5	4	40.5	-93.2	MH	0.00	0.00	0.00	0.0	127.00	0.49	127.20	30	Cir	0.013	1.00	131.90	rcp
6	1	50.0	3.0	Grate	0.00	2.95	0.50	5.0	124.00	0.40	124.20	36	Cir	0.013	1.50	129.65	rco
7	1	133.0	90.0	MH	0.00	0.00	0.00	0.0	123.38	0.50	124.05	18	Cir	0.013	0.31	128.00	proposed rcp
8	7	129.0	-15.0	Grate	0.00	0.51	0.50	5.0	123.73	0.50	124.38	18	Cir	0.013	1.00	128.00	proposed rcp
9	6	171.0	90.0	Grate	0.00	0.98	0.50	5.0	124.40	0.50	125.26	18	Cir	0.013	1.00	128.00	proposed rcp
10	3	221.0	40.0	Grate	0.00	0.32	0.50	5.0	126.21	0.50	127.32	18	Cir	0.013	1.00	132.50	proposed rcp
11	5	76.0	-90.0	Grate	0.00	1.87	0.50	5.0	127.40	0.50	127.78	30	Cir	0.013	1.50	132.00	proposed rcp
12	11	126.0	90.0	Grate	0.00	3.52	0.50	9.0	127.85	0.50	128.48	24	Cir	0.013	1.00	132.50	proposed rcp
13	5	201.0	90.0	Grate	0.00	1.95	0.50	5.0	127.40	0.50	128.41	18	Cir	0.013	1.00	132.00	proposed rcp

Proposed System #3 | Number of lines: 13 | Date: 07-21-2009

Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line size (in)	Line shape	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line slope (%)	HGL down (ft)	HGL up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns line No.	Junction Type
1	rcp	44.38	36	Cir	236.1	122.00	123.18	0.500	124.31	125.49	1.34	126.84	End	Grate
2	rcp	29.68	36	Cir	457.4	123.40	125.69	0.501	126.84	127.74	0.23	127.97	1	Manhole
3	rcp	29.77	36	Cir	21.7	125.90	126.01	0.508	127.97	127.97	0.89	128.87	2	Grate
4	rcp	26.71	36	Cir	114.7	126.21	126.78	0.497	128.87	128.96	0.55	129.51	3	Grate
5	rcp	22.63	30	Cir	40.5	127.00	127.20	0.493	129.51	129.62	0.34	129.95	4	Manhole
6	rco	13.89	36	Cir	50.0	124.00	124.20	0.400	126.84	126.85	0.10	126.95	1	Grate
7	proposed rcp	1.76	18	Cir	133.0	123.38	124.05	0.504	126.84*	126.87*	0.00	126.88	1	Manhole
8	proposed rcp	1.91	18	Cir	129.0	123.73	124.38	0.504	126.88*	126.92*	0.02	126.94	7	Grate
9	proposed rcp	3.67	18	Cir	171.0	124.40	125.26	0.503	126.95*	127.16*	0.07	127.23	6	Grate
10	proposed rcp	1.20	18	Cir	221.0	126.21	127.32	0.502	128.87*	128.90*	0.01	128.90	3	Grate
11	proposed rcp	16.83	30	Cir	76.0	127.40	127.78	0.500	129.95	130.06	0.30	130.36	5	Grate
12	proposed rcp	11.23	24	Cir	126.0	127.85	128.48	0.500	130.36*	130.67*	0.20	130.87	11	Grate
13	proposed rcp	7.31	18	Cir	201.0	127.40	128.41	0.502	129.95*	130.93*	0.27	131.19	5	Grate

Proposed System #3 | Number of lines: 13 | Run Date: 07-21-2009

NOTES: Return period = 10 Yrs. ; *Surcharged (HGL above crown).

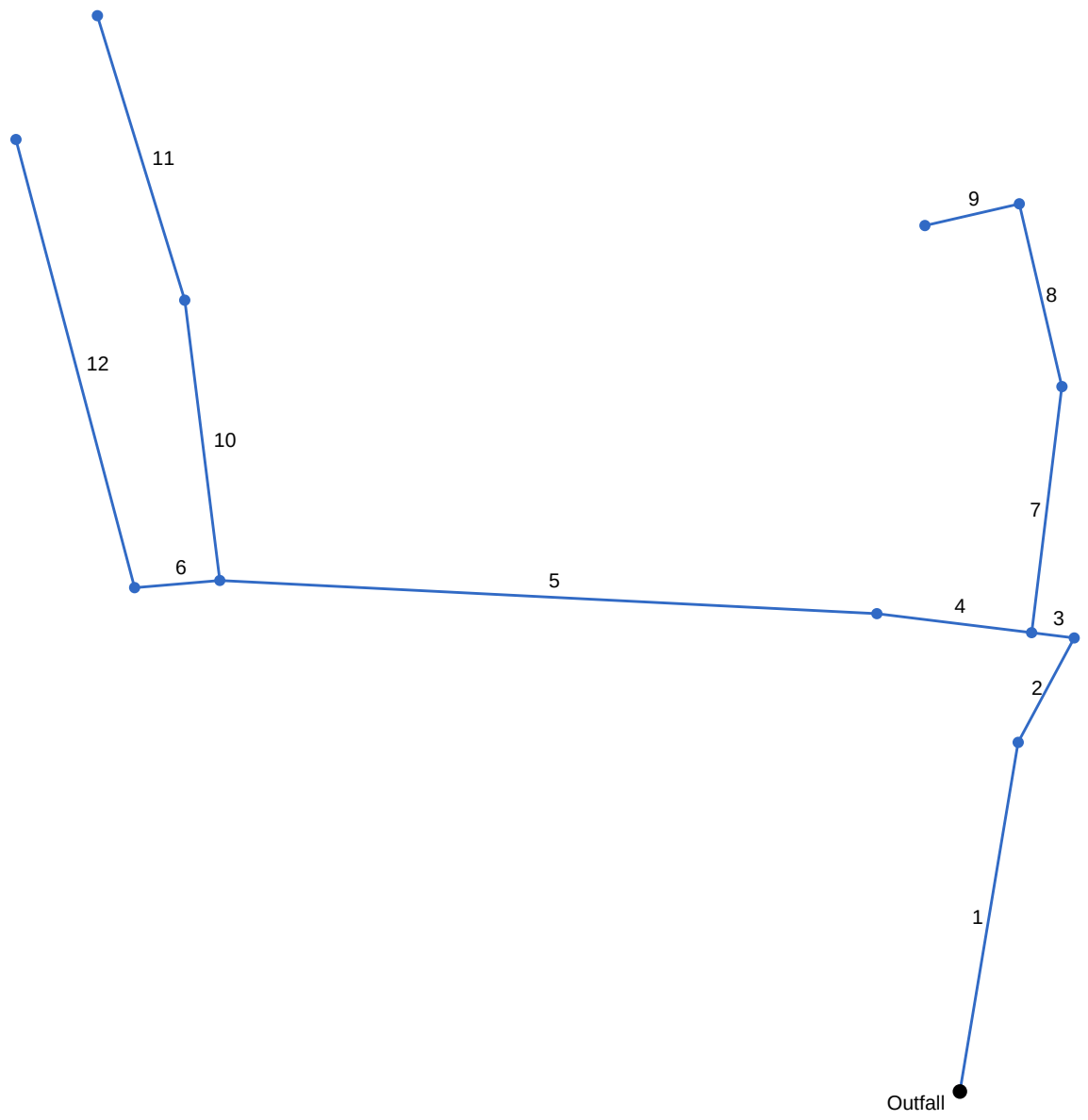
Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line		Incr	Total		Incr	Total	Inlet	Syst					Size	Slope	Dn	Up	Dn	Up	Dn	Up	
		(ft)	(ac)	(ac)	(C)			(min)	(min)	(in/hr)	(cfs)	(cfs)	(ft/s)	(in)	(%)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	
1	End	236.1	1.37	15.69	0.50	0.69	7.85	5.0	12.5	5.7	44.38	47.15	7.59	36	0.50	122.00	123.18	124.31	125.49	127.51	128.89	rcp
2	1	457.4	0.00	9.88	0.50	0.00	4.94	5.0	10.7	6.0	29.68	47.19	4.99	36	0.50	123.40	125.69	126.84	127.74	128.89	131.62	rcp
3	2	21.7	0.85	9.88	0.50	0.43	4.94	5.0	10.6	6.0	29.77	47.54	5.89	36	0.51	125.90	126.01	127.97	127.97	131.62	132.02	rcp
4	3	114.7	1.37	8.71	0.50	0.69	4.36	5.0	10.1	6.1	26.71	47.03	4.45	36	0.50	126.21	126.78	128.87	128.96	132.02	131.80	rcp
5	4	40.5	0.00	7.34	0.00	0.00	3.67	0.0	10.0	6.2	22.63	28.81	4.63	30	0.49	127.00	127.20	129.51	129.62	131.80	131.90	rcp
6	1	50.0	2.95	3.93	0.50	1.48	1.97	5.0	6.4	7.1	13.89	42.18	2.06	36	0.40	124.00	124.20	126.84	126.85	128.89	129.65	rco
7	1	133.0	0.00	0.51	0.00	0.00	0.26	0.0	7.0	6.9	1.76	7.45	0.99	18	0.50	123.38	124.05	126.84	126.87	128.89	128.00	proposed rcp
8	7	129.0	0.51	0.51	0.50	0.26	0.26	5.0	5.0	7.5	1.91	7.45	1.08	18	0.50	123.73	124.38	126.88	126.92	128.00	128.00	proposed rcp
9	6	171.0	0.98	0.98	0.50	0.49	0.49	5.0	5.0	7.5	3.67	7.45	2.08	18	0.50	124.40	125.26	126.95	127.16	129.65	128.00	proposed rcp
10	3	221.0	0.32	0.32	0.50	0.16	0.16	5.0	5.0	7.5	1.20	7.44	0.68	18	0.50	126.21	127.32	128.87	128.90	132.02	132.50	proposed rcp
11	5	76.0	1.87	5.39	0.50	0.94	2.70	5.0	9.6	6.2	16.83	29.00	3.51	30	0.50	127.40	127.78	129.95	130.06	131.90	132.00	proposed rcp
12	11	126.0	3.52	3.52	0.50	1.76	1.76	9.0	9.0	6.4	11.23	15.99	3.57	24	0.50	127.85	128.48	130.36	130.67	132.00	132.50	proposed rcp
13	5	201.0	1.95	1.95	0.50	0.98	0.98	5.0	5.0	7.5	7.31	7.44	4.14	18	0.50	127.40	128.41	129.95	130.93	131.90	132.00	proposed rcp

Proposed System #3 | Number of lines: 13 | Run Date: 07-21-2009

NOTES: Intensity = 82.60 / (Inlet time + 13.50) ^ 0.82; Return period = 10 Yrs. ; c = cir e = ellip b = box

Proposed System #4



Project File: Proposed System 4.stm	Number of lines: 12	Date: 07-21-2009

Storm Sewer Inventory Report

Line No.	Alignment				Flow Data				Physical Data								Line ID
	Dnstr line No.	Line length (ft)	Defl angle (deg)	Junc type	Known Q (cfs)	Drng area (ac)	Runoff coeff (C)	Inlet time (min)	Invert El Dn (ft)	Line slope (%)	Invert El Up (ft)	Line size (in)	Line shape	N value (n)	J-loss coeff (K)	Inlet/ Rim El (ft)	
1	End	164.1	-80.5	Grate	0.00	1.06	0.50	5.0	117.68	0.58	118.64	36	Cir	0.013	0.56	124.91	rcp
2	1	55.0	18.7	Grate	0.00	2.75	0.50	10.0	119.33	0.49	119.60	36	Cir	0.013	1.50	125.92	rcp
3	2	20.0	-111.2	MH	0.00	0.00	0.00	0.0	119.80	0.75	119.95	36	Cir	0.013	1.00	124.90	Prop 36
4	3	72.1	0.0	Grate	0.00	1.87	0.50	6.0	120.05	0.43	120.36	36	Cir	0.013	0.50	124.71	rcp
5	4	305.0	-4.1	Grate	0.00	0.60	0.50	5.0	120.46	0.50	121.98	36	Cir	0.035	1.48	127.52	open channel
6	5	39.6	-7.7	Grate	0.00	0.81	0.50	5.0	122.08	0.63	122.33	24	Cir	0.013	1.48	127.09	culvert
7	3	115.0	90.0	MH	0.00	0.00	0.00	0.0	120.15	0.22	120.40	30	Cir	0.035	0.40	127.50	Prop 30
8	7	87.0	-20.0	Grate	0.00	2.83	0.50	8.0	120.50	0.29	120.75	30	Cir	0.035	1.50	128.50	Prop 30
9	8	45.0	-90.0	Grate	0.00	1.91	0.50	7.0	120.95	0.56	121.20	24	Cir	0.035	1.00	128.50	Prop 24
10	5	131.0	80.0	MH	0.00	0.00	0.00	0.0	122.18	0.19	122.43	24	Cir	0.035	0.21	129.00	Prop 24
11	10	138.0	-10.0	Grate	0.00	0.91	0.50	5.0	122.53	0.18	122.78	24	Cir	0.035	1.00	131.00	Prop 24
12	6	215.0	80.0	Grate	0.00	1.09	0.50	5.0	122.53	0.12	122.78	24	Cir	0.035	1.00	131.00	Prop 24

Proposed System #4 | Number of lines: 12 | Date: 07-21-2009

Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line size (in)	Line shape	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line slope (%)	HGL down (ft)	HGL up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns line No.	Junction Type
1	rcp	37.91	36	Cir	164.1	117.68	118.64	0.585	119.69	120.60	n/a	120.60	End	Grate
2	rcp	35.18	36	Cir	55.0	119.33	119.60	0.491	121.27	121.54	1.23	122.77	1	Grate
3	Prop 36	27.66	36	Cir	20.0	119.80	119.95	0.750	122.77	122.80	0.25	123.04	2	Manhole
4	rcp	14.79	36	Cir	72.1	120.05	120.36	0.430	123.04	123.07	0.04	123.11	3	Grate
5	open channel	10.53	36	Cir	305.0	120.46	121.98	0.498	123.11	123.85	0.12	123.97	4	Grate
6	culvert	6.17	24	Cir	39.6	122.08	122.33	0.631	123.97	123.98	0.11	124.10	5	Grate
7	Prop 30	15.07	30	Cir	115.0	120.15	120.40	0.217	123.04*	124.17*	0.06	124.23	3	Manhole
8	Prop 30	15.32	30	Cir	87.0	120.50	120.75	0.287	124.23*	125.11*	0.23	125.34	7	Grate
9	Prop 24	6.40	24	Cir	45.0	120.95	121.20	0.556	125.34*	125.60*	0.06	125.66	8	Grate
10	Prop 24	3.03	24	Cir	131.0	122.18	122.43	0.191	123.97	124.12	0.00	124.13	5	Manhole
11	Prop 24	3.29	24	Cir	138.0	122.53	122.78	0.181	124.13	124.35	0.02	124.38	10	Grate
12	Prop 24	3.94	24	Cir	215.0	122.53	122.78	0.116	124.53*	125.00*	0.02	125.03	6	Grate

Proposed System #4 | Number of lines: 12 | Run Date: 07-21-2009

NOTES: Return period = 10 Yrs. ; *Surcharged (HGL above crown).

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line		Incr	Total		Incr	Total	Inlet	Syst					Size	Slope	Dn	Up	Dn	Up	Dn	Up	
		(ft)	(ac)	(ac)	(C)			(min)	(min)	(in/hr)	(cfs)	(cfs)	(ft/s)	(in)	(%)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	
1	End	164.1	1.06	13.83	0.50	0.53	6.92	5.0	13.2	5.5	37.91	51.01	7.63	36	0.58	117.68	118.64	119.69	120.60	121.50	124.91	rcp
2	1	55.0	2.75	12.77	0.50	1.38	6.39	10.0	13.0	5.5	35.18	46.74	7.27	36	0.49	119.33	119.60	121.27	121.54	124.91	125.92	rcp
3	2	20.0	0.00	10.02	0.00	0.00	5.01	0.0	12.9	5.5	27.66	57.76	3.96	36	0.75	119.80	119.95	122.77	122.80	125.92	124.90	Prop 36
4	3	72.1	1.87	5.28	0.50	0.94	2.64	6.0	12.4	5.6	14.79	43.72	2.15	36	0.43	120.05	120.36	123.04	123.07	124.90	124.71	rcp
5	4	305.0	0.60	3.41	0.50	0.30	1.71	5.0	9.3	6.2	10.53	17.49	1.93	36	0.50	120.46	121.98	123.11	123.85	124.71	127.52	open channel
6	5	39.6	0.81	1.90	0.50	0.41	0.95	5.0	7.9	6.5	6.17	17.97	2.12	24	0.63	122.08	122.33	123.97	123.98	127.52	127.09	culvert
7	3	115.0	0.00	4.74	0.00	0.00	2.37	0.0	8.5	6.4	15.07	7.10	3.07	30	0.22	120.15	120.40	123.04	124.17	124.90	127.50	Prop 30
8	7	87.0	2.83	4.74	0.50	1.42	2.37	8.0	8.0	6.5	15.32	8.17	3.12	30	0.29	120.50	120.75	124.23	125.11	127.50	128.50	Prop 30
9	8	45.0	1.91	1.91	0.50	0.96	0.96	7.0	7.0	6.7	6.40	6.26	2.04	24	0.56	120.95	121.20	125.34	125.60	128.50	128.50	Prop 24
10	5	131.0	0.00	0.91	0.00	0.00	0.46	0.0	7.2	6.7	3.03	3.67	1.04	24	0.19	122.18	122.43	123.97	124.12	127.52	129.00	Prop 24
11	10	138.0	0.91	0.91	0.50	0.46	0.46	5.0	5.0	7.2	3.29	3.58	1.23	24	0.18	122.53	122.78	124.13	124.35	129.00	131.00	Prop 24
12	6	215.0	1.09	1.09	0.50	0.55	0.55	5.0	5.0	7.2	3.94	2.86	1.26	24	0.12	122.53	122.78	124.53	125.00	127.09	131.00	Prop 24

Proposed System #4 | Number of lines: 12 | Run Date: 07-21-2009

NOTES: Intensity = 88.24 / (Inlet time + 15.50) ^ 0.83; Return period = 10 Yrs. ; c = cir e = ellip b = box

PROPOSED DETENTION AREAS

Hydrograph Report

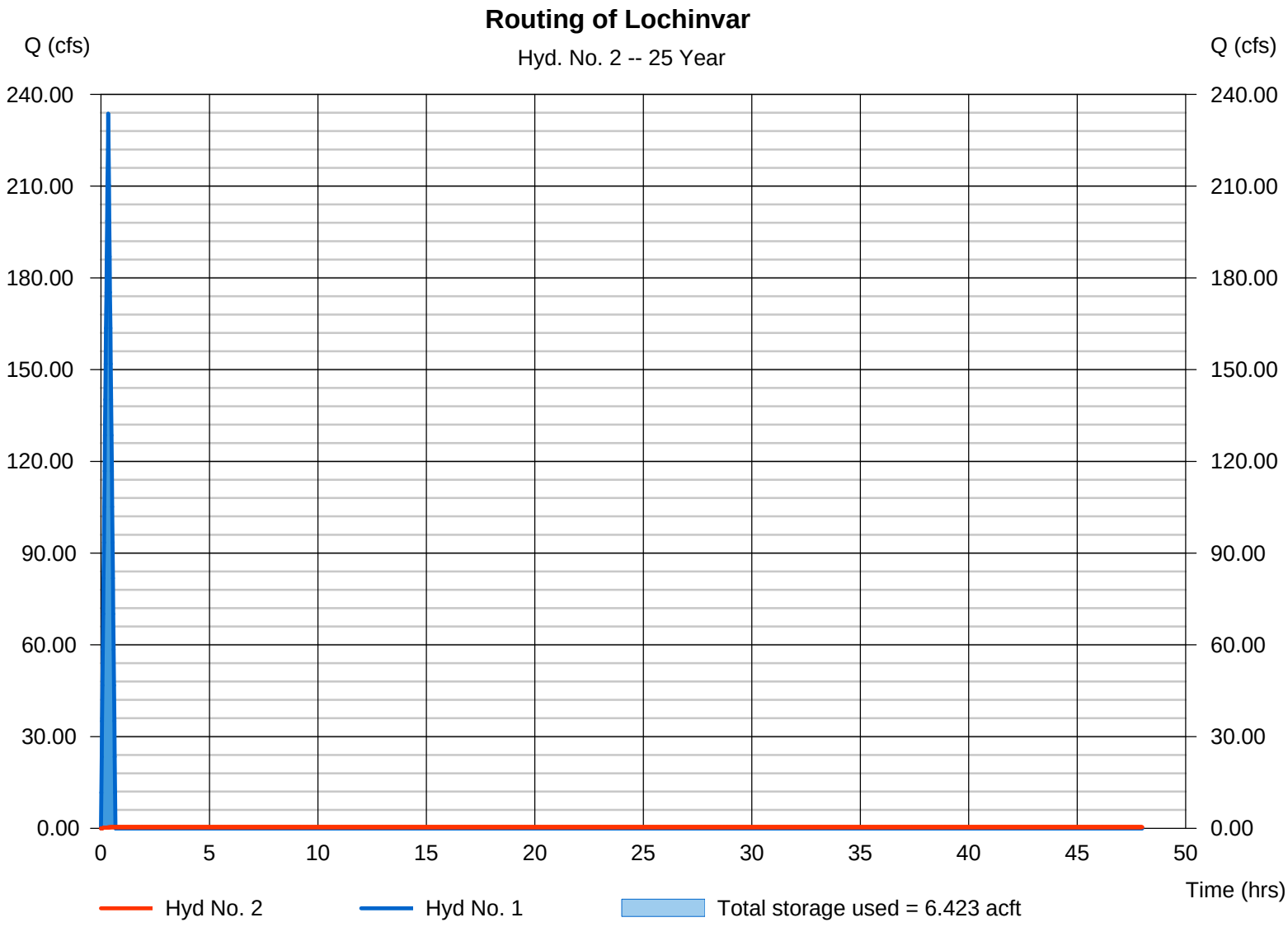
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2008 by Autodesk, Inc. v6.052 Tuesday, Jul 21, 2009

Hyd. No. 2

Routing of Lochinvar

Hydrograph type	=	Reservoir	Peak discharge	=	0.383 cfs
Storm frequency	=	25 yrs	Time to peak	=	40 min
Time interval	=	1 min	Hyd. volume	=	1.451 acft
Inflow hyd. No.	=	1 - Upstream Basin	Max. Elevation	=	134.96 ft
Reservoir name	=	Lochinvar	Max. Storage	=	6.423 acft

Storage Indication method used.



Hydrograph Report

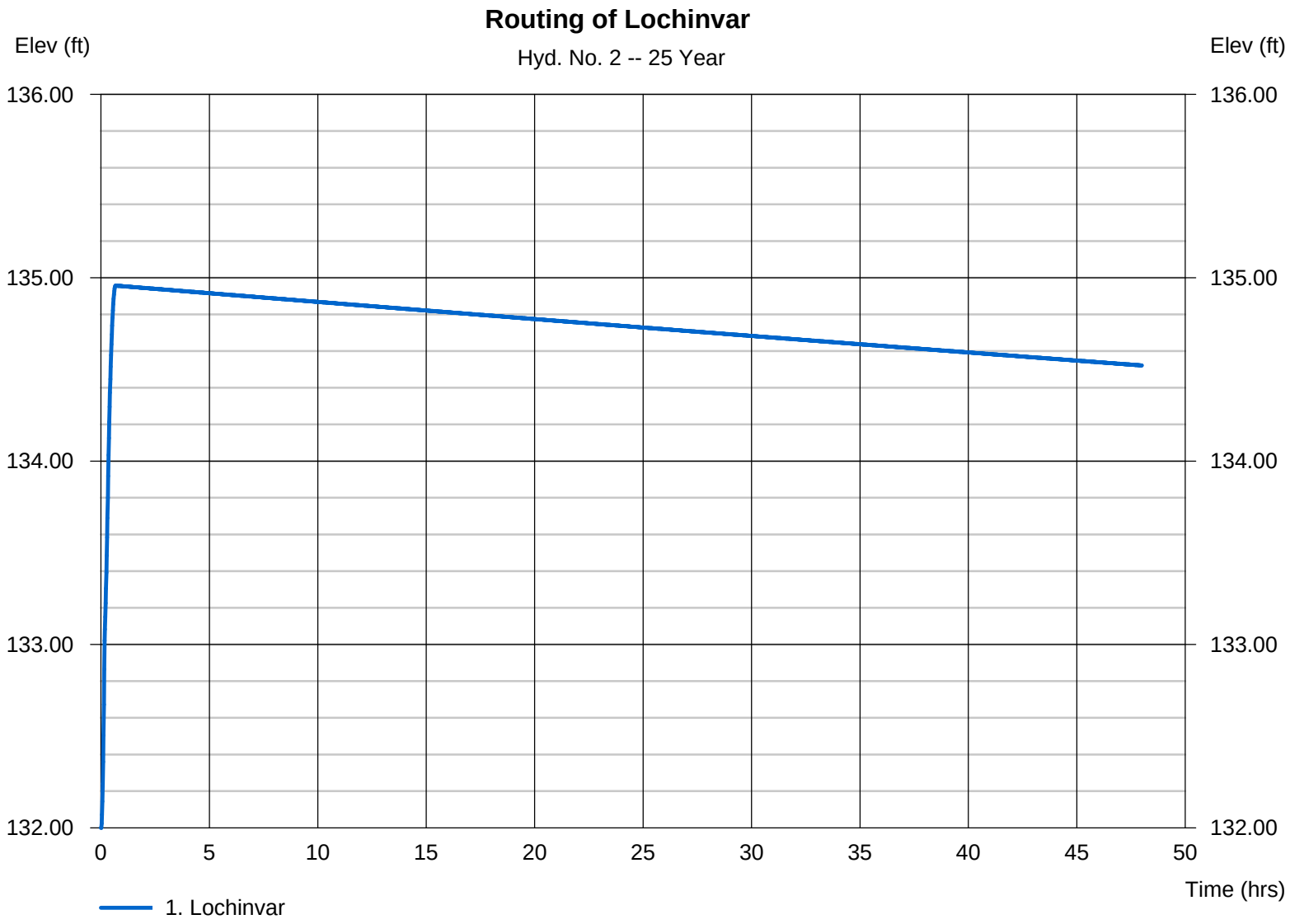
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2008 by Autodesk, Inc. v6.052 Tuesday, Jul 21, 2009

Hyd. No. 2

Routing of Lochinvar

Hydrograph type	=	Reservoir	Peak discharge	=	0.383 cfs
Storm frequency	=	25 yrs	Time to peak	=	40 min
Time interval	=	1 min	Hyd. volume	=	1.451 acft
Inflow hyd. No.	=	1 - Upstream Basin	Max. Elevation	=	134.96 ft
Reservoir name	=	Lochinvar	Max. Storage	=	6.423 acft

Storage Indication method used.



Hydrograph Report

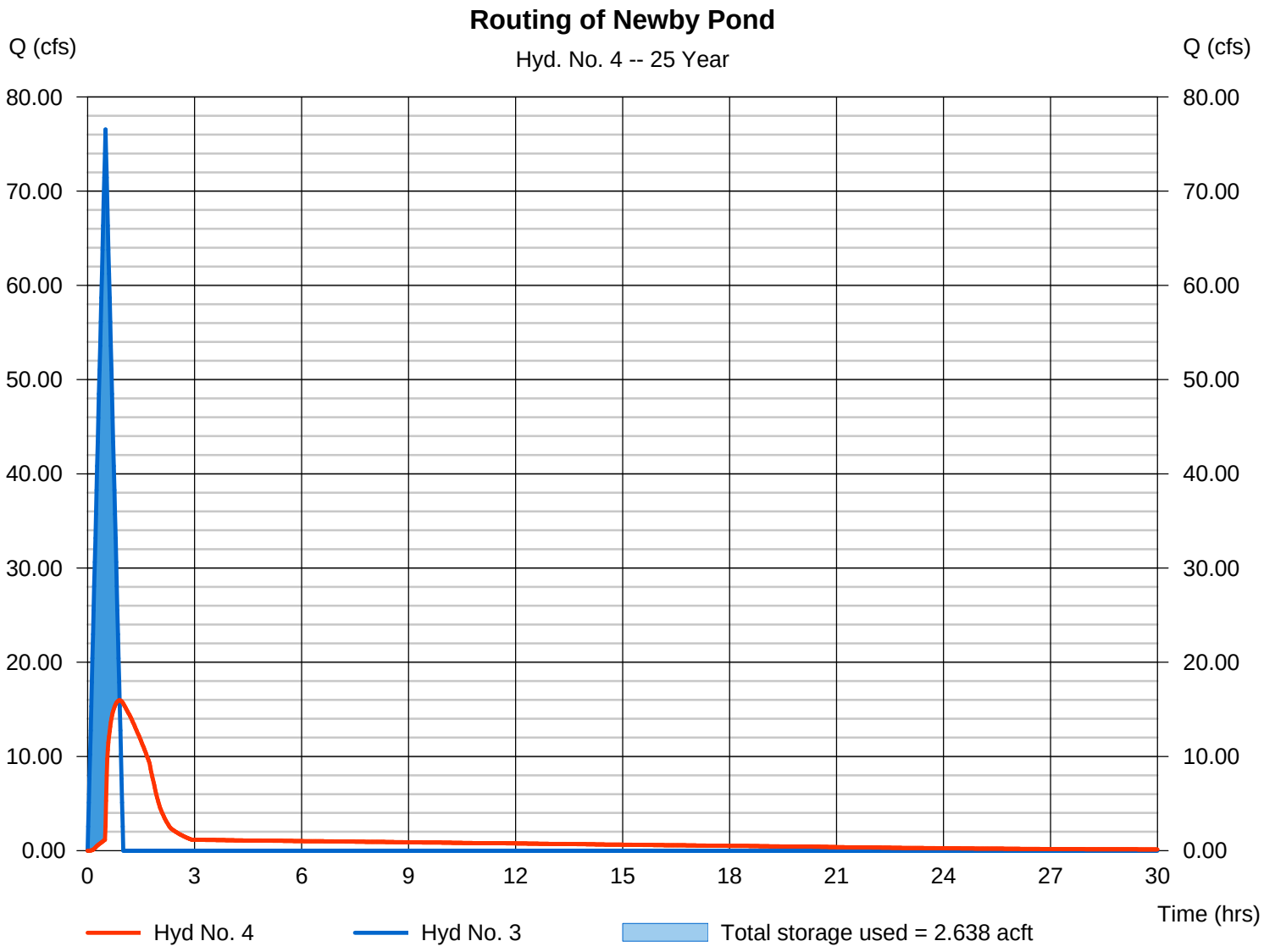
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2008 by Autodesk, Inc. v6.052 Tuesday, Jul 21, 2009

Hyd. No. 4

Routing of Newby Pond

Hydrograph type	=	Reservoir	Peak discharge	=	15.96 cfs
Storm frequency	=	25 yrs	Time to peak	=	54 min
Time interval	=	1 min	Hyd. volume	=	3.089 acft
Inflow hyd. No.	=	3 - upper area	Max. Elevation	=	132.37 ft
Reservoir name	=	Newby	Max. Storage	=	2.638 acft

Storage Indication method used.



Hydrograph Report

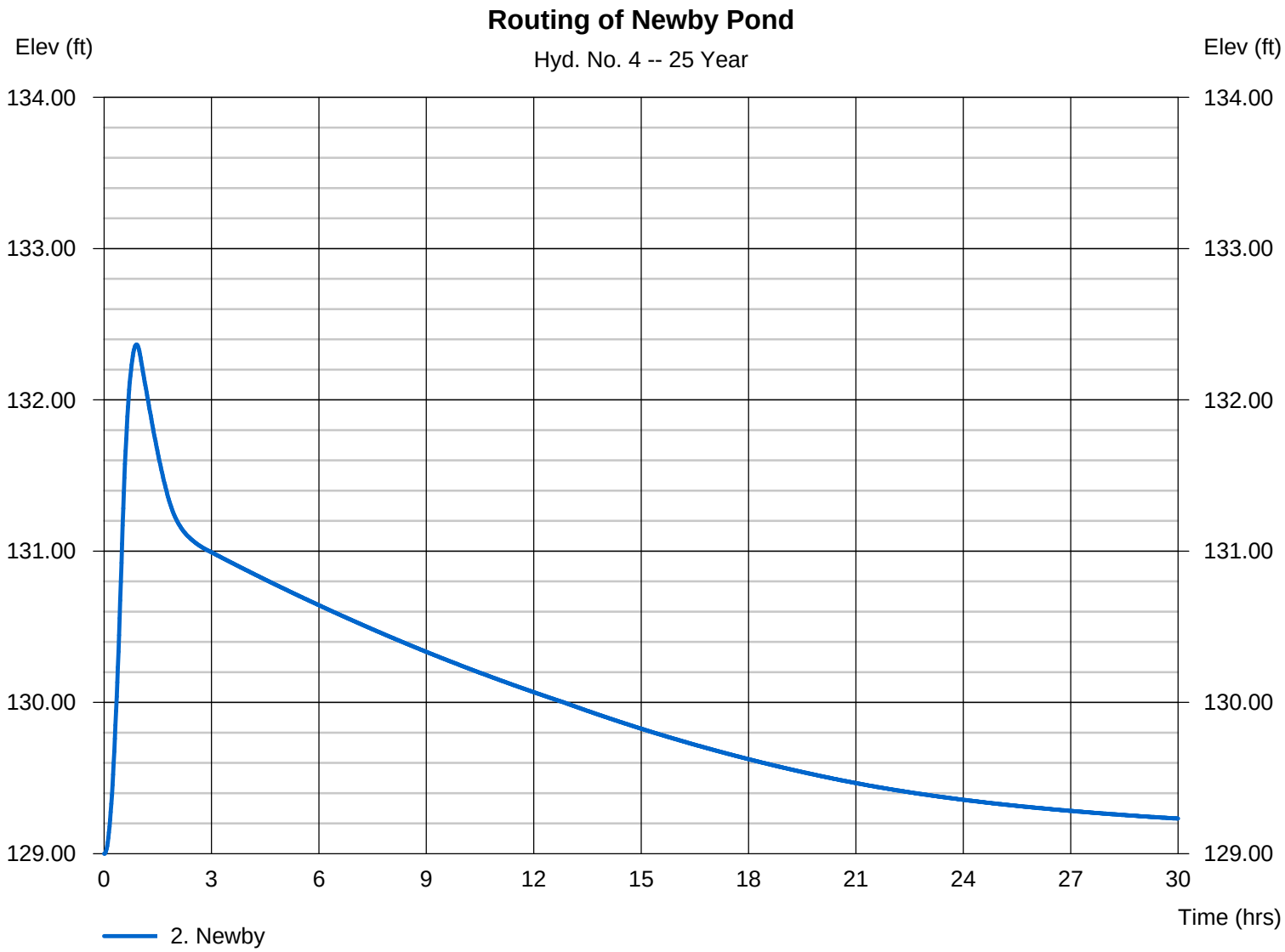
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2008 by Autodesk, Inc. v6.052 Tuesday, Jul 21, 2009

Hyd. No. 4

Routing of Newby Pond

Hydrograph type	=	Reservoir	Peak discharge	=	15.96 cfs
Storm frequency	=	25 yrs	Time to peak	=	54 min
Time interval	=	1 min	Hyd. volume	=	3.089 acft
Inflow hyd. No.	=	3 - upper area	Max. Elevation	=	132.37 ft
Reservoir name	=	Newby	Max. Storage	=	2.638 acft

Storage Indication method used.



Hydrograph Report

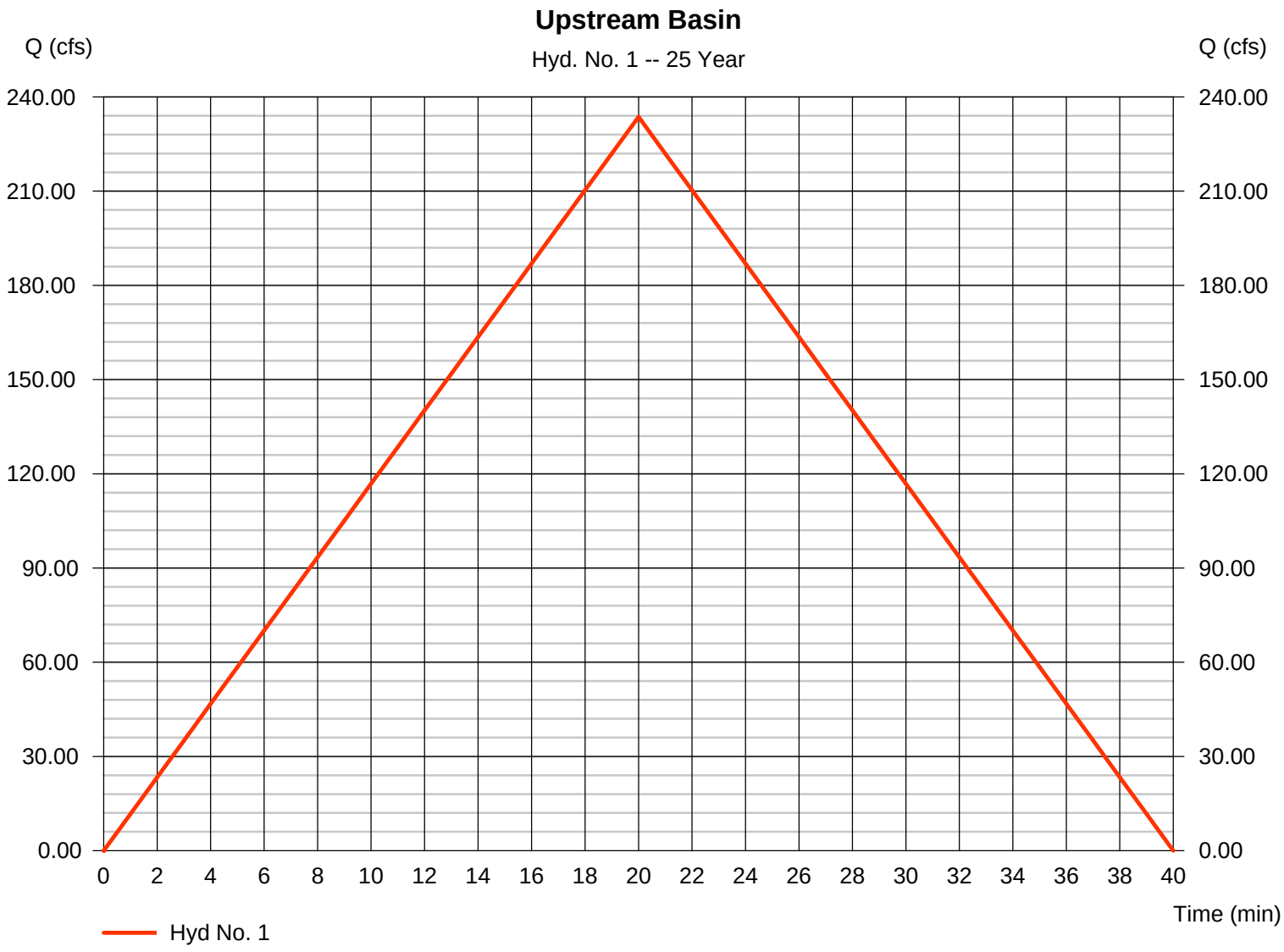
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2008 by Autodesk, Inc. v6.052 Tuesday, Jul 21, 2009

Hyd. No. 1

Upstream Basin

Hydrograph type	=	Rational	Peak discharge	=	233.68 cfs
Storm frequency	=	25 yrs	Time to peak	=	20 min
Time interval	=	1 min	Hyd. volume	=	6.437 acft
Drainage area	=	67.970 ac	Runoff coeff.	=	0.65*
Intensity	=	5.289 in/hr	Tc by User	=	20.00 min
IDF Curve	=	Rocky Mount.IDF	Asc/Rec limb fact	=	1/1

* Composite (Area/C) = [(41.000 x 0.25) + (30.500 x 0.50)] / 67.970



Hydrograph Report

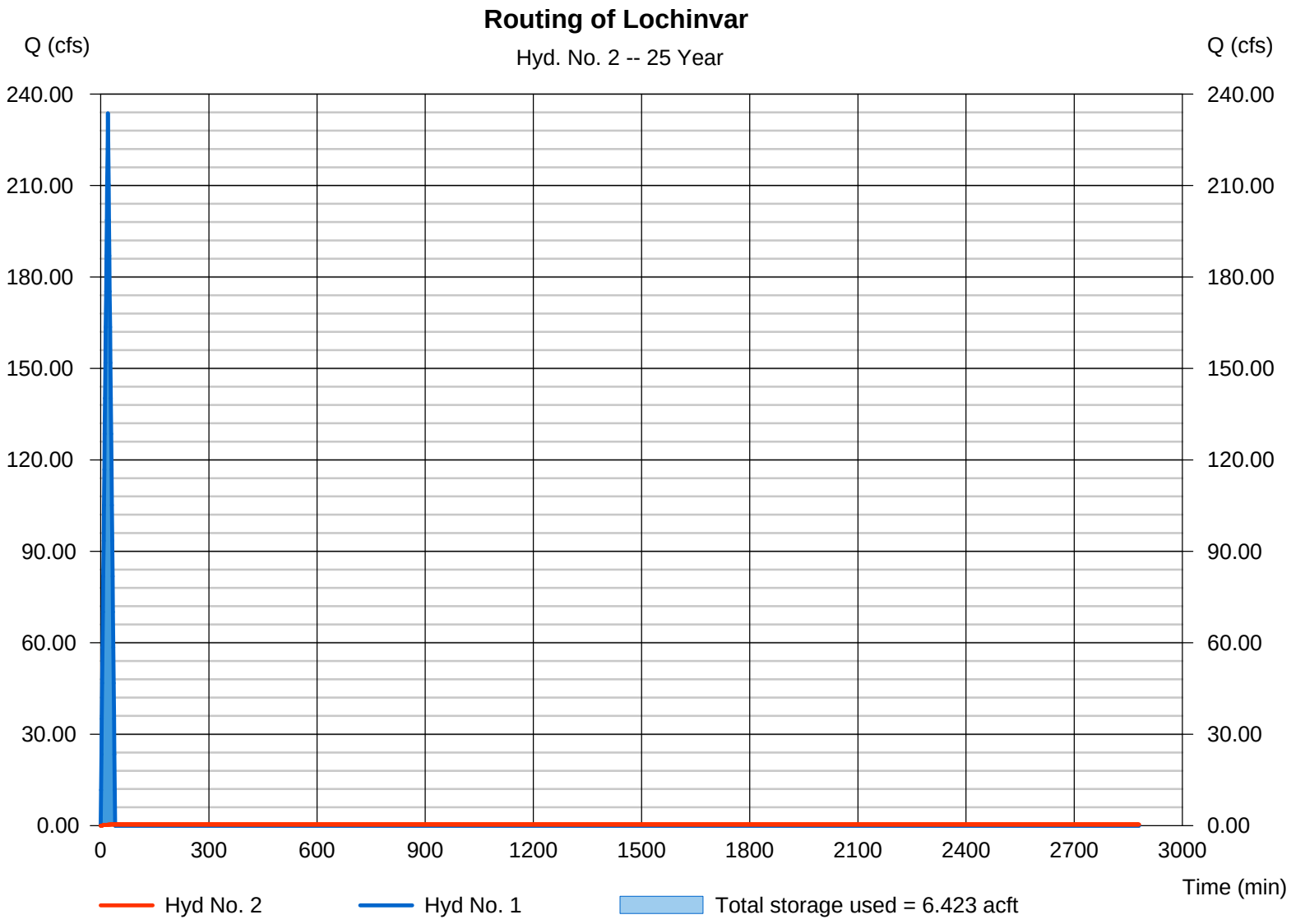
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2008 by Autodesk, Inc. v6.052 Tuesday, Jul 21, 2009

Hyd. No. 2

Routing of Lochinvar

Hydrograph type	=	Reservoir	Peak discharge	=	0.383 cfs
Storm frequency	=	25 yrs	Time to peak	=	40 min
Time interval	=	1 min	Hyd. volume	=	1.451 acft
Inflow hyd. No.	=	1 - Upstream Basin	Max. Elevation	=	134.96 ft
Reservoir name	=	Lochinvar	Max. Storage	=	6.423 acft

Storage Indication method used.



Pond Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2008 by Autodesk, Inc. v6.052 Tuesday, Jul 21, 2009

Pond No. 1 - Lochinvar

Pond Data

Contours - User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 132.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (acft)	Total storage (acft)
0.00	132.00	01	0.000	0.000
1.00	133.00	87,144	0.669	0.669
2.00	134.00	141,270	2.597	3.266
3.00	135.00	146,207	3.299	6.565
4.00	136.00	151,175	3.413	9.978
5.00	137.00	156,216	3.528	13.506
6.00	138.00	183,546	3.895	17.401

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 18.00	3.00	12.00	0.00
Span (in)	= 18.00	3.00	144.00	0.00
No. Barrels	= 1	1	1	0
Invert El. (ft)	= 132.00	132.00	135.00	0.00
Length (ft)	= 230.00	0.00	0.00	0.00
Slope (%)	= 0.13	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	Yes	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 200.00	0.00	0.00	0.00
Crest El. (ft)	= 138.00	0.00	0.00	0.00
Weir Coeff.	= 2.60	3.33	3.33	3.33
Weir Type	= Broad	---	---	---
Multi-Stage	= No	No	No	No

Exfil.(in/hr) = 0.000 (by Contour)

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 acft	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	0.000	132.00	0.00	0.00	0.00	---	0.00	---	---	---	---	---	0.000
0.10	0.067	132.10	0.02 oc	0.02 ic	0.00	---	0.00	---	---	---	---	---	0.016
0.20	0.134	132.20	0.06 oc	0.06 ic	0.00	---	0.00	---	---	---	---	---	0.056
0.30	0.201	132.30	0.09 oc	0.09 ic	0.00	---	0.00	---	---	---	---	---	0.089
0.40	0.268	132.40	0.11 oc	0.11 ic	0.00	---	0.00	---	---	---	---	---	0.112
0.50	0.335	132.50	0.13 oc	0.13 ic	0.00	---	0.00	---	---	---	---	---	0.132
0.60	0.401	132.60	0.16 oc	0.15 ic	0.00	---	0.00	---	---	---	---	---	0.149
0.70	0.468	132.70	0.17 oc	0.17 ic	0.00	---	0.00	---	---	---	---	---	0.165
0.80	0.535	132.80	0.18 oc	0.18 ic	0.00	---	0.00	---	---	---	---	---	0.180
0.90	0.602	132.90	0.20 oc	0.19 ic	0.00	---	0.00	---	---	---	---	---	0.194
1.00	0.669	133.00	0.21 oc	0.21 ic	0.00	---	0.00	---	---	---	---	---	0.206
1.10	0.929	133.10	0.23 oc	0.22 ic	0.00	---	0.00	---	---	---	---	---	0.218
1.20	1.188	133.20	0.24 oc	0.23 ic	0.00	---	0.00	---	---	---	---	---	0.230
1.30	1.448	133.30	0.24 oc	0.24 ic	0.00	---	0.00	---	---	---	---	---	0.241
1.40	1.708	133.40	0.26 oc	0.25 ic	0.00	---	0.00	---	---	---	---	---	0.252
1.50	1.967	133.50	0.28 oc	0.26 ic	0.00	---	0.00	---	---	---	---	---	0.262
1.60	2.227	133.60	0.28 oc	0.27 ic	0.00	---	0.00	---	---	---	---	---	0.272
1.70	2.487	133.70	0.29 oc	0.28 ic	0.00	---	0.00	---	---	---	---	---	0.282
1.80	2.746	133.80	0.29 oc	0.29 ic	0.00	---	0.00	---	---	---	---	---	0.291
1.90	3.006	133.90	0.31 oc	0.30 ic	0.00	---	0.00	---	---	---	---	---	0.300
2.00	3.266	134.00	0.31 oc	0.31 ic	0.00	---	0.00	---	---	---	---	---	0.309
2.10	3.596	134.10	0.33 oc	0.32 ic	0.00	---	0.00	---	---	---	---	---	0.317
2.20	3.926	134.20	0.33 oc	0.33 ic	0.00	---	0.00	---	---	---	---	---	0.326
2.30	4.256	134.30	0.35 oc	0.33 ic	0.00	---	0.00	---	---	---	---	---	0.333
2.40	4.585	134.40	0.35 oc	0.34 ic	0.00	---	0.00	---	---	---	---	---	0.342
2.50	4.915	134.50	0.35 oc	0.35 ic	0.00	---	0.00	---	---	---	---	---	0.350
2.60	5.245	134.60	0.37 oc	0.36 ic	0.00	---	0.00	---	---	---	---	---	0.357
2.70	5.575	134.70	0.37 oc	0.36 ic	0.00	---	0.00	---	---	---	---	---	0.365
2.80	5.905	134.80	0.37 oc	0.37 ic	0.00	---	0.00	---	---	---	---	---	0.372
2.90	6.235	134.90	0.39 oc	0.38 ic	0.00	---	0.00	---	---	---	---	---	0.379
3.00	6.565	135.00	0.39 oc	0.39 ic	0.00	---	0.00	---	---	---	---	---	0.386
3.10	6.906	135.10	1.67 oc	0.36 ic	1.29 ic	---	0.00	---	---	---	---	---	1.654
3.20	7.248	135.20	3.95 oc	0.30 ic	3.65 ic	---	0.00	---	---	---	---	---	3.950
3.30	7.589	135.30	6.92 oc	0.20 ic	6.71 ic	---	0.00	---	---	---	---	---	6.919
3.40	7.930	135.40	8.57 oc	0.09 ic	8.48 ic	---	0.00	---	---	---	---	---	8.565
3.50	8.272	135.50	8.86 oc	0.07 ic	8.78 ic	---	0.00	---	---	---	---	---	8.856
3.60	8.613	135.60	9.10 oc	0.06 ic	9.04 ic	---	0.00	---	---	---	---	---	9.099
3.70	8.954	135.70	9.33 oc	0.05 ic	9.26 ic	---	0.00	---	---	---	---	---	9.318

Continues on next page...

Lochinvar

Stage / Storage / Discharge Table

Stage ft	Storage acft	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
3.80	9.295	135.80	9.53 oc	0.05 ic	9.48 ic	---	0.00	---	---	---	---	---	9.529
3.90	9.637	135.90	9.73 oc	0.04 ic	9.68 ic	---	0.00	---	---	---	---	---	9.727
4.00	9.978	136.00	9.92 oc	0.04 ic	9.87 ic	---	0.00	---	---	---	---	---	9.914
4.10	10.331	136.10	10.10 oc	0.04 ic	10.04 ic	---	0.00	---	---	---	---	---	10.08
4.20	10.684	136.20	10.27 oc	0.04 ic	10.22 ic	---	0.00	---	---	---	---	---	10.27
4.30	11.036	136.30	10.44 oc	0.04 ic	10.39 ic	---	0.00	---	---	---	---	---	10.43
4.40	11.389	136.40	10.61 oc	0.04 ic	10.56 ic	---	0.00	---	---	---	---	---	10.61
4.50	11.742	136.50	10.77 oc	0.04 ic	10.72 ic	---	0.00	---	---	---	---	---	10.77
4.60	12.095	136.60	10.94 oc	0.04 ic	10.88 ic	---	0.00	---	---	---	---	---	10.92
4.70	12.447	136.70	11.09 oc	0.05 ic	11.05 ic	---	0.00	---	---	---	---	---	11.09
4.80	12.800	136.80	11.25 oc	0.05 ic	11.20 ic	---	0.00	---	---	---	---	---	11.24
4.90	13.153	136.90	11.41 oc	0.05 ic	11.35 ic	---	0.00	---	---	---	---	---	11.39
5.00	13.506	137.00	11.56 oc	0.05 ic	11.50 ic	---	0.00	---	---	---	---	---	11.55
5.10	13.895	137.10	11.71 oc	0.05 ic	11.66 ic	---	0.00	---	---	---	---	---	11.71
5.20	14.285	137.20	11.86 oc	0.05 ic	11.80 ic	---	0.00	---	---	---	---	---	11.85
5.30	14.674	137.30	12.01 oc	0.05 ic	11.96 ic	---	0.00	---	---	---	---	---	12.01
5.40	15.064	137.40	12.15 oc	0.05 ic	12.10 ic	---	0.00	---	---	---	---	---	12.15
5.50	15.454	137.50	12.30 oc	0.05 ic	12.24 ic	---	0.00	---	---	---	---	---	12.29
5.60	15.843	137.60	12.44 oc	0.05 ic	12.39 ic	---	0.00	---	---	---	---	---	12.44
5.70	16.233	137.70	12.58 oc	0.05 ic	12.52 ic	---	0.00	---	---	---	---	---	12.57
5.80	16.622	137.80	12.72 oc	0.05 ic	12.66 ic	---	0.00	---	---	---	---	---	12.71
5.90	17.012	137.90	12.86 oc	0.05 ic	12.80 ic	---	0.00	---	---	---	---	---	12.85
6.00	17.401	138.00	12.99 oc	0.05 ic	12.94 ic	---	0.00	---	---	---	---	---	12.99

...End

Hydrograph Report

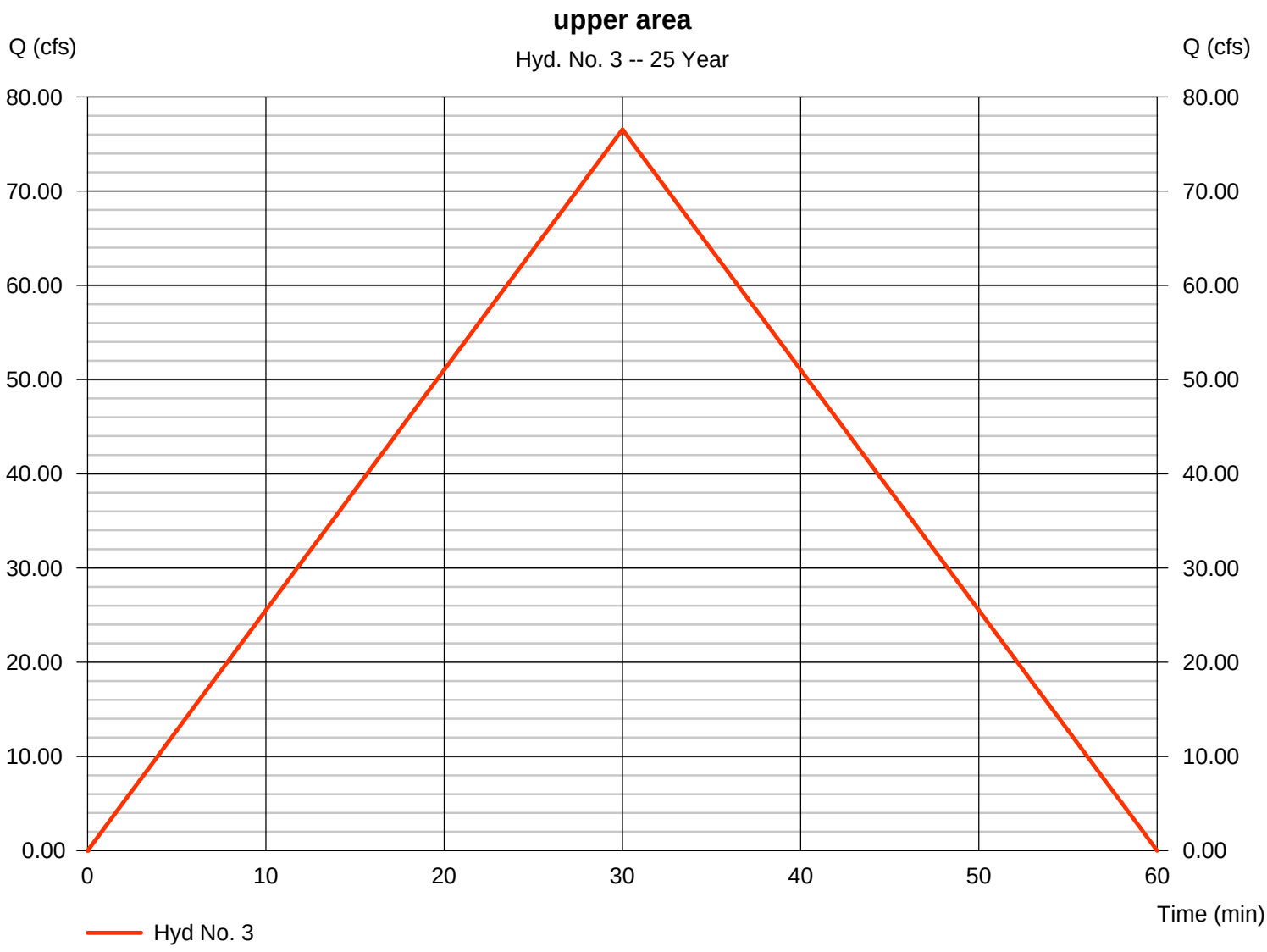
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2008 by Autodesk, Inc. v6.052 Tuesday, Jul 21, 2009

Hyd. No. 3

upper area

Hydrograph type	=	Rational	Peak discharge	=	76.55 cfs
Storm frequency	=	25 yrs	Time to peak	=	30 min
Time interval	=	1 min	Hyd. volume	=	3.163 acft
Drainage area	=	46.630 ac	Runoff coeff.	=	0.38*
Intensity	=	4.320 in/hr	Tc by FAA	=	30.00 min
IDF Curve	=	Rocky Mount.IDF	Asc/Rec limb fact	=	1/1

* Composite (Area/C) = [(22.220 x 0.40) + (10.250 x 0.32) + (12.300 x 0.40)] / 46.630



Hydrograph Report

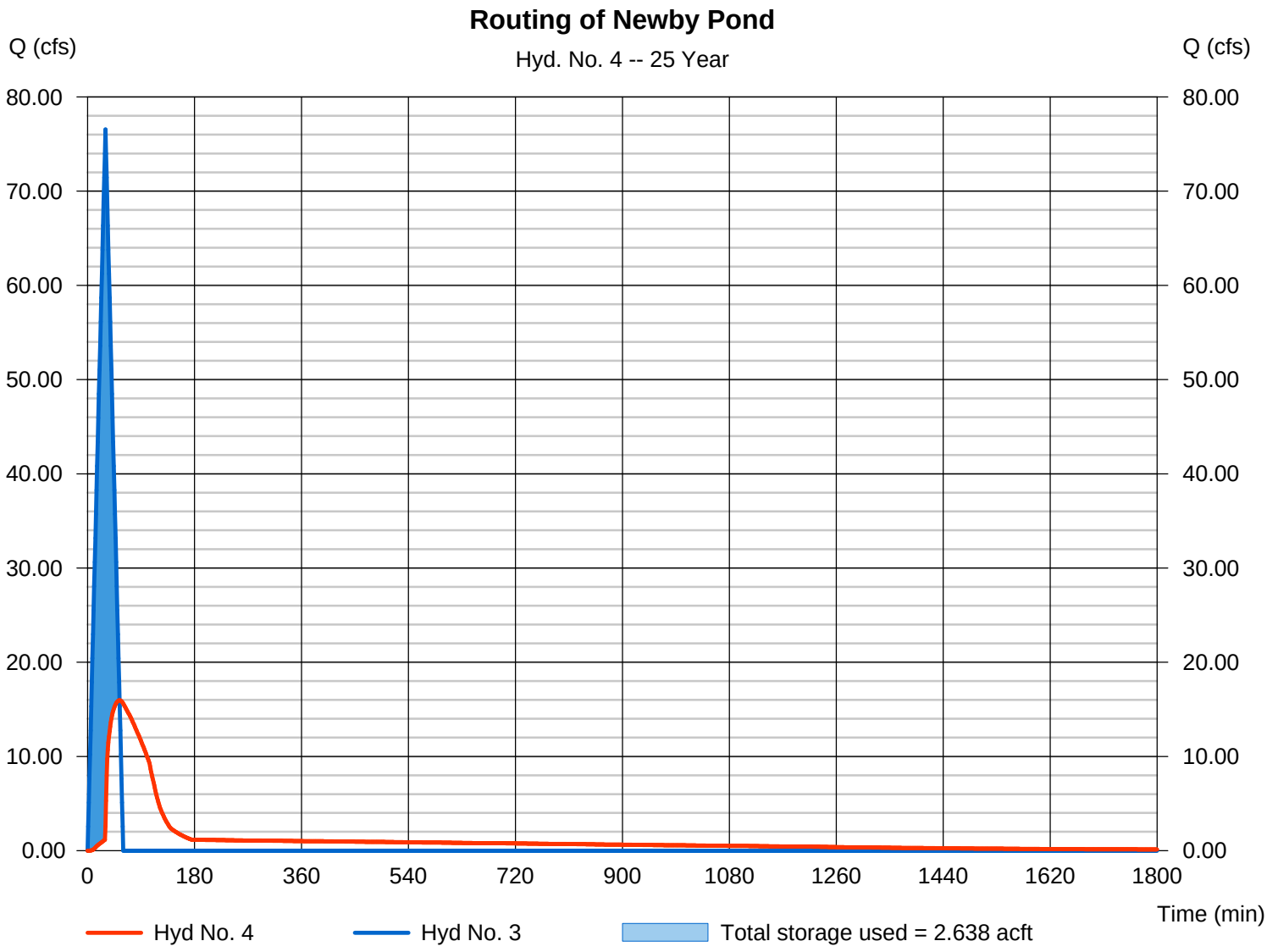
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2008 by Autodesk, Inc. v6.052 Tuesday, Jul 21, 2009

Hyd. No. 4

Routing of Newby Pond

Hydrograph type	=	Reservoir	Peak discharge	=	15.96 cfs
Storm frequency	=	25 yrs	Time to peak	=	54 min
Time interval	=	1 min	Hyd. volume	=	3.089 acft
Inflow hyd. No.	=	3 - upper area	Max. Elevation	=	132.37 ft
Reservoir name	=	Newby	Max. Storage	=	2.638 acft

Storage Indication method used.



Pond Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2008 by Autodesk, Inc. v6.052 Tuesday, Jul 21, 2009

Pond No. 2 - Newby

Pond Data

Contours - User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 129.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (acft)	Total storage (acft)
0.00	129.00	29,181	0.000	0.000
1.00	130.00	31,984	0.702	0.702
2.00	131.00	34,931	0.768	1.470
3.00	132.00	38,023	0.837	2.307
4.00	133.00	41,259	0.910	3.216
5.00	134.00	47,602	1.019	4.235
6.00	135.00	37,934	0.980	5.215
7.00	136.00	46,127	0.963	6.178

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 24.00	6.00	12.00	0.00
Span (in)	= 24.00	6.00	144.00	0.00
No. Barrels	= 1	1	1	0
Invert El. (ft)	= 129.00	129.00	131.00	0.00
Length (ft)	= 200.00	0.00	0.00	0.00
Slope (%)	= 0.15	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	Yes	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 215.00	0.00	0.00	0.00
Crest El. (ft)	= 134.00	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= Rect	---	---	---
Multi-Stage	= No	No	No	No

Exfil.(in/hr) = 0.000 (by Contour)

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 acft	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	0.000	129.00	0.00	0.00	0.00	---	0.00	---	---	---	---	---	0.000
0.10	0.070	129.10	0.02 oc	0.02 ic	0.00	---	0.00	---	---	---	---	---	0.023
0.20	0.140	129.20	0.09 oc	0.09 ic	0.00	---	0.00	---	---	---	---	---	0.089
0.30	0.211	129.30	0.19 oc	0.19 ic	0.00	---	0.00	---	---	---	---	---	0.187
0.40	0.281	129.40	0.32 oc	0.30 ic	0.00	---	0.00	---	---	---	---	---	0.303
0.50	0.351	129.50	0.44 oc	0.42 ic	0.00	---	0.00	---	---	---	---	---	0.418
0.60	0.421	129.60	0.50 oc	0.49 ic	0.00	---	0.00	---	---	---	---	---	0.494
0.70	0.491	129.70	0.58 oc	0.56 ic	0.00	---	0.00	---	---	---	---	---	0.559
0.80	0.561	129.80	0.65 oc	0.62 ic	0.00	---	0.00	---	---	---	---	---	0.616
0.90	0.632	129.90	0.69 oc	0.68 ic	0.00	---	0.00	---	---	---	---	---	0.677
1.00	0.702	130.00	0.74 oc	0.73 ic	0.00	---	0.00	---	---	---	---	---	0.732
1.10	0.779	130.10	0.78 oc	0.78 ic	0.00	---	0.00	---	---	---	---	---	0.780
1.20	0.855	130.20	0.83 oc	0.83 ic	0.00	---	0.00	---	---	---	---	---	0.826
1.30	0.932	130.30	0.87 oc	0.87 ic	0.00	---	0.00	---	---	---	---	---	0.873
1.40	1.009	130.40	0.92 oc	0.92 ic	0.00	---	0.00	---	---	---	---	---	0.921
1.50	1.086	130.50	0.97 oc	0.96 ic	0.00	---	0.00	---	---	---	---	---	0.962
1.60	1.162	130.60	1.02 oc	1.00 ic	0.00	---	0.00	---	---	---	---	---	1.001
1.70	1.239	130.70	1.08 oc	1.04 ic	0.00	---	0.00	---	---	---	---	---	1.039
1.80	1.316	130.80	1.13 oc	1.08 ic	0.00	---	0.00	---	---	---	---	---	1.076
1.90	1.393	130.90	1.13 oc	1.12 ic	0.00	---	0.00	---	---	---	---	---	1.117
2.00	1.470	131.00	1.19 oc	1.15 ic	0.00	---	0.00	---	---	---	---	---	1.151
2.10	1.553	131.10	2.41 oc	1.09 ic	1.29 ic	---	0.00	---	---	---	---	---	2.377
2.20	1.637	131.20	4.63 oc	0.94 ic	3.65 ic	---	0.00	---	---	---	---	---	4.598
2.30	1.721	131.30	7.21 oc	0.50 ic	6.71 ic	---	0.00	---	---	---	---	---	7.210
2.40	1.804	131.40	9.37 oc	0.37 ic	9.00 ic	---	0.00	---	---	---	---	---	9.373
2.50	1.888	131.50	10.42 oc	0.33 ic	10.09 ic	---	0.00	---	---	---	---	---	10.42
2.60	1.972	131.60	11.32 oc	0.30 ic	11.01 ic	---	0.00	---	---	---	---	---	11.31
2.70	2.055	131.70	12.11 oc	0.28 ic	11.83 ic	---	0.00	---	---	---	---	---	12.10
2.80	2.139	131.80	12.82 oc	0.26 ic	12.56 ic	---	0.00	---	---	---	---	---	12.82
2.90	2.223	131.90	13.49 oc	0.24 ic	13.24 ic	---	0.00	---	---	---	---	---	13.48
3.00	2.307	132.00	14.11 oc	0.23 ic	13.88 ic	---	0.00	---	---	---	---	---	14.11
3.10	2.398	132.10	14.64 oc	0.24 ic	14.40 ic	---	0.00	---	---	---	---	---	14.63
3.20	2.489	132.20	15.16 oc	0.24 ic	14.91 ic	---	0.00	---	---	---	---	---	15.16
3.30	2.579	132.30	15.65 oc	0.25 ic	15.40 ic	---	0.00	---	---	---	---	---	15.65
3.40	2.670	132.40	16.14 oc	0.26 ic	15.87 ic	---	0.00	---	---	---	---	---	16.13
3.50	2.761	132.50	16.60 oc	0.27 ic	16.33 ic	---	0.00	---	---	---	---	---	16.60
3.60	2.852	132.60	17.06 oc	0.27 ic	16.78 ic	---	0.00	---	---	---	---	---	17.05

Continues on next page...

Newby

Stage / Storage / Discharge Table

Stage ft	Storage acft	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	2.943	132.70	17.50 oc	0.28 ic	17.22 ic	---	0.00	---	---	---	---	---	17.50
3.80	3.034	132.80	17.93 oc	0.29 ic	17.64 ic	---	0.00	---	---	---	---	---	17.93
3.90	3.125	132.90	18.36 oc	0.30 ic	18.05 ic	---	0.00	---	---	---	---	---	18.35
4.00	3.216	133.00	18.77 oc	0.30 ic	18.46 ic	---	0.00	---	---	---	---	---	18.77
4.10	3.318	133.10	19.17 oc	0.31 ic	18.86 ic	---	0.00	---	---	---	---	---	19.17
4.20	3.420	133.20	19.57 oc	0.31 ic	19.24 ic	---	0.00	---	---	---	---	---	19.56
4.30	3.522	133.30	19.96 oc	0.32 ic	19.63 ic	---	0.00	---	---	---	---	---	19.95
4.40	3.624	133.40	20.34 oc	0.33 ic	20.00 ic	---	0.00	---	---	---	---	---	20.33
4.50	3.726	133.50	20.71 oc	0.33 ic	20.37 ic	---	0.00	---	---	---	---	---	20.71
4.60	3.828	133.60	21.08 oc	0.34 ic	20.73 ic	---	0.00	---	---	---	---	---	21.07
4.70	3.930	133.70	21.44 oc	0.34 ic	21.08 ic	---	0.00	---	---	---	---	---	21.43
4.80	4.031	133.80	21.79 oc	0.35 ic	21.44 ic	---	0.00	---	---	---	---	---	21.79
4.90	4.133	133.90	22.14 oc	0.36 ic	21.78 ic	---	0.00	---	---	---	---	---	22.13
5.00	4.235	134.00	22.48 oc	0.36 ic	22.11 ic	---	0.00	---	---	---	---	---	22.47
5.10	4.333	134.10	22.82 oc	0.37 ic	22.45 ic	---	22.64	---	---	---	---	---	45.46
5.20	4.431	134.20	23.15 oc	0.37 ic	22.77 ic	---	64.04	---	---	---	---	---	87.18
5.30	4.529	134.30	23.48 oc	0.38 ic	23.10 ic	---	117.64	---	---	---	---	---	141.13
5.40	4.627	134.40	23.81 oc	0.38 ic	23.42 ic	---	181.12	---	---	---	---	---	204.92
5.50	4.725	134.50	24.13 oc	0.39 ic	23.73 ic	---	253.13	---	---	---	---	---	277.25
5.60	4.823	134.60	24.44 oc	0.39 ic	24.05 ic	---	332.75	---	---	---	---	---	357.19
5.70	4.921	134.70	24.75 oc	0.40 ic	24.35 ic	---	419.30	---	---	---	---	---	444.05
5.80	5.019	134.80	25.06 oc	0.40 ic	24.65 ic	---	512.30	---	---	---	---	---	537.35
5.90	5.117	134.90	25.36 oc	0.41 ic	24.95 ic	---	611.39	---	---	---	---	---	636.75
6.00	5.215	135.00	25.66 oc	0.41 ic	25.25 ic	---	715.95	---	---	---	---	---	741.61
6.10	5.311	135.10	25.96 oc	0.42 ic	25.54 ic	---	825.99	---	---	---	---	---	851.95
6.20	5.408	135.20	26.25 oc	0.42 ic	25.83 ic	---	941.14	---	---	---	---	---	967.39
6.30	5.504	135.30	26.54 oc	0.43 ic	26.11 ic	---	1061.21	---	---	---	---	---	1087.74
6.40	5.600	135.40	26.83 oc	0.43 ic	26.40 ic	---	1185.97	---	---	---	---	---	1212.79
6.50	5.697	135.50	27.11 oc	0.44 ic	26.67 ic	---	1315.28	---	---	---	---	---	1342.39
6.60	5.793	135.60	27.40 oc	0.44 ic	26.95 ic	---	1448.99	---	---	---	---	---	1476.38
6.70	5.889	135.70	27.67 oc	0.45 ic	27.23 ic	---	1586.92	---	---	---	---	---	1614.59
6.80	5.986	135.80	27.95 oc	0.45 ic	27.49 ic	---	1728.99	---	---	---	---	---	1756.93
6.90	6.082	135.90	28.22 oc	0.45 ic	27.77 ic	---	1875.20	---	---	---	---	---	1903.42
7.00	6.178	136.00	28.49 oc	0.46 ic	28.03 ic	---	2025.01	---	---	---	---	---	2053.50

...End

Hydrograph Report

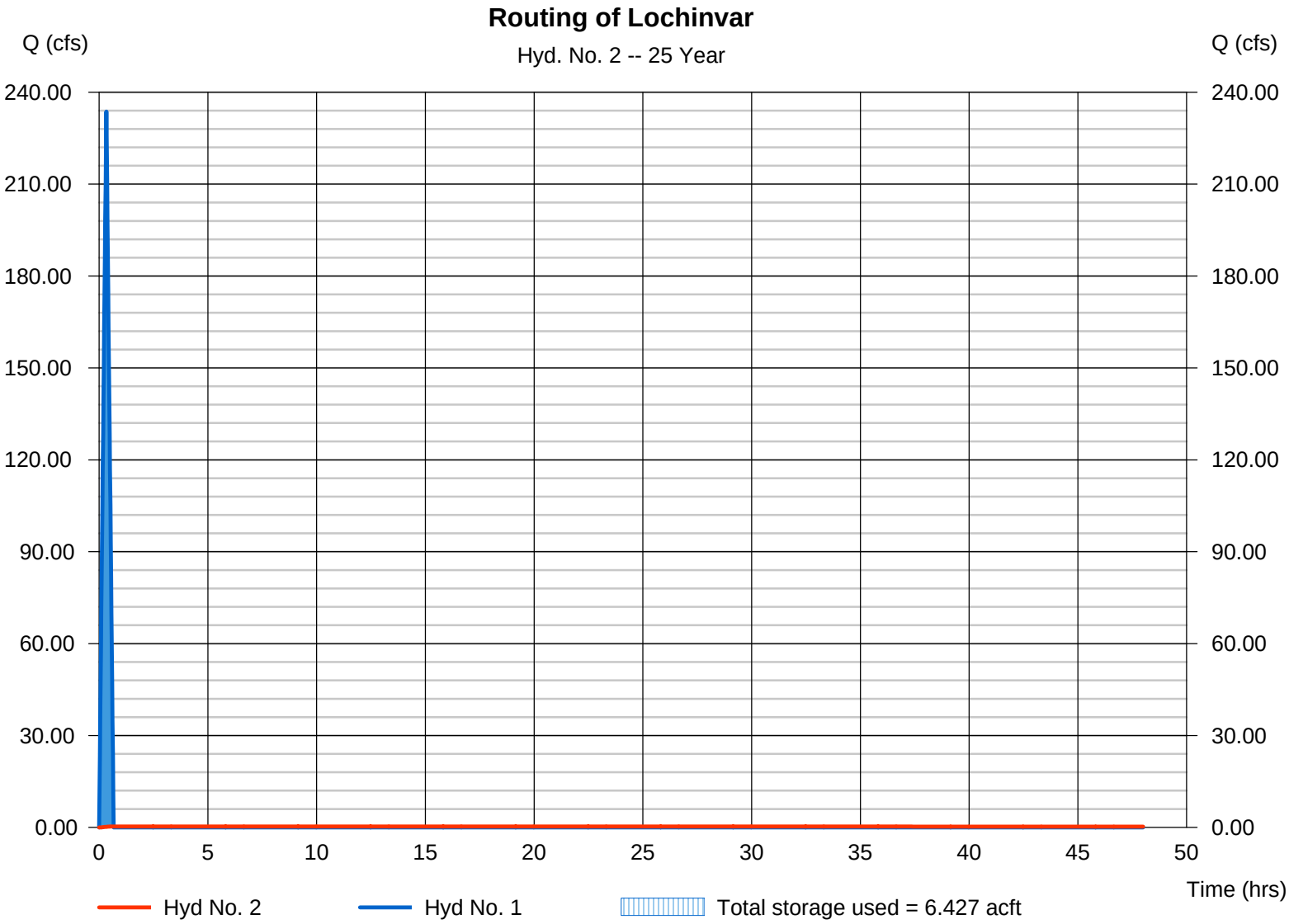
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2008 by Autodesk, Inc. v6.052 Thursday, Sep 17, 2009

Hyd. No. 2

Routing of Lochinvar

Hydrograph type	=	Reservoir	Peak discharge	=	0.309 cfs
Storm frequency	=	25 yrs	Time to peak	=	40 min
Time interval	=	1 min	Hyd. volume	=	1.158 acft
Inflow hyd. No.	=	1 - Upstream Basin	Max. Elevation	=	134.01 ft
Reservoir name	=	Lochinvar	Max. Storage	=	6.427 acft

Storage Indication method used.



Hydrograph Report

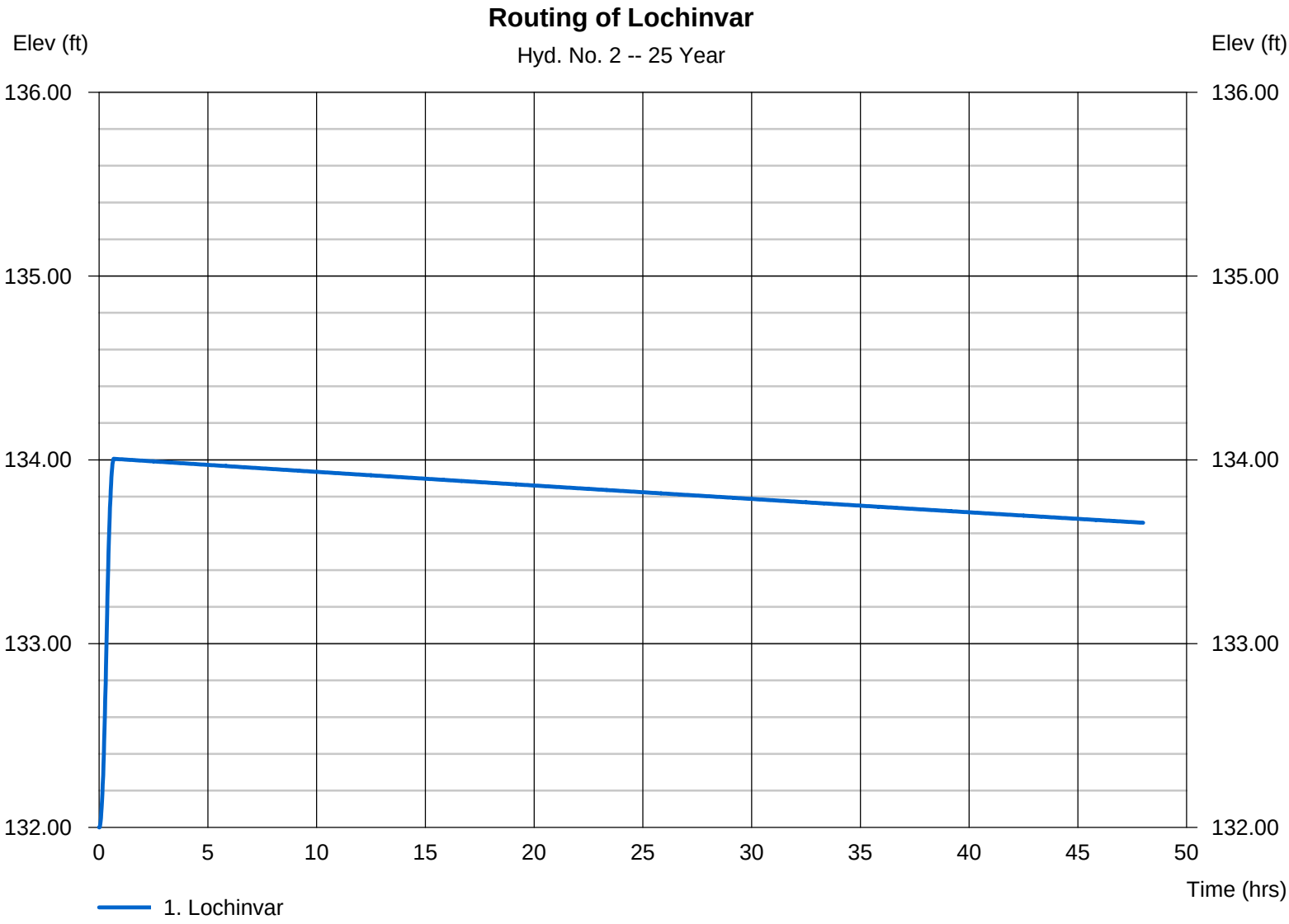
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2008 by Autodesk, Inc. v6.052 Thursday, Sep 17, 2009

Hyd. No. 2

Routing of Lochinvar

Hydrograph type	=	Reservoir	Peak discharge	=	0.309 cfs
Storm frequency	=	25 yrs	Time to peak	=	40 min
Time interval	=	1 min	Hyd. volume	=	1.158 acft
Inflow hyd. No.	=	1 - Upstream Basin	Max. Elevation	=	134.01 ft
Reservoir name	=	Lochinvar	Max. Storage	=	6.427 acft

Storage Indication method used.



Hydrograph Report

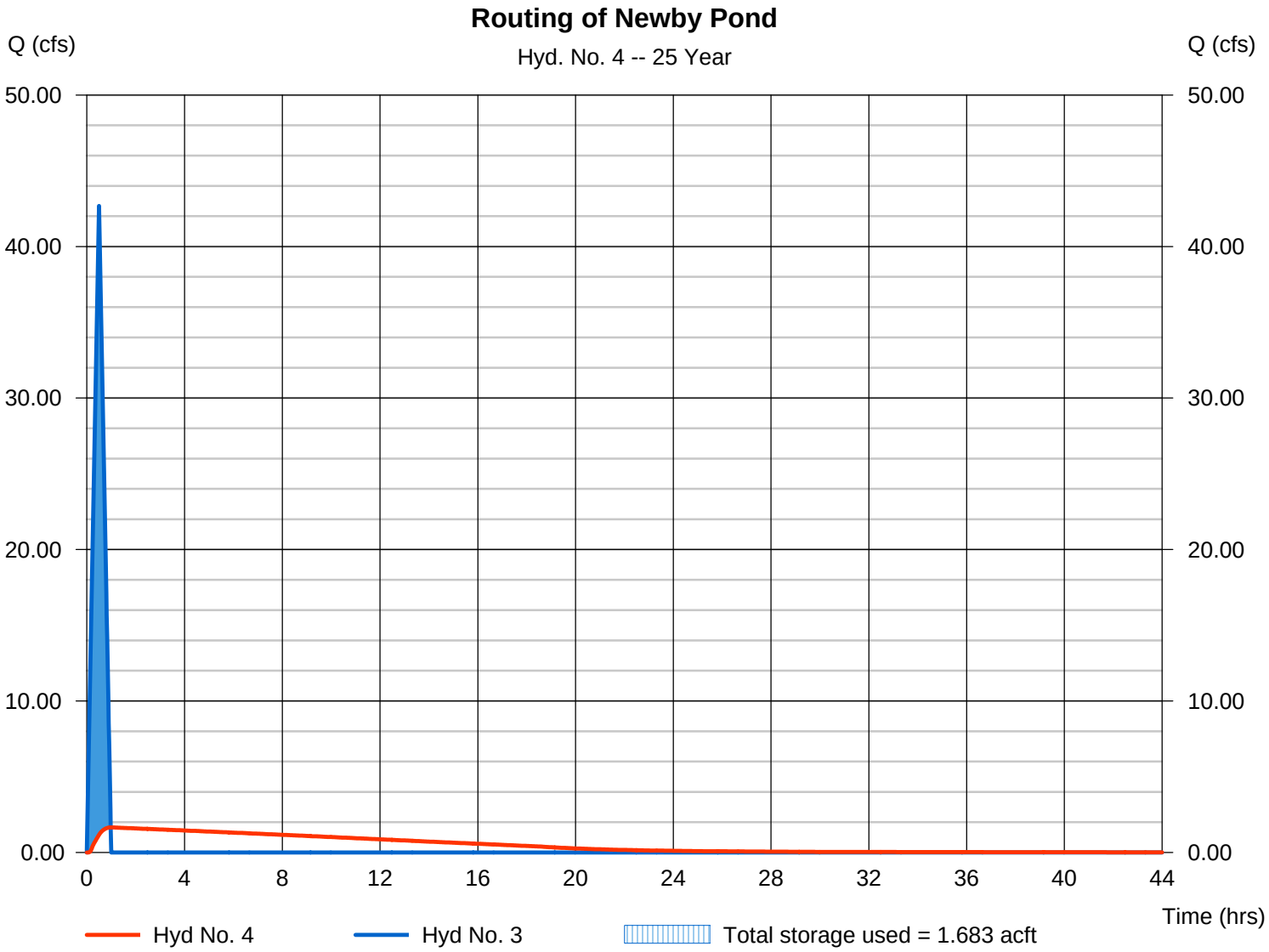
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2008 by Autodesk, Inc. v6.052 Thursday, Sep 17, 2009

Hyd. No. 4

Routing of Newby Pond

Hydrograph type	=	Reservoir	Peak discharge	=	1.656 cfs
Storm frequency	=	25 yrs	Time to peak	=	59 min
Time interval	=	1 min	Hyd. volume	=	1.740 acft
Inflow hyd. No.	=	3 - upper area	Max. Elevation	=	133.70 ft
Reservoir name	=	Newby	Max. Storage	=	1.683 acft

Storage Indication method used.



Hydrograph Report

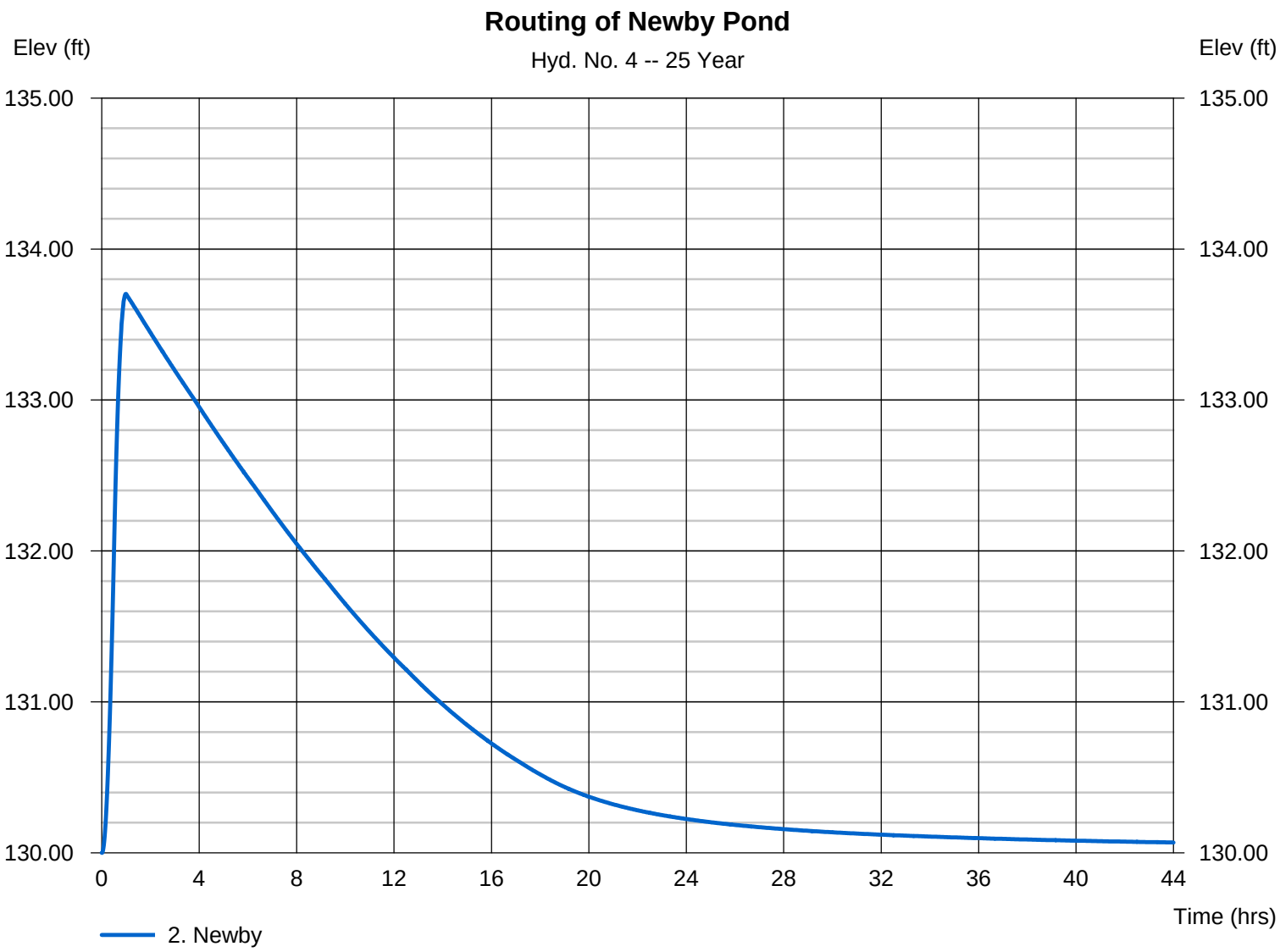
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2008 by Autodesk, Inc. v6.052 Thursday, Sep 17, 2009

Hyd. No. 4

Routing of Newby Pond

Hydrograph type	=	Reservoir	Peak discharge	=	1.656 cfs
Storm frequency	=	25 yrs	Time to peak	=	59 min
Time interval	=	1 min	Hyd. volume	=	1.740 acft
Inflow hyd. No.	=	3 - upper area	Max. Elevation	=	133.70 ft
Reservoir name	=	Newby	Max. Storage	=	1.683 acft

Storage Indication method used.



Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2008 by Autodesk, Inc. v6.052

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (acft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (acft)	Hydrograph description
1	Rational	233.68	1	20	6.437	------	------	------	Upstream Basin
2	Reservoir	0.309	1	40	1.158	1	134.01	6.43	Routing of Lochinvar
3	Rational	42.68	1	30	1.764	------	------	------	upper area
4	Reservoir	1.656	1	59	1.740	3	133.70	1.68	Routing of Newby Pond

Hydrograph Report

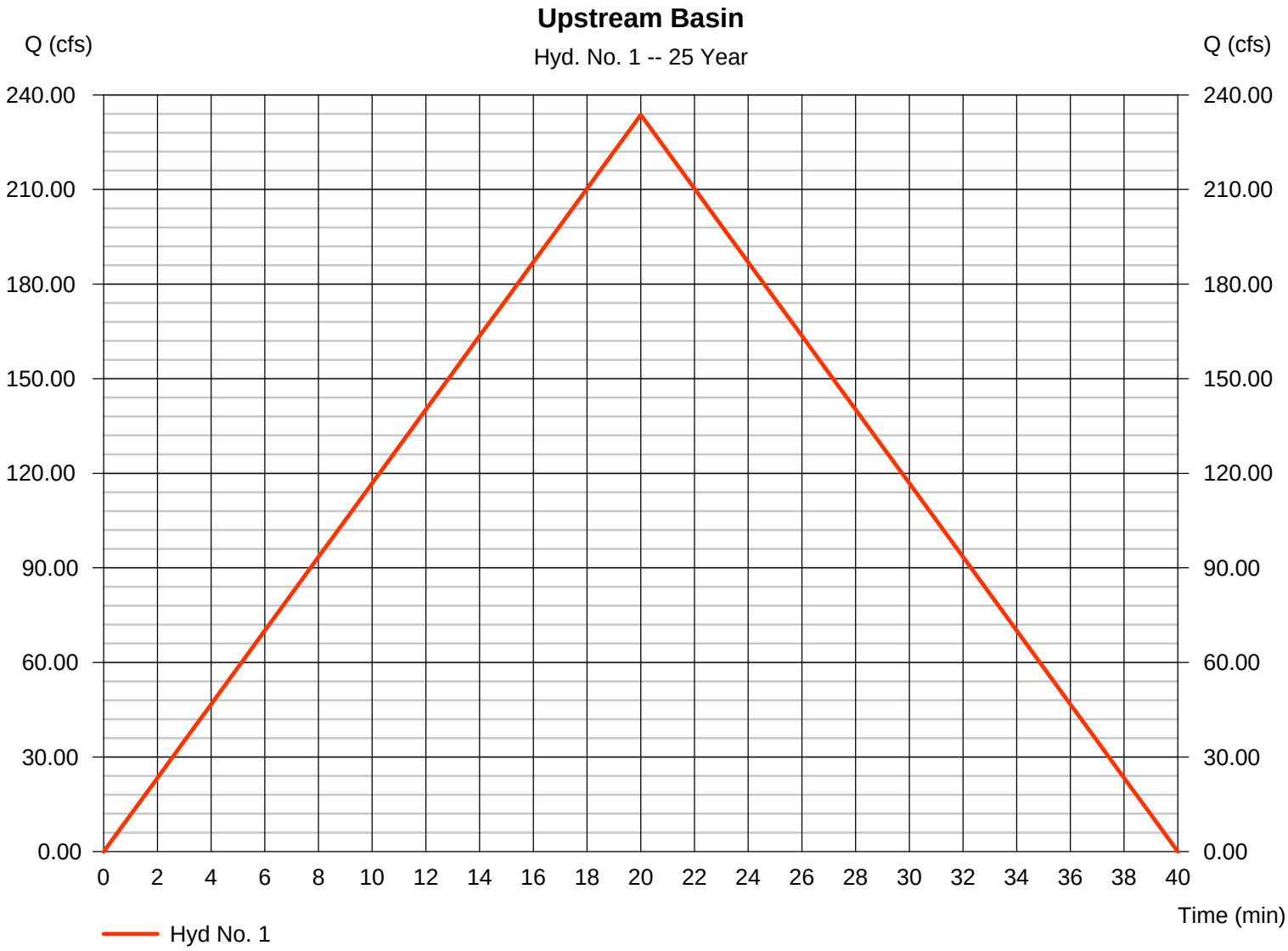
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2008 by Autodesk, Inc. v6.052 Thursday, Sep 17, 2009

Hyd. No. 1

Upstream Basin

Hydrograph type	=	Rational	Peak discharge	=	233.68 cfs
Storm frequency	=	25 yrs	Time to peak	=	20 min
Time interval	=	1 min	Hyd. volume	=	6.437 acft
Drainage area	=	67.970 ac	Runoff coeff.	=	0.65*
Intensity	=	5.289 in/hr	Tc by User	=	20.00 min
IDF Curve	=	Rocky Mount.IDF	Asc/Rec limb fact	=	1/1

* Composite (Area/C) = [(41.000 x 0.25) + (30.500 x 0.50)] / 67.970



Hydrograph Report

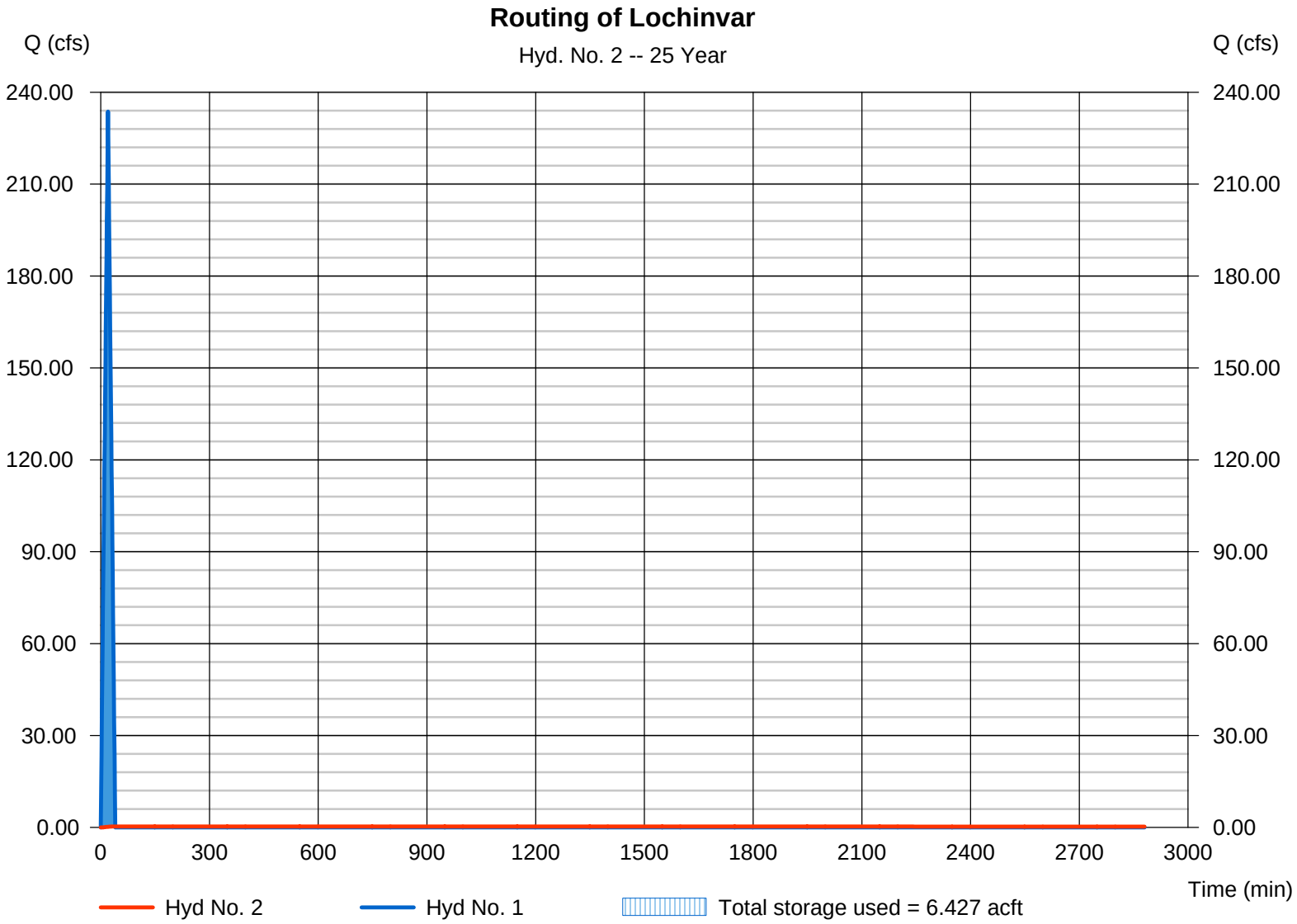
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2008 by Autodesk, Inc. v6.052 Thursday, Sep 17, 2009

Hyd. No. 2

Routing of Lochinvar

Hydrograph type	=	Reservoir	Peak discharge	=	0.309 cfs
Storm frequency	=	25 yrs	Time to peak	=	40 min
Time interval	=	1 min	Hyd. volume	=	1.158 acft
Inflow hyd. No.	=	1 - Upstream Basin	Max. Elevation	=	134.01 ft
Reservoir name	=	Lochinvar	Max. Storage	=	6.427 acft

Storage Indication method used.



Pond Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2008 by Autodesk, Inc. v6.052 Thursday, Sep 17, 2009

Pond No. 1 - Lochinvar

Pond Data

Trapezoid - Bottom L x W = 585.0 x 230.0 ft, Side slope = 3.00:1, Bottom elev. = 132.00 ft, Depth = 6.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (acft)	Total storage (acft)
0.00	132.00	134,550	0.000	0.000
0.60	132.60	137,497	1.874	1.874
1.20	133.20	140,470	1.914	3.788
1.80	133.80	143,469	1.955	5.743
2.40	134.40	146,493	1.997	7.740
3.00	135.00	149,544	2.039	9.779
3.60	135.60	152,621	2.081	11.860
4.20	136.20	155,723	2.124	13.984
4.80	136.80	158,851	2.166	16.150
5.40	137.40	162,006	2.210	18.360
6.00	138.00	165,186	2.253	20.613

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 18.00	3.00	12.00	0.00
Span (in)	= 18.00	3.00	144.00	0.00
No. Barrels	= 1	1	1	0
Invert El. (ft)	= 132.00	132.00	135.00	0.00
Length (ft)	= 230.00	0.00	0.00	0.00
Slope (%)	= 0.13	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	Yes	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 200.00	0.00	0.00	0.00
Crest El. (ft)	= 138.00	0.00	0.00	0.00
Weir Coeff.	= 2.60	3.33	3.33	3.33
Weir Type	= Broad	---	---	---
Multi-Stage	= No	No	No	No

Exfil.(in/hr) = 0.000 (by Contour)
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 acft	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	0.000	132.00	0.00	0.00	0.00	---	0.00	---	---	---	---	---	0.000
0.06	0.187	132.06	0.01 oc	0.01 ic	0.00	---	0.00	---	---	---	---	---	0.006
0.12	0.375	132.12	0.02 oc	0.02 ic	0.00	---	0.00	---	---	---	---	---	0.022
0.18	0.562	132.18	0.05 oc	0.05 ic	0.00	---	0.00	---	---	---	---	---	0.046
0.24	0.749	132.24	0.08 oc	0.07 ic	0.00	---	0.00	---	---	---	---	---	0.073
0.30	0.937	132.30	0.09 oc	0.09 ic	0.00	---	0.00	---	---	---	---	---	0.089
0.36	1.124	132.36	0.10 oc	0.10 ic	0.00	---	0.00	---	---	---	---	---	0.103
0.42	1.312	132.42	0.12 oc	0.12 ic	0.00	---	0.00	---	---	---	---	---	0.116
0.48	1.499	132.48	0.13 oc	0.13 ic	0.00	---	0.00	---	---	---	---	---	0.128
0.54	1.686	132.54	0.14 oc	0.14 ic	0.00	---	0.00	---	---	---	---	---	0.139
0.60	1.874	132.60	0.16 oc	0.15 ic	0.00	---	0.00	---	---	---	---	---	0.149
0.66	2.065	132.66	0.17 oc	0.16 ic	0.00	---	0.00	---	---	---	---	---	0.158
0.72	2.256	132.72	0.17 oc	0.17 ic	0.00	---	0.00	---	---	---	---	---	0.169
0.78	2.448	132.78	0.18 oc	0.18 ic	0.00	---	0.00	---	---	---	---	---	0.177
0.84	2.639	132.84	0.20 oc	0.18 ic	0.00	---	0.00	---	---	---	---	---	0.185
0.90	2.831	132.90	0.20 oc	0.19 ic	0.00	---	0.00	---	---	---	---	---	0.194
0.96	3.022	132.96	0.21 oc	0.20 ic	0.00	---	0.00	---	---	---	---	---	0.201
1.02	3.214	133.02	0.21 oc	0.21 ic	0.00	---	0.00	---	---	---	---	---	0.209
1.08	3.405	133.08	0.23 oc	0.22 ic	0.00	---	0.00	---	---	---	---	---	0.216
1.14	3.596	133.14	0.23 oc	0.22 ic	0.00	---	0.00	---	---	---	---	---	0.224
1.20	3.788	133.20	0.24 oc	0.23 ic	0.00	---	0.00	---	---	---	---	---	0.230
1.26	3.983	133.26	0.24 oc	0.24 ic	0.00	---	0.00	---	---	---	---	---	0.237
1.32	4.179	133.32	0.26 oc	0.24 ic	0.00	---	0.00	---	---	---	---	---	0.243
1.38	4.375	133.38	0.26 oc	0.25 ic	0.00	---	0.00	---	---	---	---	---	0.250
1.44	4.570	133.44	0.26 oc	0.26 ic	0.00	---	0.00	---	---	---	---	---	0.256
1.50	4.766	133.50	0.28 oc	0.26 ic	0.00	---	0.00	---	---	---	---	---	0.262
1.56	4.961	133.56	0.28 oc	0.27 ic	0.00	---	0.00	---	---	---	---	---	0.268
1.62	5.157	133.62	0.28 oc	0.27 ic	0.00	---	0.00	---	---	---	---	---	0.274
1.68	5.352	133.68	0.29 oc	0.28 ic	0.00	---	0.00	---	---	---	---	---	0.280
1.74	5.548	133.74	0.29 oc	0.29 ic	0.00	---	0.00	---	---	---	---	---	0.285
1.80	5.743	133.80	0.29 oc	0.29 ic	0.00	---	0.00	---	---	---	---	---	0.291
1.86	5.943	133.86	0.31 oc	0.30 ic	0.00	---	0.00	---	---	---	---	---	0.296
1.92	6.143	133.92	0.31 oc	0.30 ic	0.00	---	0.00	---	---	---	---	---	0.302
1.98	6.342	133.98	0.31 oc	0.31 ic	0.00	---	0.00	---	---	---	---	---	0.307

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Lochinvar

Stage / Storage / Discharge Table

Stage ft	Storage acft	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
2.04	6.542	134.04	0.31 oc	0.31 ic	0.00	---	0.00	---	---	---	---	---	0.312
2.10	6.742	134.10	0.33 oc	0.32 ic	0.00	---	0.00	---	---	---	---	---	0.317
2.16	6.942	134.16	0.33 oc	0.32 ic	0.00	---	0.00	---	---	---	---	---	0.322
2.22	7.141	134.22	0.33 oc	0.33 ic	0.00	---	0.00	---	---	---	---	---	0.327
2.28	7.341	134.28	0.35 oc	0.33 ic	0.00	---	0.00	---	---	---	---	---	0.332
2.34	7.541	134.34	0.35 oc	0.34 ic	0.00	---	0.00	---	---	---	---	---	0.337
2.40	7.740	134.40	0.35 oc	0.34 ic	0.00	---	0.00	---	---	---	---	---	0.342
2.46	7.944	134.46	0.35 oc	0.35 ic	0.00	---	0.00	---	---	---	---	---	0.347
2.52	8.148	134.52	0.35 oc	0.35 ic	0.00	---	0.00	---	---	---	---	---	0.351
2.58	8.352	134.58	0.37 oc	0.36 ic	0.00	---	0.00	---	---	---	---	---	0.355
2.64	8.556	134.64	0.37 oc	0.36 ic	0.00	---	0.00	---	---	---	---	---	0.360
2.70	8.760	134.70	0.37 oc	0.36 ic	0.00	---	0.00	---	---	---	---	---	0.365
2.76	8.964	134.76	0.37 oc	0.37 ic	0.00	---	0.00	---	---	---	---	---	0.369
2.82	9.167	134.82	0.39 oc	0.37 ic	0.00	---	0.00	---	---	---	---	---	0.373
2.88	9.371	134.88	0.39 oc	0.38 ic	0.00	---	0.00	---	---	---	---	---	0.377
2.94	9.575	134.94	0.39 oc	0.38 ic	0.00	---	0.00	---	---	---	---	---	0.382
3.00	9.779	135.00	0.39 oc	0.39 ic	0.00	---	0.00	---	---	---	---	---	0.386
3.06	9.987	135.06	0.98 oc	0.38 ic	0.60 ic	---	0.00	---	---	---	---	---	0.976
3.12	10.195	135.12	2.08 oc	0.35 ic	1.70 ic	---	0.00	---	---	---	---	---	2.053
3.18	10.403	135.18	3.42 oc	0.30 ic	3.12 ic	---	0.00	---	---	---	---	---	3.423
3.24	10.612	135.24	5.07 oc	0.27 ic	4.80 ic	---	0.00	---	---	---	---	---	5.074
3.30	10.820	135.30	6.92 oc	0.21 ic	6.71 ic	---	0.00	---	---	---	---	---	6.918
3.36	11.028	135.36	8.43 oc	0.09 ic	8.33 ic	---	0.00	---	---	---	---	---	8.428
3.42	11.236	135.42	8.63 oc	0.08 ic	8.55 ic	---	0.00	---	---	---	---	---	8.629
3.48	11.444	135.48	8.80 oc	0.07 ic	8.73 ic	---	0.00	---	---	---	---	---	8.801
3.54	11.652	135.54	8.96 oc	0.07 ic	8.89 ic	---	0.00	---	---	---	---	---	8.958
3.60	11.860	135.60	9.10 oc	0.06 ic	9.04 ic	---	0.00	---	---	---	---	---	9.097
3.66	12.072	135.66	9.24 oc	0.06 ic	9.18 ic	---	0.00	---	---	---	---	---	9.234
3.72	12.285	135.72	9.37 oc	0.05 ic	9.31 ic	---	0.00	---	---	---	---	---	9.366
3.78	12.497	135.78	9.49 oc	0.05 ic	9.44 ic	---	0.00	---	---	---	---	---	9.493
3.84	12.710	135.84	9.61 oc	0.05 ic	9.56 ic	---	0.00	---	---	---	---	---	9.607
3.90	12.922	135.90	9.73 oc	0.04 ic	9.69 ic	---	0.00	---	---	---	---	---	9.731
3.96	13.134	135.96	9.85 oc	0.04 ic	9.80 ic	---	0.00	---	---	---	---	---	9.839
4.02	13.347	136.02	9.96 oc	0.04 ic	9.91 ic	---	0.00	---	---	---	---	---	9.947
4.08	13.559	136.08	10.06 oc	0.04 ic	10.02 ic	---	0.00	---	---	---	---	---	10.06
4.14	13.771	136.14	10.17 oc	0.04 ic	10.12 ic	---	0.00	---	---	---	---	---	10.16
4.20	13.984	136.20	10.27 oc	0.04 ic	10.22 ic	---	0.00	---	---	---	---	---	10.26
4.26	14.200	136.26	10.37 oc	0.04 ic	10.32 ic	---	0.00	---	---	---	---	---	10.36
4.32	14.417	136.32	10.47 oc	0.04 ic	10.43 ic	---	0.00	---	---	---	---	---	10.47
4.38	14.634	136.38	10.58 oc	0.04 ic	10.53 ic	---	0.00	---	---	---	---	---	10.57
4.44	14.850	136.44	10.67 oc	0.04 ic	10.62 ic	---	0.00	---	---	---	---	---	10.66
4.50	15.067	136.50	10.77 oc	0.04 ic	10.73 ic	---	0.00	---	---	---	---	---	10.77
4.56	15.284	136.56	10.87 oc	0.04 ic	10.82 ic	---	0.00	---	---	---	---	---	10.86
4.62	15.500	136.62	10.97 oc	0.04 ic	10.91 ic	---	0.00	---	---	---	---	---	10.96
4.68	15.717	136.68	11.06 oc	0.05 ic	11.02 ic	---	0.00	---	---	---	---	---	11.06
4.74	15.933	136.74	11.16 oc	0.05 ic	11.11 ic	---	0.00	---	---	---	---	---	11.15
4.80	16.150	136.80	11.25 oc	0.05 ic	11.20 ic	---	0.00	---	---	---	---	---	11.25
4.86	16.371	136.86	11.35 oc	0.05 ic	11.29 ic	---	0.00	---	---	---	---	---	11.33
4.92	16.592	136.92	11.44 oc	0.05 ic	11.38 ic	---	0.00	---	---	---	---	---	11.42
4.98	16.813	136.98	11.53 oc	0.05 ic	11.48 ic	---	0.00	---	---	---	---	---	11.53
5.04	17.034	137.04	11.62 oc	0.05 ic	11.56 ic	---	0.00	---	---	---	---	---	11.61
5.10	17.255	137.10	11.71 oc	0.05 ic	11.65 ic	---	0.00	---	---	---	---	---	11.70
5.16	17.476	137.16	11.80 oc	0.05 ic	11.75 ic	---	0.00	---	---	---	---	---	11.80
5.22	17.697	137.22	11.89 oc	0.05 ic	11.83 ic	---	0.00	---	---	---	---	---	11.88
5.28	17.918	137.28	11.98 oc	0.05 ic	11.92 ic	---	0.00	---	---	---	---	---	11.97
5.34	18.139	137.34	12.07 oc	0.05 ic	12.01 ic	---	0.00	---	---	---	---	---	12.06
5.40	18.360	137.40	12.15 oc	0.05 ic	12.10 ic	---	0.00	---	---	---	---	---	12.15
5.46	18.585	137.46	12.24 oc	0.05 ic	12.18 ic	---	0.00	---	---	---	---	---	12.23
5.52	18.811	137.52	12.33 oc	0.05 ic	12.27 ic	---	0.00	---	---	---	---	---	12.32
5.58	19.036	137.58	12.41 oc	0.05 ic	12.36 ic	---	0.00	---	---	---	---	---	12.41
5.64	19.261	137.64	12.50 oc	0.05 ic	12.44 ic	---	0.00	---	---	---	---	---	12.49
5.70	19.487	137.70	12.58 oc	0.05 ic	12.53 ic	---	0.00	---	---	---	---	---	12.58
5.76	19.712	137.76	12.66 oc	0.05 ic	12.61 ic	---	0.00	---	---	---	---	---	12.66
5.82	19.937	137.82	12.75 oc	0.05 ic	12.69 ic	---	0.00	---	---	---	---	---	12.74
5.88	20.163	137.88	12.83 oc	0.05 ic	12.78 ic	---	0.00	---	---	---	---	---	12.83
5.94	20.388	137.94	12.91 oc	0.05 ic	12.85 ic	---	0.00	---	---	---	---	---	12.91
6.00	20.613	138.00	12.99 oc	0.05 ic	12.94 ic	---	0.00	---	---	---	---	---	12.99

...End

Hydrograph Report

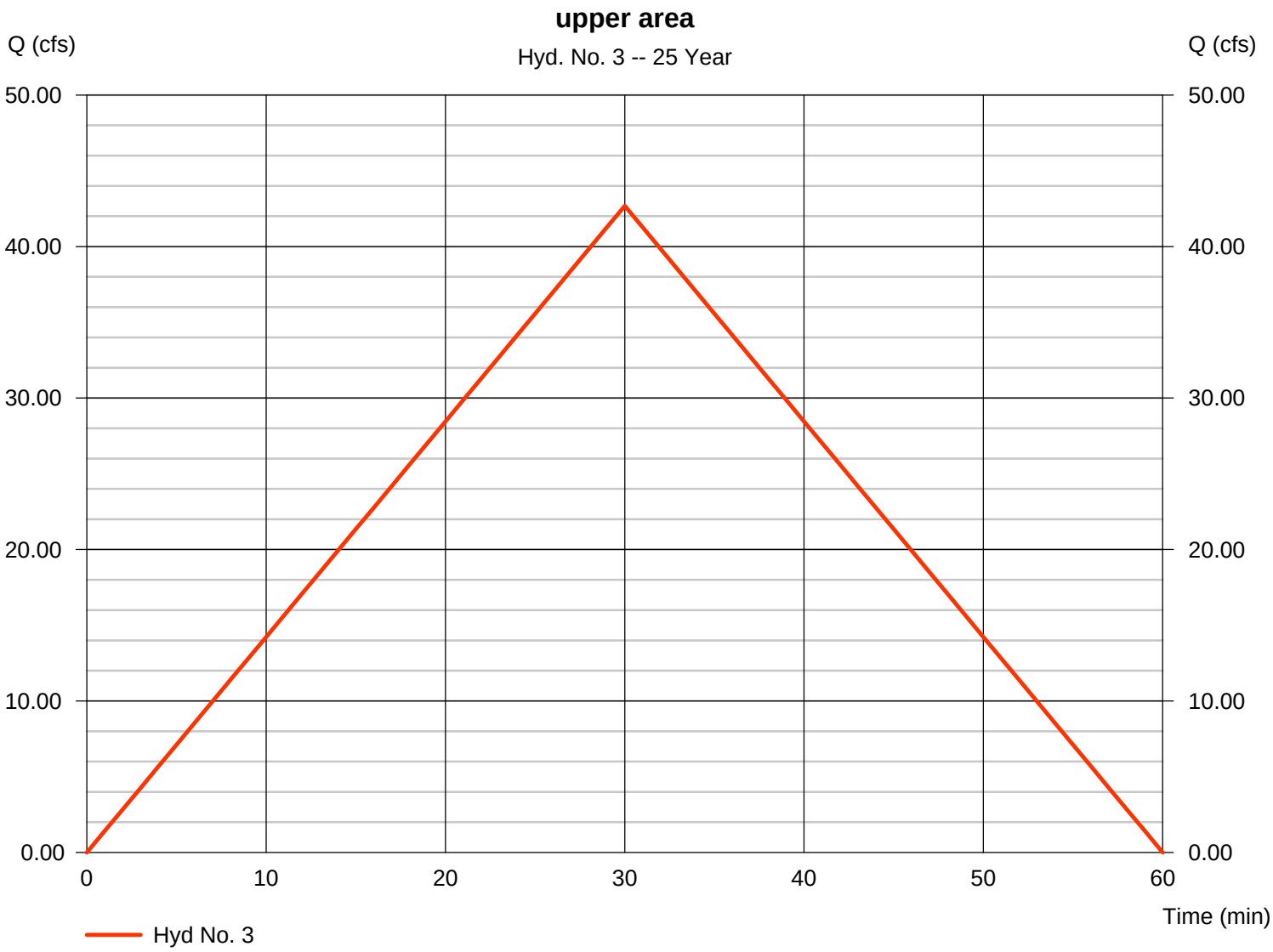
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2008 by Autodesk, Inc. v6.052 Thursday, Sep 17, 2009

Hyd. No. 3

upper area

Hydrograph type	=	Rational	Peak discharge	=	42.68 cfs
Storm frequency	=	25 yrs	Time to peak	=	30 min
Time interval	=	1 min	Hyd. volume	=	1.764 acft
Drainage area	=	26.000 ac	Runoff coeff.	=	0.38*
Intensity	=	4.320 in/hr	Tc by User	=	30.00 min
IDF Curve	=	Rocky Mount.IDF	Asc/Rec limb fact	=	1/1

* Composite (Area/C) = [(22.220 x 0.40) + (10.250 x 0.32) + (12.300 x 0.40)] / 26.000



Hydrograph Report

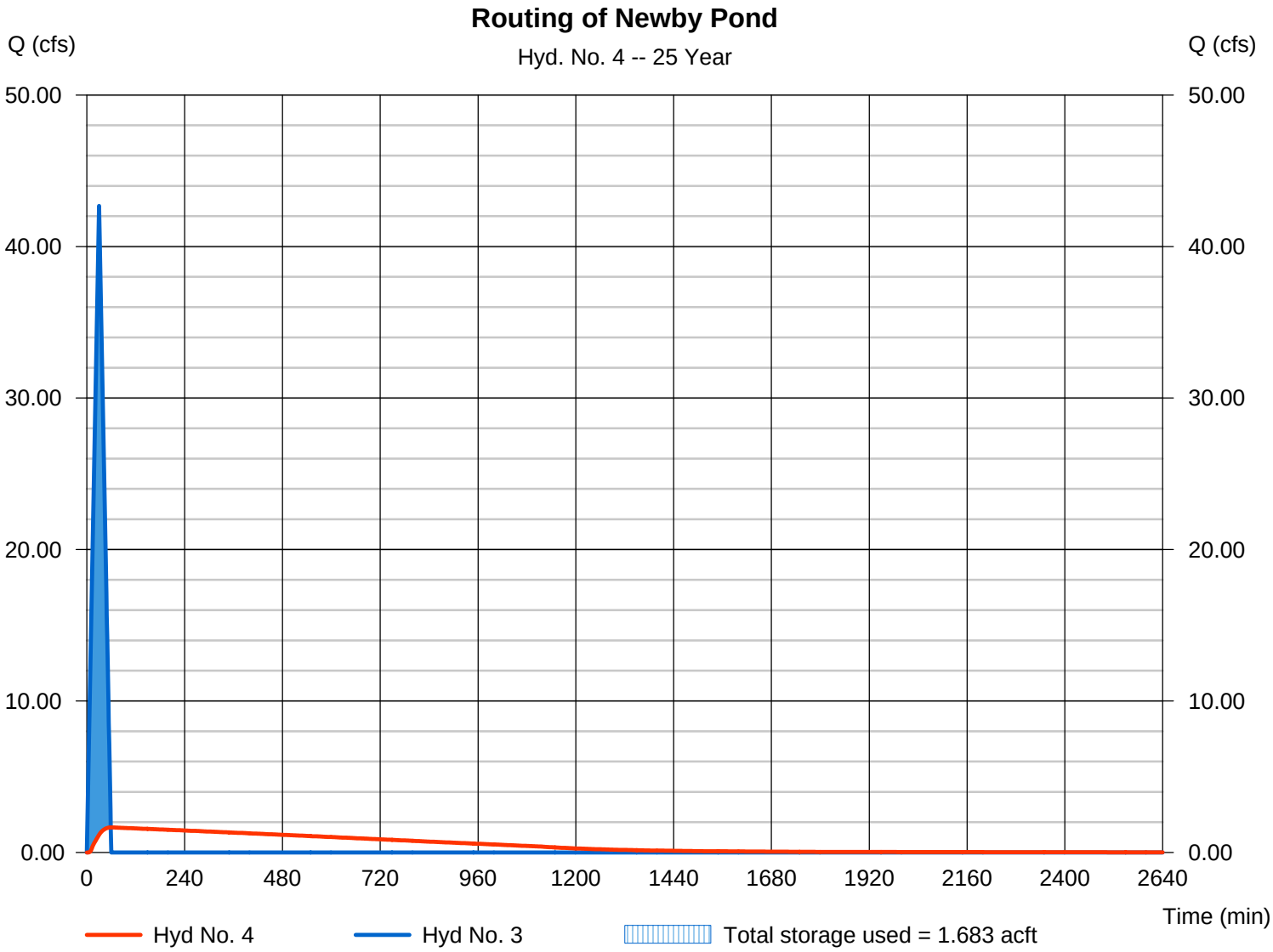
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2008 by Autodesk, Inc. v6.052 Thursday, Sep 17, 2009

Hyd. No. 4

Routing of Newby Pond

Hydrograph type	=	Reservoir	Peak discharge	=	1.656 cfs
Storm frequency	=	25 yrs	Time to peak	=	59 min
Time interval	=	1 min	Hyd. volume	=	1.740 acft
Inflow hyd. No.	=	3 - upper area	Max. Elevation	=	133.70 ft
Reservoir name	=	Newby	Max. Storage	=	1.683 acft

Storage Indication method used.



Pond Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2008 by Autodesk, Inc. v6.052 Thursday, Sep 17, 2009

Pond No. 2 - Newby

Pond Data

Trapezoid - Bottom L x W = 175.0 x 95.0 ft, Side slope = 3.00:1, Bottom elev. = 130.00 ft, Depth = 6.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (acft)	Total storage (acft)
0.00	130.00	16,625	0.000	0.000
0.60	130.60	17,610	0.236	0.236
1.20	131.20	18,621	0.249	0.485
1.80	131.80	19,658	0.264	0.749
2.40	132.40	20,720	0.278	1.027
3.00	133.00	21,809	0.293	1.320
3.60	133.60	22,924	0.308	1.628
4.20	134.20	24,064	0.324	1.951
4.80	134.80	25,230	0.339	2.291
5.40	135.40	26,423	0.356	2.647
6.00	136.00	27,641	0.372	3.019

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 24.00	6.00	12.00	0.00
Span (in)	= 24.00	6.00	144.00	0.00
No. Barrels	= 1	1	1	0
Invert El. (ft)	= 130.00	130.00	134.00	0.00
Length (ft)	= 200.00	0.00	0.00	0.00
Slope (%)	= 0.15	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	Yes	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 215.00	0.00	0.00	0.00
Crest El. (ft)	= 134.00	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= Rect	---	---	---
Multi-Stage	= No	No	No	No

Exfil.(in/hr) = 0.000 (by Contour)
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 acft	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	0.000	130.00	0.00	0.00	0.00	---	0.00	---	---	---	---	---	0.000
0.06	0.024	130.06	0.01 oc	0.01 ic	0.00	---	0.00	---	---	---	---	---	0.009
0.12	0.047	130.12	0.03 oc	0.03 ic	0.00	---	0.00	---	---	---	---	---	0.032
0.18	0.071	130.18	0.07 oc	0.07 ic	0.00	---	0.00	---	---	---	---	---	0.073
0.24	0.094	130.24	0.13 oc	0.12 ic	0.00	---	0.00	---	---	---	---	---	0.125
0.30	0.118	130.30	0.19 oc	0.19 ic	0.00	---	0.00	---	---	---	---	---	0.187
0.36	0.141	130.36	0.28 oc	0.26 ic	0.00	---	0.00	---	---	---	---	---	0.255
0.42	0.165	130.42	0.35 oc	0.33 ic	0.00	---	0.00	---	---	---	---	---	0.328
0.48	0.189	130.48	0.41 oc	0.40 ic	0.00	---	0.00	---	---	---	---	---	0.404
0.54	0.212	130.54	0.47 oc	0.45 ic	0.00	---	0.00	---	---	---	---	---	0.448
0.60	0.236	130.60	0.50 oc	0.49 ic	0.00	---	0.00	---	---	---	---	---	0.494
0.66	0.261	130.66	0.54 oc	0.54 ic	0.00	---	0.00	---	---	---	---	---	0.536
0.72	0.286	130.72	0.58 oc	0.57 ic	0.00	---	0.00	---	---	---	---	---	0.575
0.78	0.311	130.78	0.61 oc	0.61 ic	0.00	---	0.00	---	---	---	---	---	0.611
0.84	0.336	130.84	0.65 oc	0.64 ic	0.00	---	0.00	---	---	---	---	---	0.645
0.90	0.360	130.90	0.69 oc	0.68 ic	0.00	---	0.00	---	---	---	---	---	0.677
0.96	0.385	130.96	0.74 oc	0.71 ic	0.00	---	0.00	---	---	---	---	---	0.708
1.02	0.410	131.02	0.78 oc	0.74 ic	0.00	---	0.00	---	---	---	---	---	0.737
1.08	0.435	131.08	0.78 oc	0.77 ic	0.00	---	0.00	---	---	---	---	---	0.772
1.14	0.460	131.14	0.83 oc	0.80 ic	0.00	---	0.00	---	---	---	---	---	0.799
1.20	0.485	131.20	0.83 oc	0.83 ic	0.00	---	0.00	---	---	---	---	---	0.826
1.26	0.512	131.26	0.87 oc	0.86 ic	0.00	---	0.00	---	---	---	---	---	0.857
1.32	0.538	131.32	0.92 oc	0.88 ic	0.00	---	0.00	---	---	---	---	---	0.881
1.38	0.564	131.38	0.92 oc	0.91 ic	0.00	---	0.00	---	---	---	---	---	0.911
1.44	0.591	131.44	0.97 oc	0.93 ic	0.00	---	0.00	---	---	---	---	---	0.934
1.50	0.617	131.50	0.97 oc	0.96 ic	0.00	---	0.00	---	---	---	---	---	0.962
1.56	0.643	131.56	1.02 oc	0.98 ic	0.00	---	0.00	---	---	---	---	---	0.983
1.62	0.670	131.62	1.02 oc	1.01 ic	0.00	---	0.00	---	---	---	---	---	1.010
1.68	0.696	131.68	1.08 oc	1.03 ic	0.00	---	0.00	---	---	---	---	---	1.031
1.74	0.722	131.74	1.08 oc	1.06 ic	0.00	---	0.00	---	---	---	---	---	1.056
1.80	0.749	131.80	1.13 oc	1.08 ic	0.00	---	0.00	---	---	---	---	---	1.076
1.86	0.777	131.86	1.13 oc	1.10 ic	0.00	---	0.00	---	---	---	---	---	1.101
1.92	0.804	131.92	1.13 oc	1.12 ic	0.00	---	0.00	---	---	---	---	---	1.125
1.98	0.832	131.98	1.19 oc	1.14 ic	0.00	---	0.00	---	---	---	---	---	1.143

Continues on next page...

Newby

Stage / Storage / Discharge Table

Stage ft	Storage acft	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
2.04	0.860	132.04	1.19 oc	1.17 ic	0.00	---	0.00	---	---	---	---	---	1.166
2.10	0.888	132.10	1.19 oc	1.19 ic	0.00	---	0.00	---	---	---	---	---	1.186
2.16	0.916	132.16	1.24 oc	1.21 ic	0.00	---	0.00	---	---	---	---	---	1.206
2.22	0.943	132.22	1.24 oc	1.23 ic	0.00	---	0.00	---	---	---	---	---	1.228
2.28	0.971	132.28	1.30 oc	1.24 ic	0.00	---	0.00	---	---	---	---	---	1.245
2.34	0.999	132.34	1.30 oc	1.27 ic	0.00	---	0.00	---	---	---	---	---	1.266
2.40	1.027	132.40	1.30 oc	1.29 ic	0.00	---	0.00	---	---	---	---	---	1.287
2.46	1.056	132.46	1.36 oc	1.30 ic	0.00	---	0.00	---	---	---	---	---	1.303
2.52	1.085	132.52	1.36 oc	1.32 ic	0.00	---	0.00	---	---	---	---	---	1.323
2.58	1.115	132.58	1.36 oc	1.34 ic	0.00	---	0.00	---	---	---	---	---	1.343
2.64	1.144	132.64	1.36 oc	1.36 ic	0.00	---	0.00	---	---	---	---	---	1.362
2.70	1.173	132.70	1.42 oc	1.38 ic	0.00	---	0.00	---	---	---	---	---	1.378
2.76	1.203	132.76	1.42 oc	1.40 ic	0.00	---	0.00	---	---	---	---	---	1.398
2.82	1.232	132.82	1.42 oc	1.42 ic	0.00	---	0.00	---	---	---	---	---	1.417
2.88	1.261	132.88	1.49 oc	1.43 ic	0.00	---	0.00	---	---	---	---	---	1.431
2.94	1.290	132.94	1.49 oc	1.45 ic	0.00	---	0.00	---	---	---	---	---	1.450
3.00	1.320	133.00	1.49 oc	1.47 ic	0.00	---	0.00	---	---	---	---	---	1.468
3.06	1.351	133.06	1.49 oc	1.49 ic	0.00	---	0.00	---	---	---	---	---	1.486
3.12	1.381	133.12	1.55 oc	1.50 ic	0.00	---	0.00	---	---	---	---	---	1.500
3.18	1.412	133.18	1.55 oc	1.52 ic	0.00	---	0.00	---	---	---	---	---	1.518
3.24	1.443	133.24	1.55 oc	1.54 ic	0.00	---	0.00	---	---	---	---	---	1.535
3.30	1.474	133.30	1.55 oc	1.55 ic	0.00	---	0.00	---	---	---	---	---	1.551
3.36	1.505	133.36	1.62 oc	1.57 ic	0.00	---	0.00	---	---	---	---	---	1.566
3.42	1.535	133.42	1.62 oc	1.58 ic	0.00	---	0.00	---	---	---	---	---	1.583
3.48	1.566	133.48	1.62 oc	1.60 ic	0.00	---	0.00	---	---	---	---	---	1.599
3.54	1.597	133.54	1.62 oc	1.62 ic	0.00	---	0.00	---	---	---	---	---	1.616
3.60	1.628	133.60	1.68 oc	1.63 ic	0.00	---	0.00	---	---	---	---	---	1.629
3.66	1.660	133.66	1.68 oc	1.64 ic	0.00	---	0.00	---	---	---	---	---	1.645
3.72	1.693	133.72	1.68 oc	1.66 ic	0.00	---	0.00	---	---	---	---	---	1.661
3.78	1.725	133.78	1.68 oc	1.68 ic	0.00	---	0.00	---	---	---	---	---	1.677
3.84	1.757	133.84	1.75 oc	1.69 ic	0.00	---	0.00	---	---	---	---	---	1.689
3.90	1.790	133.90	1.75 oc	1.71 ic	0.00	---	0.00	---	---	---	---	---	1.705
3.96	1.822	133.96	1.75 oc	1.72 ic	0.00	---	0.00	---	---	---	---	---	1.721
4.02	1.854	134.02	1.89 oc	1.73 ic	0.12 ic	---	2.02	---	---	---	---	---	3.867
4.08	1.887	134.08	2.65 oc	1.70 ic	0.92 ic	---	16.20	---	---	---	---	---	18.82
4.14	1.919	134.14	3.80 oc	1.66 ic	2.14 ic	---	37.50	---	---	---	---	---	41.30
4.20	1.951	134.20	5.32 oc	1.60 ic	3.65 ic	---	64.04	---	---	---	---	---	69.29
4.26	1.985	134.26	6.93 oc	1.50 ic	5.42 ic	---	94.91	---	---	---	---	---	101.83
4.32	2.019	134.32	8.78 oc	1.38 ic	7.40 ic	---	129.60	---	---	---	---	---	138.37
4.38	2.053	134.38	10.89 oc	1.32 ic	9.57 ic	---	167.70	---	---	---	---	---	178.59
4.44	2.087	134.44	13.14 oc	1.22 ic	11.92 ic	---	208.95	---	---	---	---	---	222.09
4.50	2.121	134.50	15.52 oc	1.08 ic	14.44 ic	---	253.12	---	---	---	---	---	268.64
4.56	2.155	134.56	17.99 oc	0.87 ic	17.12 ic	---	300.02	---	---	---	---	---	318.00
4.62	2.189	134.62	20.45 oc	0.53 ic	19.93 ic	---	349.50	---	---	---	---	---	369.95
4.68	2.223	134.68	20.85 oc	0.49 ic	20.36 ic	---	401.44	---	---	---	---	---	422.29
4.74	2.257	134.74	21.20 oc	0.46 ic	20.74 ic	---	455.73	---	---	---	---	---	476.93
4.80	2.291	134.80	21.53 oc	0.43 ic	21.09 ic	---	512.30	---	---	---	---	---	533.82
4.86	2.326	134.86	21.83 oc	0.41 ic	21.42 ic	---	570.99	---	---	---	---	---	592.82
4.92	2.362	134.92	22.12 oc	0.39 ic	21.73 ic	---	631.78	---	---	---	---	---	653.90
4.98	2.398	134.98	22.39 oc	0.37 ic	22.02 ic	---	694.57	---	---	---	---	---	716.96
5.04	2.433	135.04	22.62 oc	0.36 ic	22.25 ic	---	759.33	---	---	---	---	---	781.94
5.10	2.469	135.10	22.82 oc	0.37 ic	22.45 ic	---	825.97	---	---	---	---	---	848.79
5.16	2.504	135.16	23.02 oc	0.37 ic	22.65 ic	---	894.46	---	---	---	---	---	917.48
5.22	2.540	135.22	23.22 oc	0.37 ic	22.84 ic	---	964.75	---	---	---	---	---	987.97
5.28	2.575	135.28	23.42 oc	0.38 ic	23.03 ic	---	1036.79	---	---	---	---	---	1060.20
5.34	2.611	135.34	23.61 oc	0.38 ic	23.23 ic	---	1110.53	---	---	---	---	---	1134.14
5.40	2.647	135.40	23.81 oc	0.38 ic	23.42 ic	---	1185.97	---	---	---	---	---	1209.77
5.46	2.684	135.46	24.00 oc	0.39 ic	23.61 ic	---	1263.01	---	---	---	---	---	1287.01
5.52	2.721	135.52	24.19 oc	0.39 ic	23.80 ic	---	1341.66	---	---	---	---	---	1365.85
5.58	2.758	135.58	24.38 oc	0.39 ic	23.98 ic	---	1421.88	---	---	---	---	---	1446.26
5.64	2.795	135.64	24.57 oc	0.40 ic	24.16 ic	---	1503.63	---	---	---	---	---	1528.19
5.70	2.833	135.70	24.75 oc	0.40 ic	24.35 ic	---	1586.90	---	---	---	---	---	1611.65
5.76	2.870	135.76	24.94 oc	0.40 ic	24.53 ic	---	1671.65	---	---	---	---	---	1696.58
5.82	2.907	135.82	25.12 oc	0.40 ic	24.71 ic	---	1757.85	---	---	---	---	---	1782.97
5.88	2.944	135.88	25.30 oc	0.41 ic	24.89 ic	---	1845.49	---	---	---	---	---	1870.78
5.94	2.982	135.94	25.48 oc	0.41 ic	25.07 ic	---	1934.53	---	---	---	---	---	1960.01
6.00	3.019	136.00	25.66 oc	0.41 ic	25.24 ic	---	2025.01	---	---	---	---	---	2050.67

...End

APPENDIX G

HEC-RAS Plan: Ex.StorageRt River: Mansfield Drive Reach: Reach 1

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Reach 1	226.5911	2-YEAR	432.00	89.00	95.18	92.36	95.44	0.002002	4.22	162.77	115.72	0.33
Reach 1	226.5911	10-YEAR	797.00	89.00	96.53	94.51	96.80	0.002001	4.91	374.62	196.36	0.34
Reach 1	226.5911	25-YEAR	1008.00	89.00	97.04	95.33	97.32	0.002001	5.17	478.45	209.78	0.34
Reach 1	226.5911	50-YEAR	1153.00	89.00	97.36	95.68	97.64	0.002001	5.32	548.68	228.29	0.34
Reach 1	226.5911	100-YEAR	1268.00	89.00	97.59	95.82	97.87	0.002002	5.44	603.60	241.78	0.35
Reach 1	561.3285	2-YEAR	415.00	92.00	96.09		96.28	0.003234	4.20	156.16	124.43	0.40
Reach 1	561.3285	10-YEAR	751.00	92.00	97.32		97.45	0.001748	3.78	318.37	145.48	0.31
Reach 1	561.3285	25-YEAR	946.00	92.00	97.80		97.93	0.001572	3.82	389.80	151.52	0.29
Reach 1	561.3285	50-YEAR	1070.00	92.00	98.12		98.25	0.001561	3.96	440.00	171.54	0.30
Reach 1	561.3285	100-YEAR	1181.00	92.00	98.34		98.47	0.001518	4.01	479.24	177.66	0.29
Reach 1	936.8371	2-YEAR	415.00	93.00	97.76	97.67	98.23	0.008590	6.25	113.52	106.52	0.58
Reach 1	936.8371	10-YEAR	751.00	93.00	98.32		98.93	0.010875	7.75	177.75	120.19	0.67
Reach 1	936.8371	25-YEAR	946.00	93.00	98.70		99.26	0.009858	7.82	225.09	129.06	0.65
Reach 1	936.8371	50-YEAR	1070.00	93.00	99.01		99.50	0.008385	7.53	265.72	136.71	0.60
Reach 1	936.8371	100-YEAR	1181.00	93.00	99.21		99.68	0.008007	7.56	293.13	141.52	0.59
Reach 1	1131.113	2-YEAR	415.00	93.85	99.00	97.21	99.34	0.003862	4.92	102.27	49.25	0.42
Reach 1	1131.113	10-YEAR	751.00	93.85	99.83	98.80	100.38	0.005311	6.49	152.83	89.44	0.50
Reach 1	1131.113	25-YEAR	946.00	93.85	100.15	99.58	100.77	0.005980	7.17	203.29	124.89	0.54
Reach 1	1131.113	50-YEAR	1070.00	93.85	100.32	99.79	100.96	0.006135	7.42	225.15	129.95	0.55
Reach 1	1131.113	100-YEAR	1181.00	93.85	100.48	100.31	101.12	0.006096	7.54	246.49	134.71	0.55
Reach 1	1210.67		Culvert									
Reach 1	1240.228	2-YEAR	415.00	94.34	101.02	97.69	101.03	0.000092	0.93	589.72	228.86	0.07
Reach 1	1240.228	10-YEAR	751.00	94.34	101.57	99.12	101.60	0.000173	1.35	721.27	246.49	0.09
Reach 1	1240.228	25-YEAR	946.00	94.34	101.78	99.51	101.81	0.000227	1.58	772.94	253.08	0.11
Reach 1	1240.228	50-YEAR	1070.00	94.34	101.95	99.71	101.98	0.000251	1.69	815.32	258.36	0.11
Reach 1	1240.228	100-YEAR	1181.00	94.34	102.04	99.88	102.07	0.000283	1.81	838.40	261.19	0.12
Reach 1	1290.228	2-YEAR	356.00	94.76	101.03		101.04	0.000077	0.80	552.51	229.07	0.06
Reach 1	1290.228	10-YEAR	566.00	94.76	101.59		101.60	0.000108	1.01	686.88	247.05	0.08
Reach 1	1290.228	25-YEAR	700.00	94.76	101.81		101.82	0.000135	1.16	740.47	253.86	0.09
Reach 1	1290.228	50-YEAR	792.00	94.76	101.98		101.99	0.000148	1.24	783.87	259.25	0.09
Reach 1	1290.228	100-YEAR	861.00	94.76	102.07		102.09	0.000161	1.31	808.32	262.24	0.09
Reach 1	1934.031	2-YEAR	356.00	96.00	100.91	99.92	101.32	0.007585	5.42	87.88	66.67	0.56
Reach 1	1934.031	10-YEAR	566.00	96.00	101.71	101.42	101.85	0.003063	4.00	308.32	314.61	0.37
Reach 1	1934.031	25-YEAR	700.00	96.00	101.98	101.54	102.09	0.002545	3.82	394.10	322.88	0.34
Reach 1	1934.031	50-YEAR	792.00	96.00	102.17	101.61	102.27	0.002186	3.66	456.72	324.84	0.32

HEC-RAS Plan: Ex.StorageRt River: Mansfield Drive Reach: Reach 1 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Reach 1	1934.031	100-YEAR	861.00	96.00	102.28	101.66	102.37	0.002081	3.63	493.34	325.65	0.31
Reach 1	2346.988	2-YEAR	356.00	99.00	103.81		104.19	0.006380	5.38	78.71	53.84	0.52
Reach 1	2346.988	10-YEAR	566.00	99.00	103.88	103.88	104.77	0.014425	8.21	82.68	56.02	0.79
Reach 1	2346.988	25-YEAR	700.00	99.00	104.42	104.42	105.07	0.009634	7.41	122.69	83.29	0.66
Reach 1	2346.988	50-YEAR	792.00	99.00	104.55	104.55	105.23	0.009907	7.68	133.79	85.68	0.68
Reach 1	2346.988	100-YEAR	861.00	99.00	104.64	104.64	105.35	0.010056	7.86	141.94	87.39	0.68
Reach 1	2446.988	2-YEAR	356.00	99.00	104.39	102.75	104.64	0.002768	4.16	93.82	82.86	0.36
Reach 1	2446.988	10-YEAR	566.00	99.00	105.18	103.61	105.52	0.003143	4.97	127.83	149.98	0.39
Reach 1	2446.988	25-YEAR	700.00	99.00	105.25	104.07	105.75	0.004456	5.98	131.33	152.12	0.47
Reach 1	2446.988	50-YEAR	792.00	99.00	105.38	104.35	105.95	0.005024	6.45	137.31	155.77	0.50
Reach 1	2446.988	100-YEAR	861.00	99.00	105.46	104.54	106.10	0.005487	6.81	141.11	158.09	0.52
Reach 1	2529.61		Culvert									
Reach 1	2612.216	2-YEAR	356.00	99.80	105.18	104.16	105.41	0.002026	4.50	108.75	67.18	0.37
Reach 1	2612.216	10-YEAR	566.00	99.80	106.92	104.89	107.03	0.000689	3.24	232.90	120.80	0.23
Reach 1	2612.216	25-YEAR	700.00	99.80	108.10	105.25	108.18	0.000379	2.69	325.69	240.76	0.17
Reach 1	2612.216	50-YEAR	792.00	99.80	109.08	105.40	109.14	0.000246	2.36	403.09	338.12	0.14
Reach 1	2612.216	100-YEAR	861.00	99.80	109.55	105.52	109.60	0.000201	2.20	591.84	352.49	0.13
Reach 1	2983.577	2-YEAR	327.00	102.00	106.26	105.75	106.89	0.007809	6.63	76.16	139.12	0.72
Reach 1	2983.577	10-YEAR	535.00	102.00	107.30		107.55	0.002879	5.02	250.79	212.11	0.46
Reach 1	2983.577	25-YEAR	706.00	102.00	108.30		108.39	0.000961	3.40	476.76	244.44	0.28
Reach 1	2983.577	50-YEAR	815.00	102.00	109.21		109.26	0.000446	2.61	716.50	292.68	0.19
Reach 1	2983.577	100-YEAR	895.00	102.00	109.65		109.69	0.000324	2.33	845.02	296.44	0.17
Reach 1	3631.216	2-YEAR	327.00	103.00	108.75		108.95	0.001666	3.85	108.10	72.94	0.33
Reach 1	3631.216	10-YEAR	535.00	103.00	109.10	107.35	109.48	0.002949	5.34	135.93	83.61	0.44
Reach 1	3631.216	25-YEAR	706.00	103.00	109.13		109.76	0.004990	6.96	137.91	83.93	0.58
Reach 1	3631.216	50-YEAR	815.00	103.00	109.54		110.06	0.004084	6.57	173.63	89.62	0.53
Reach 1	3631.216	100-YEAR	895.00	103.00	109.86		110.30	0.003438	6.22	203.19	94.07	0.49
Reach 1	3876.848	2-YEAR	327.00	104.00	109.29	107.88	109.67	0.005033	5.23	96.39	167.13	0.49
Reach 1	3876.848	10-YEAR	535.00	104.00	110.01	109.66	110.19	0.002708	4.31	230.35	193.22	0.37
Reach 1	3876.848	25-YEAR	706.00	104.00	110.44	109.85	110.58	0.002157	4.10	314.79	205.90	0.34
Reach 1	3876.848	50-YEAR	815.00	104.00	110.65	109.95	110.78	0.002040	4.10	358.73	212.21	0.33
Reach 1	3876.848	100-YEAR	895.00	104.00	110.81	110.00	110.95	0.001904	4.06	394.91	217.26	0.32
Reach 1	4046.245	2-YEAR	159.00	104.00	109.91		109.95	0.000404	1.80	136.41	107.13	0.15
Reach 1	4046.245	10-YEAR	178.00	104.00	110.37		110.40	0.000284	1.61	201.95	156.37	0.13

HEC-RAS Plan: Ex.StorageRt River: Mansfield Drive Reach: Reach 1 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Reach 1	4046.245	25-YEAR	202.00	104.00	110.73		110.76	0.000221	1.49	260.84	166.26	0.12
Reach 1	4046.245	50-YEAR	215.00	104.00	110.94		110.96	0.000193	1.43	294.78	171.70	0.11
Reach 1	4046.245	100-YEAR	228.00	104.00	111.09		111.11	0.000184	1.43	322.75	183.92	0.11
Reach 1	4934.843	2-YEAR	159.00	109.00	112.10	112.10	113.19	0.026346	8.36	19.01	8.77	1.00
Reach 1	4934.843	10-YEAR	178.00	109.00	112.29	112.29	113.44	0.026138	8.58	20.74	9.10	1.00
Reach 1	4934.843	25-YEAR	202.00	109.00	112.53	112.53	113.73	0.025679	8.80	22.95	9.50	1.00
Reach 1	4934.843	50-YEAR	215.00	109.00	112.65	112.65	113.89	0.025660	8.94	24.06	9.70	1.00
Reach 1	4934.843	100-YEAR	228.00	109.00	112.76	112.76	114.03	0.025544	9.05	25.18	9.89	1.00
Reach 1	5405.203	2-YEAR	159.00	114.00	117.63	116.37	117.80	0.004939	3.27	49.27	39.21	0.40
Reach 1	5405.203	10-YEAR	178.00	114.00	117.78	116.50	117.94	0.004768	3.29	56.16	57.32	0.39
Reach 1	5405.203	25-YEAR	202.00	114.00	117.91	116.65	118.06	0.004530	3.27	64.70	73.85	0.39
Reach 1	5405.203	50-YEAR	215.00	114.00	117.97	116.74	118.12	0.004380	3.25	69.34	81.43	0.38
Reach 1	5405.203	100-YEAR	228.00	114.00	118.02	116.81	118.17	0.004249	3.23	73.50	86.40	0.38
Reach 1	5567.782	2-YEAR	159.00	116.00	118.46	118.46	119.26	0.034822	7.15	22.23	13.97	1.00
Reach 1	5567.782	10-YEAR	178.00	116.00	118.61	118.61	119.44	0.034242	7.33	24.28	14.49	1.00
Reach 1	5567.782	25-YEAR	202.00	116.00	118.77	118.77	119.66	0.033715	7.54	26.77	15.10	1.00
Reach 1	5567.782	50-YEAR	215.00	116.00	118.86	118.86	119.77	0.033482	7.65	28.09	15.41	1.00
Reach 1	5567.782	100-YEAR	228.00	116.00	118.94	118.94	119.88	0.033254	7.76	29.40	15.71	1.00
Reach 1	5667.782	2-YEAR	159.00	116.00	120.15	118.46	120.29	0.003714	3.09	51.48	21.10	0.35
Reach 1	5667.782	10-YEAR	178.00	116.00	120.34	118.61	120.50	0.003796	3.20	55.63	21.97	0.35
Reach 1	5667.782	25-YEAR	202.00	116.00	120.57	118.77	120.74	0.003880	3.33	60.72	22.99	0.36
Reach 1	5667.782	50-YEAR	215.00	116.00	120.68	118.86	120.86	0.003919	3.39	63.42	23.52	0.36
Reach 1	5667.782	100-YEAR	228.00	116.00	120.79	118.94	120.98	0.003955	3.45	66.08	24.02	0.37
Reach 1	5762.91		Culvert									
Reach 1	5858.043	2-YEAR	159.00	117.70	124.30	119.82	124.31	0.000034	0.72	281.02	167.46	0.06
Reach 1	5858.043	10-YEAR	178.00	117.70	124.41	119.95	124.42	0.000038	0.77	294.23	171.34	0.06
Reach 1	5858.043	25-YEAR	202.00	117.70	124.50	120.09	124.50	0.000045	0.85	304.03	174.16	0.06
Reach 1	5858.043	50-YEAR	215.00	117.70	124.58	120.16	124.58	0.000047	0.87	313.65	176.90	0.07
Reach 1	5858.043	100-YEAR	228.00	117.70	124.60	120.23	124.61	0.000051	0.92	316.88	177.81	0.07
Reach 1	5938.291	2-YEAR	167.00	118.00	124.28		124.34	0.000510	2.00	84.13	30.33	0.19
Reach 1	5938.291	10-YEAR	178.00	118.00	124.39		124.46	0.000526	2.07	87.71	33.40	0.19
Reach 1	5938.291	25-YEAR	202.00	118.00	124.47		124.55	0.000634	2.29	90.38	35.51	0.21
Reach 1	5938.291	50-YEAR	215.00	118.00	124.55		124.63	0.000672	2.38	93.22	37.63	0.22
Reach 1	5938.291	100-YEAR	228.00	118.00	124.57		124.67	0.000741	2.51	94.11	38.26	0.23

HEC-RAS Plan: Ex.StorageRt River: Mansfield Drive Reach: Reach 1 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Reach 1	6061.843	2-YEAR	167.00	119.00	124.36	121.37	124.39	0.000233	1.50	149.82	115.43	0.14
Reach 1	6061.843	10-YEAR	178.00	119.00	124.48	121.44	124.51	0.000221	1.49	163.91	123.42	0.13
Reach 1	6061.843	25-YEAR	202.00	119.00	124.58	121.60	124.61	0.000244	1.59	176.39	130.09	0.14
Reach 1	6061.843	50-YEAR	215.00	119.00	124.67	121.69	124.70	0.000242	1.61	187.90	135.95	0.14
Reach 1	6061.843	100-YEAR	228.00	119.00	124.70	121.76	124.74	0.000258	1.67	192.92	138.42	0.15
Reach 1	6123.71		Culvert									
Reach 1	6185.588	2-YEAR	167.00	119.20	125.75	121.95	125.76	0.000017	0.52	336.34	196.61	0.04
Reach 1	6185.588	10-YEAR	178.00	119.20	126.01	122.03	126.02	0.000016	0.51	359.36	225.37	0.04
Reach 1	6185.588	25-YEAR	202.00	119.20	126.51	122.09	126.51	0.000014	0.51	402.88	239.76	0.03
Reach 1	6185.588	50-YEAR	215.00	119.20	126.83	122.13	126.83	0.000013	0.50	431.04	249.07	0.03
Reach 1	6185.588	100-YEAR	228.00	119.20	127.16	122.16	127.16	0.000012	0.49	460.03	261.15	0.03
Reach 1	6318.029	2-YEAR	49.00	120.00	125.76		125.76	0.000012	0.34	378.16	220.71	0.03
Reach 1	6318.029	10-YEAR	171.00	120.00	126.02		126.02	0.000101	1.02	436.44	231.08	0.08
Reach 1	6318.029	25-YEAR	172.00	120.00	126.51		126.52	0.000054	0.79	554.47	245.61	0.06
Reach 1	6318.029	50-YEAR	172.00	120.00	126.83		126.83	0.000037	0.68	634.76	255.03	0.05
Reach 1	6318.029	100-YEAR	172.00	120.00	127.16		127.16	0.000026	0.59	720.41	263.50	0.04
Reach 1	6386.012	2-YEAR	49.00	121.60	125.74	123.19	125.78	0.000617	1.55	35.44	48.43	0.16
Reach 1	6386.012	10-YEAR	171.00	121.60	125.86	124.75	126.22	0.006037	4.97	42.22	66.62	0.51
Reach 1	6386.012	25-YEAR	172.00	121.60	126.50	124.77	126.55	0.001005	2.31	128.60	185.10	0.22
Reach 1	6386.012	50-YEAR	172.00	121.60	126.83	124.77	126.85	0.000373	1.50	195.47	215.36	0.13
Reach 1	6386.012	100-YEAR	172.00	121.60	127.16	124.77	127.17	0.000155	1.02	270.30	231.65	0.09
Reach 1	6447.81		Culvert									
Reach 1	6509.500	2-YEAR	49.00	121.80	125.81	123.14	125.82	0.000136	0.90	69.24	81.98	0.10
Reach 1	6509.500	10-YEAR	171.00	121.80	126.47	124.40	126.51	0.000396	1.78	133.13	105.22	0.17
Reach 1	6509.500	25-YEAR	172.00	121.80	126.70	124.41	126.72	0.000261	1.51	157.67	111.29	0.14
Reach 1	6509.500	50-YEAR	172.00	121.80	126.87	124.41	126.89	0.000192	1.33	177.56	115.97	0.12
Reach 1	6509.500	100-YEAR	172.00	121.80	127.17	124.41	127.19	0.000165	1.30	227.96	279.95	0.11
Reach 1	6672.867	2-YEAR	111.00	122.78	125.85		125.86	0.000402	1.54	154.86	115.35	0.16
Reach 1	6672.867	10-YEAR	217.00	122.78	126.56		126.58	0.000485	1.96	269.82	182.69	0.18
Reach 1	6672.867	25-YEAR	298.00	122.78	126.77		126.79	0.000636	2.33	308.07	190.27	0.21
Reach 1	6672.867	50-YEAR	351.00	122.78	126.93		126.96	0.000673	2.46	340.13	196.40	0.22
Reach 1	6672.867	100-YEAR	393.00	122.78	127.23		127.25	0.000588	2.41	403.99	228.54	0.20

HEC-RAS Plan: Ex.StorageRt River: Mansfield Drive Reach: Reach 2

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Reach 2	187.7009	2-YEAR	153.00	106.00	110.46	108.76	110.57	0.002404	3.06	77.76	69.98	0.30
Reach 2	187.7009	10-YEAR	245.00	106.00	111.09	109.73	111.21	0.002402	3.45	125.91	90.85	0.31
Reach 2	187.7009	25-YEAR	351.00	106.00	111.58	110.43	111.71	0.002400	3.73	172.48	99.23	0.32
Reach 2	187.7009	50-YEAR	422.00	106.00	111.85	110.64	111.99	0.002400	3.89	200.91	104.02	0.32
Reach 2	187.7009	100-YEAR	470.00	106.00	112.12	110.77	112.26	0.002401	4.04	231.81	129.52	0.32
Reach 2	457.8682	2-YEAR	153.00	108.00	111.46	110.72	111.92	0.012386	5.47	27.98	12.18	0.64
Reach 2	457.8682	10-YEAR	245.00	108.00	112.02	111.49	112.77	0.017286	6.97	35.13	13.49	0.76
Reach 2	457.8682	25-YEAR	351.00	108.00	112.33	112.20	113.56	0.026014	8.89	39.46	14.23	0.94
Reach 2	457.8682	50-YEAR	422.00	108.00	112.61	112.61	114.07	0.028965	9.70	43.52	14.89	1.00
Reach 2	457.8682	100-YEAR	470.00	108.00	112.86	112.86	114.39	0.028603	9.91	47.42	15.50	1.00
Reach 2	557.8682	2-YEAR	153.00	108.00	112.47	110.73	112.68	0.004317	3.68	41.52	14.57	0.38
Reach 2	557.8682	10-YEAR	245.00	108.00	113.45	111.49	113.74	0.004796	4.31	56.85	16.87	0.41
Reach 2	557.8682	25-YEAR	351.00	108.00	114.35	112.20	114.66	0.004008	4.60	91.92	72.04	0.39
Reach 2	557.8682	50-YEAR	422.00	108.00	114.88	112.61	115.17	0.003355	4.55	119.02	81.55	0.37
Reach 2	557.8682	100-YEAR	470.00	108.00	115.19	112.86	115.47	0.003100	4.56	134.58	85.93	0.36
Reach 2	636.2772		Culvert									
Reach 2	714.6862	2-YEAR	153.00	110.33	115.94	113.67	115.96	0.000338	1.34	135.62	70.34	0.11
Reach 2	714.6862	10-YEAR	245.00	110.33	118.54	114.43	118.55	0.000047	0.67	407.38	126.62	0.04
Reach 2	714.6862	25-YEAR	351.00	110.33	119.29	114.81	119.30	0.000055	0.78	508.74	148.01	0.05
Reach 2	714.6862	50-YEAR	422.00	110.33	119.61	115.03	119.62	0.000063	0.85	556.79	155.25	0.05
Reach 2	714.6862	100-YEAR	470.00	110.33	119.78	115.12	119.79	0.000068	0.90	584.56	159.28	0.05
Reach 2	764.6862	2-YEAR	97.00	112.00	115.93		116.03	0.002834	2.87	42.03	42.51	0.30
Reach 2	764.6862	10-YEAR	171.00	112.00	118.55		118.55	0.000064	0.66	296.72	126.67	0.05
Reach 2	764.6862	25-YEAR	226.00	112.00	119.30		119.30	0.000052	0.64	398.53	148.14	0.05
Reach 2	764.6862	50-YEAR	263.00	112.00	119.61		119.62	0.000051	0.66	446.89	155.42	0.05
Reach 2	764.6862	100-YEAR	290.00	112.00	119.79		119.80	0.000052	0.68	474.86	159.47	0.05
Reach 2	1536.607	2-YEAR	97.00	117.00	120.02	119.19	120.36	0.015016	4.68	20.73	9.74	0.57
Reach 2	1536.607	10-YEAR	171.00	117.00	120.01	120.01	121.07	0.047067	8.28	20.66	9.72	1.00
Reach 2	1536.607	25-YEAR	226.00	117.00	120.50	120.50	121.71	0.045850	8.80	25.67	10.66	1.00
Reach 2	1536.607	50-YEAR	263.00	117.00	120.79	120.79	122.08	0.045304	9.11	28.87	11.22	1.00
Reach 2	1536.607	100-YEAR	290.00	117.00	121.00	121.00	122.34	0.044762	9.30	31.20	11.60	1.00

HEC-RAS Plan: QC_Proposed River: Mansfield Drive Reach: Reach 1

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Reach 1	226.5911	2-YEAR	501.00	89.00	95.50	92.69	95.77	0.002003	4.39	202.45	132.07	0.33
Reach 1	226.5911	10-YEAR	817.00	89.00	96.58	94.53	96.86	0.002001	4.94	384.87	197.58	0.34
Reach 1	226.5911	25-YEAR	1030.00	89.00	97.09	95.45	97.37	0.002002	5.19	488.99	212.66	0.34
Reach 1	226.5911	50-YEAR	1167.00	89.00	97.39	95.70	97.67	0.002001	5.34	555.45	230.00	0.35
Reach 1	226.5911	100-YEAR	1299.00	89.00	97.66	95.91	97.93	0.002000	5.46	618.72	245.37	0.35
Reach 1	561.3285	2-YEAR	481.00	90.00	96.25		96.41	0.001802	3.74	200.75	125.57	0.29
Reach 1	561.3285	10-YEAR	769.00	90.00	97.29		97.42	0.001362	3.68	338.50	145.13	0.26
Reach 1	561.3285	25-YEAR	962.00	90.00	97.79		97.91	0.001271	3.74	411.73	151.33	0.26
Reach 1	561.3285	50-YEAR	1087.00	90.00	98.09		98.22	0.001306	3.91	459.25	170.76	0.26
Reach 1	561.3285	100-YEAR	1210.00	90.00	98.35		98.48	0.001277	3.96	504.56	177.84	0.26
Reach 1	936.8371	2-YEAR	481.00	92.00	97.01	96.70	98.44	0.022742	9.58	51.26	87.73	0.89
Reach 1	936.8371	10-YEAR	769.00	92.00	98.15	98.15	98.88	0.011153	8.06	167.72	116.24	0.65
Reach 1	936.8371	25-YEAR	962.00	92.00	98.41		99.20	0.012189	8.73	198.34	122.23	0.69
Reach 1	936.8371	50-YEAR	1087.00	92.00	98.79		99.41	0.009490	8.09	246.37	131.08	0.62
Reach 1	936.8371	100-YEAR	1210.00	92.00	99.04		99.62	0.008692	7.98	279.98	137.47	0.59
Reach 1	1131.113	2-YEAR	481.00	92.50	99.17	95.06	99.29	0.000836	2.81	188.14	74.92	0.20
Reach 1	1131.113	10-YEAR	769.00	92.50	99.46	95.96	99.72	0.001738	4.19	205.84	81.32	0.30
Reach 1	1131.113	25-YEAR	962.00	92.50	99.83	96.48	100.16	0.002102	4.79	228.49	89.52	0.33
Reach 1	1131.113	50-YEAR	1087.00	92.50	99.93	96.79	100.33	0.002507	5.28	234.63	91.74	0.36
Reach 1	1131.113	100-YEAR	1210.00	92.50	100.09	97.09	100.54	0.002785	5.65	271.46	123.14	0.38
Reach 1	1210.67		Culvert									
Reach 1	1240.228	2-YEAR	481.00	93.00	99.38	95.50	99.48	0.000704	2.52	208.17	164.30	0.19
Reach 1	1240.228	10-YEAR	769.00	93.00	100.00	96.35	100.17	0.001149	3.46	243.43	198.37	0.25
Reach 1	1240.228	25-YEAR	962.00	93.00	100.91	96.84	100.95	0.000304	1.95	629.14	218.57	0.13
Reach 1	1240.228	50-YEAR	1087.00	93.00	101.32	97.13	101.36	0.000269	1.91	746.27	238.41	0.12
Reach 1	1240.228	100-YEAR	1210.00	93.00	101.83	97.41	101.86	0.000222	1.81	871.36	254.58	0.11
Reach 1	1290.228	2-YEAR	419.00	93.92	99.48		99.53	0.000688	1.99	258.43	155.71	0.18
Reach 1	1290.228	10-YEAR	594.00	93.92	100.21		100.25	0.000543	1.98	388.94	203.04	0.16
Reach 1	1290.228	25-YEAR	721.00	93.92	100.94		100.97	0.000328	1.69	542.18	219.20	0.13
Reach 1	1290.228	50-YEAR	837.00	93.92	101.34		101.38	0.000288	1.66	636.43	239.17	0.12
Reach 1	1290.228	100-YEAR	940.00	93.92	101.85		101.88	0.000224	1.55	761.09	255.23	0.11
Reach 1	1934.031	2-YEAR	419.00	96.00	100.59	100.59	101.43	0.016024	7.58	68.00	55.22	0.80
Reach 1	1934.031	10-YEAR	594.00	96.00	101.44	101.44	101.77	0.006624	5.60	226.77	306.53	0.53
Reach 1	1934.031	25-YEAR	721.00	96.00	101.55	101.55	101.90	0.007269	6.00	260.98	309.94	0.56
Reach 1	1934.031	50-YEAR	837.00	96.00	101.66	101.64	102.01	0.007557	6.23	292.84	313.09	0.57

HEC-RAS Plan: QC_Proposed River: Mansfield Drive Reach: Reach 1 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Reach 1	1934.031	100-YEAR	940.00	96.00	102.14	101.71	102.29	0.003248	4.44	448.01	324.65	0.38
Reach 1	2346.988	2-YEAR	419.00	99.00	104.28		104.57	0.004333	4.86	111.87	80.89	0.44
Reach 1	2346.988	10-YEAR	594.00	99.00	104.32		104.86	0.008216	6.73	114.57	81.49	0.61
Reach 1	2346.988	25-YEAR	721.00	99.00	104.56		105.12	0.008097	6.96	134.52	85.83	0.61
Reach 1	2346.988	50-YEAR	837.00	99.00	104.73		105.33	0.008237	7.22	149.96	89.04	0.62
Reach 1	2346.988	100-YEAR	940.00	99.00	105.09	105.09	105.67	0.007819	7.43	187.31	147.42	0.61
Reach 1	2446.988	2-YEAR	419.00	99.00	104.64	103.03	104.93	0.002939	4.46	104.03	87.46	0.37
Reach 1	2446.988	10-YEAR	594.00	99.00	105.04	103.71	105.46	0.003989	5.49	121.22	145.93	0.44
Reach 1	2446.988	25-YEAR	721.00	99.00	105.20	104.14	105.75	0.004967	6.27	129.05	150.72	0.49
Reach 1	2446.988	50-YEAR	837.00	99.00	105.38	104.47	106.02	0.005595	6.81	137.45	155.86	0.53
Reach 1	2446.988	100-YEAR	940.00	99.00	105.69	104.74	106.34	0.005262	6.86	151.91	164.69	0.52
Reach 1	2529.61		Culvert									
Reach 1	2612.216	2-YEAR	419.00	99.80	105.74	104.43	105.91	0.001367	3.98	143.07	80.82	0.31
Reach 1	2612.216	10-YEAR	594.00	99.80	107.06	104.97	107.17	0.000660	3.22	244.13	206.03	0.22
Reach 1	2612.216	25-YEAR	721.00	99.80	108.35	105.28	108.42	0.000334	2.58	345.47	245.64	0.16
Reach 1	2612.216	50-YEAR	837.00	99.80	109.47	105.48	109.52	0.000203	2.21	575.68	350.11	0.13
Reach 1	2612.216	100-YEAR	940.00	99.80	109.70	105.64	109.75	0.000209	2.27	624.50	357.27	0.13
Reach 1	2983.577	2-YEAR	402.00	102.00	106.49		107.09	0.007218	6.74	109.49	145.62	0.70
Reach 1	2983.577	10-YEAR	578.00	102.00	107.43		107.66	0.002598	4.88	278.67	215.20	0.44
Reach 1	2983.577	25-YEAR	742.00	102.00	108.53		108.60	0.000779	3.16	532.25	250.37	0.25
Reach 1	2983.577	50-YEAR	851.00	102.00	109.58		109.61	0.000318	2.29	822.47	295.79	0.17
Reach 1	2983.577	100-YEAR	939.00	102.00	109.81		109.85	0.000301	2.29	892.63	297.82	0.16
Reach 1	3631.216	2-YEAR	402.00	103.00	109.01		109.25	0.001864	4.20	128.28	82.33	0.35
Reach 1	3631.216	10-YEAR	578.00	103.00	109.17	107.55	109.57	0.003186	5.59	141.29	84.49	0.46
Reach 1	3631.216	25-YEAR	742.00	103.00	109.17		109.83	0.005249	7.17	141.30	84.49	0.59
Reach 1	3631.216	50-YEAR	851.00	103.00	109.78		110.22	0.003391	6.13	195.74	92.97	0.48
Reach 1	3631.216	100-YEAR	939.00	103.00	110.00		110.42	0.003255	6.13	216.55	96.01	0.48
Reach 1	3876.848	2-YEAR	402.00	104.00	109.62	108.34	109.87	0.003588	4.65	156.95	186.36	0.42
Reach 1	3876.848	10-YEAR	578.00	104.00	110.12	109.71	110.29	0.002533	4.24	252.31	196.60	0.36
Reach 1	3876.848	25-YEAR	742.00	104.00	110.51	109.88	110.65	0.002087	4.08	331.21	208.28	0.33
Reach 1	3876.848	50-YEAR	851.00	104.00	110.73	109.98	110.86	0.001953	4.06	376.70	214.73	0.32
Reach 1	3876.848	100-YEAR	939.00	104.00	110.91	110.05	111.04	0.001825	4.02	415.69	220.11	0.31
Reach 1	4046.245	2-YEAR	196.00	104.00	110.09		110.15	0.000518	2.09	159.35	148.81	0.17
Reach 1	4046.245	10-YEAR	236.00	104.00	110.47		110.52	0.000433	2.02	217.73	159.08	0.16

HEC-RAS Plan: QC_Proposed River: Mansfield Drive Reach: Reach 1 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Reach 1	4046.245	25-YEAR	326.00	104.00	110.81		110.87	0.000519	2.31	274.13	168.41	0.18
Reach 1	4046.245	50-YEAR	400.00	104.00	111.02		111.08	0.000623	2.60	309.09	181.11	0.20
Reach 1	4046.245	100-YEAR	401.00	104.00	111.18		111.24	0.000509	2.40	339.92	187.40	0.18
Reach 1	4934.843	2-YEAR	196.00	109.00	112.47	112.47	113.66	0.025811	8.75	22.40	9.40	1.00
Reach 1	4934.843	10-YEAR	236.00	109.00	112.83	112.83	114.12	0.025569	9.14	25.83	10.00	1.00
Reach 1	4934.843	25-YEAR	326.00	109.00	113.54	113.54	115.02	0.024699	9.77	33.36	11.21	1.00
Reach 1	4934.843	50-YEAR	400.00	109.00	114.61	114.61	115.52	0.011894	7.99	76.08	67.40	0.72
Reach 1	4934.843	100-YEAR	401.00	109.00	114.62	114.62	115.52	0.011808	7.97	76.73	67.59	0.72
Reach 1	5405.203	2-YEAR	196.00	114.00	117.88	116.62	118.04	0.004589	3.28	62.61	70.16	0.39
Reach 1	5405.203	10-YEAR	236.00	114.00	118.04	116.86	118.19	0.004153	3.22	75.81	87.54	0.37
Reach 1	5405.203	25-YEAR	326.00	114.00	118.30	117.32	118.47	0.003295	3.08	100.28	98.80	0.34
Reach 1	5405.203	50-YEAR	400.00	114.00	118.37	118.06	118.60	0.003996	3.45	107.24	101.77	0.37
Reach 1	5405.203	100-YEAR	401.00	114.00	118.37	118.07	118.60	0.004010	3.45	107.29	101.80	0.37
Reach 1	5567.782	2-YEAR	196.00	116.00	118.73	118.73	119.61	0.033929	7.50	26.13	14.94	1.00
Reach 1	5567.782	10-YEAR	236.00	116.00	118.99	118.99	119.94	0.033358	7.84	30.12	15.88	1.00
Reach 1	5567.782	25-YEAR	326.00	116.00	119.52	119.52	120.60	0.031958	8.32	39.19	18.27	1.00
Reach 1	5567.782	50-YEAR	400.00	116.00	119.89	119.89	121.05	0.031049	8.64	46.31	19.96	1.00
Reach 1	5567.782	100-YEAR	401.00	116.00	119.90	119.90	121.06	0.031056	8.64	46.40	19.98	1.00
Reach 1	5667.782	2-YEAR	196.00	116.00	120.51	118.73	120.68	0.003858	3.30	59.48	22.75	0.36
Reach 1	5667.782	10-YEAR	236.00	116.00	120.86	118.99	121.05	0.003968	3.48	67.75	24.33	0.37
Reach 1	5667.782	25-YEAR	326.00	116.00	121.50	119.52	121.73	0.004049	3.85	85.21	31.34	0.38
Reach 1	5667.782	50-YEAR	400.00	116.00	121.91	119.89	122.16	0.003831	4.05	99.91	40.67	0.38
Reach 1	5667.782	100-YEAR	401.00	116.00	121.91	119.90	122.17	0.003826	4.06	100.13	40.79	0.38
Reach 1	5762.91		Culvert									
Reach 1	5858.043	2-YEAR	196.00	116.00	121.24	119.03	121.36	0.001249	2.73	71.93	28.31	0.29
Reach 1	5858.043	10-YEAR	236.00	116.00	121.69	119.30	121.81	0.001057	2.78	87.74	42.21	0.28
Reach 1	5858.043	25-YEAR	326.00	116.00	122.67	119.82	122.76	0.000658	2.63	143.59	72.47	0.23
Reach 1	5858.043	50-YEAR	400.00	116.00	123.43	120.19	123.50	0.000425	2.37	196.99	107.37	0.19
Reach 1	5858.043	100-YEAR	401.00	116.00	123.44	120.20	123.51	0.000422	2.37	197.68	107.86	0.19
Reach 1	5938.291	2-YEAR	204.00	116.35	121.31		121.60	0.003124	4.30	47.42	15.13	0.43
Reach 1	5938.291	10-YEAR	242.00	116.35	121.73		122.04	0.003109	4.48	54.01	16.08	0.43
Reach 1	5938.291	25-YEAR	326.00	116.35	122.64		122.98	0.002875	4.68	69.60	18.12	0.42
Reach 1	5938.291	50-YEAR	400.00	116.35	123.36		123.72	0.002748	4.80	83.25	20.30	0.42
Reach 1	5938.291	100-YEAR	401.00	116.35	123.37		123.73	0.002746	4.81	83.44	20.33	0.42

HEC-RAS Plan: QC_Proposed River: Mansfield Drive Reach: Reach 1 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Reach 1	6061.843	2-YEAR	204.00	117.00	121.73	119.87	121.93	0.002088	3.63	56.22	19.18	0.37
Reach 1	6061.843	10-YEAR	242.00	117.00	122.16	120.14	122.38	0.002011	3.74	64.77	20.51	0.37
Reach 1	6061.843	25-YEAR	326.00	117.00	123.06	120.65	123.29	0.001775	3.86	84.59	27.12	0.36
Reach 1	6061.843	50-YEAR	400.00	117.00	123.78	121.05	123.99	0.001325	3.76	121.72	75.93	0.32
Reach 1	6061.843	100-YEAR	401.00	117.00	123.79	121.05	124.00	0.001318	3.75	122.47	76.60	0.32
Reach 1	6123.71		Culvert									
Reach 1	6185.588	2-YEAR	204.00	117.20	122.53	120.75	122.63	0.001325	3.03	90.11	87.81	0.25
Reach 1	6185.588	10-YEAR	242.00	117.20	123.25	121.88	123.30	0.000546	2.15	139.72	110.08	0.17
Reach 1	6185.588	25-YEAR	326.00	117.20	124.98	122.20	125.00	0.000126	1.25	280.47	167.80	0.08
Reach 1	6185.588	50-YEAR	400.00	117.20	126.68	122.35	126.70	0.000047	0.88	430.87	244.90	0.05
Reach 1	6185.588	100-YEAR	401.00	117.20	126.71	122.36	126.72	0.000046	0.88	433.03	245.62	0.05
Reach 1	6318.029	2-YEAR	88.00	117.90	122.73		122.80	0.000953	2.09	42.19	14.27	0.20
Reach 1	6318.029	10-YEAR	144.00	117.90	123.31		123.43	0.001473	2.86	55.03	39.67	0.26
Reach 1	6318.029	25-YEAR	189.00	117.90	124.99		125.03	0.000369	1.83	239.42	188.88	0.14
Reach 1	6318.029	50-YEAR	220.00	117.90	126.70		126.71	0.000059	0.88	620.35	251.22	0.06
Reach 1	6318.029	100-YEAR	245.00	117.90	126.73		126.73	0.000072	0.97	626.25	251.91	0.06
Reach 1	6386.012	2-YEAR	88.00	118.10	122.82	118.78	122.82	0.000044	0.59	149.15	36.03	0.05
Reach 1	6386.012	10-YEAR	144.00	118.10	123.47	119.04	123.48	0.000076	0.83	173.12	37.25	0.07
Reach 1	6386.012	25-YEAR	189.00	118.10	125.03	119.23	125.04	0.000055	0.81	233.57	40.17	0.06
Reach 1	6386.012	50-YEAR	220.00	118.10	126.70	119.35	126.71	0.000027	0.67	403.35	205.37	0.04
Reach 1	6386.012	100-YEAR	245.00	118.10	126.73	119.44	126.74	0.000033	0.74	408.28	207.71	0.05
Reach 1	6447.81		Culvert									
Reach 1	6509.500	2-YEAR	88.00	118.30	122.83	118.98	122.84	0.000039	0.61	143.39	36.03	0.05
Reach 1	6509.500	10-YEAR	144.00	118.30	123.50	119.24	123.51	0.000065	0.86	167.92	37.32	0.07
Reach 1	6509.500	25-YEAR	189.00	118.30	125.09	119.43	125.10	0.000045	0.82	230.01	44.56	0.06
Reach 1	6509.500	50-YEAR	220.00	118.30	126.73	119.55	126.74	0.000023	0.69	364.63	112.26	0.05
Reach 1	6509.500	100-YEAR	245.00	118.30	126.76	119.64	126.77	0.000028	0.76	368.02	113.07	0.05
Reach 1	6672.867	2-YEAR	45.00	119.03	122.83		122.85	0.000197	1.05	42.92	11.96	0.10
Reach 1	6672.867	10-YEAR	89.00	119.03	123.50		123.55	0.000477	1.75	50.95	12.18	0.15
Reach 1	6672.867	25-YEAR	122.00	119.03	125.09		125.12	0.000236	1.48	126.68	89.37	0.11
Reach 1	6672.867	50-YEAR	144.00	119.03	126.74		126.75	0.000059	0.87	351.84	189.19	0.06
Reach 1	6672.867	100-YEAR	162.00	119.03	126.77		126.78	0.000072	0.97	357.78	190.35	0.06

HEC-RAS Plan: QC_Proposed River: Mansfield Drive Reach: Reach 2

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Reach 2	187.7009	2-YEAR	151.00	106.00	110.44	108.75	110.56	0.002404	3.05	76.68	69.71	0.30
Reach 2	187.7009	10-YEAR	258.00	106.00	111.15	109.80	111.28	0.002402	3.48	131.98	91.98	0.31
Reach 2	187.7009	25-YEAR	358.00	106.00	111.60	110.45	111.74	0.002400	3.75	175.36	99.73	0.32
Reach 2	187.7009	50-YEAR	426.00	106.00	111.87	110.66	112.01	0.002400	3.90	202.46	104.27	0.32
Reach 2	187.7009	100-YEAR	480.00	106.00	112.15	110.79	112.29	0.002401	4.06	235.68	129.76	0.32
Reach 2	457.8682	2-YEAR	151.00	108.00	111.44	110.70	111.90	0.012273	5.43	27.80	12.14	0.63
Reach 2	457.8682	10-YEAR	258.00	108.00	112.07	111.59	112.87	0.018204	7.20	35.82	13.61	0.78
Reach 2	457.8682	25-YEAR	358.00	108.00	112.34	112.24	113.61	0.026730	9.03	39.65	14.26	0.95
Reach 2	457.8682	50-YEAR	426.00	108.00	112.62	112.62	114.10	0.029077	9.73	43.77	14.93	1.00
Reach 2	457.8682	100-YEAR	480.00	108.00	112.91	112.91	114.45	0.028618	9.97	48.16	15.61	1.00
Reach 2	557.8682	2-YEAR	151.00	108.00	112.30	109.95	112.43	0.002140	2.90	52.10	15.25	0.28
Reach 2	557.8682	10-YEAR	258.00	108.00	113.42	110.72	113.63	0.002778	3.68	70.08	16.88	0.32
Reach 2	557.8682	25-YEAR	358.00	108.00	114.28	111.33	114.53	0.002664	4.07	102.35	70.84	0.32
Reach 2	557.8682	50-YEAR	426.00	108.00	114.80	111.70	115.04	0.002410	4.13	128.63	80.10	0.31
Reach 2	557.8682	100-YEAR	480.00	108.00	115.16	111.98	115.40	0.002273	4.19	146.77	85.56	0.30
Reach 2	636.2772		Culvert									
Reach 2	714.6862	2-YEAR	151.00	108.33	113.42	110.24	113.49	0.000939	2.13	71.07	20.95	0.19
Reach 2	714.6862	10-YEAR	258.00	108.33	114.98	110.99	115.05	0.000670	2.26	132.97	58.48	0.17
Reach 2	714.6862	25-YEAR	358.00	108.33	116.01	111.57	116.07	0.000526	2.25	199.82	84.87	0.16
Reach 2	714.6862	50-YEAR	426.00	108.33	117.31	111.92	117.34	0.000236	1.70	321.40	109.15	0.11
Reach 2	714.6862	100-YEAR	480.00	108.33	118.16	112.18	118.18	0.000148	1.45	419.09	120.40	0.09
Reach 2	764.6862	2-YEAR	98.00	110.00	113.28		113.84	0.020245	5.98	16.39	6.97	0.69
Reach 2	764.6862	10-YEAR	176.00	110.00	114.79		115.39	0.015620	6.22	28.29	8.79	0.61
Reach 2	764.6862	25-YEAR	232.00	110.00	115.91		116.28	0.007583	5.19	53.33	41.86	0.44
Reach 2	764.6862	50-YEAR	269.00	110.00	117.32		117.37	0.000887	2.15	164.35	109.28	0.16
Reach 2	764.6862	100-YEAR	299.00	110.00	118.17		118.19	0.000288	1.35	262.38	120.60	0.09
Reach 2	1536.607	2-YEAR	98.00	117.00	120.95	119.21	121.11	0.005378	3.20	30.61	11.51	0.35
Reach 2	1536.607	10-YEAR	176.00	117.00	122.16	120.06	122.39	0.005863	3.83	45.96	13.81	0.37
Reach 2	1536.607	25-YEAR	232.00	117.00	122.31	120.55	122.67	0.009070	4.83	48.01	14.09	0.46
Reach 2	1536.607	50-YEAR	269.00	117.00	120.84	120.84	122.14	0.045019	9.14	29.43	11.31	1.00
Reach 2	1536.607	100-YEAR	299.00	117.00	121.06	121.06	122.42	0.044784	9.37	31.91	11.72	1.00

APPENDIX H

Project: Maple Creek Tributary #1, Rocky Mount, NC
Location: Winstead Road
Project # : 80450.00.RA
Date: 03/18/2009

Item No.	Item Description	Quantity	Unit	Unit Cost	Total Cost
1	Mobilization (5% of total cost)	1	LS	$ 19,400.00	$ 19,400.00
2	Comprehensive Grading[1]	1	LS	$ 77,500.00	$ 77,500.00
3	Clearing and Grubbing	1	LS	$ 3,000.00	$ 3,000.00
4	Bedding Material, Pipe Culverts	110	TN	$ 30.00	$ 3,300.00
5	Aggregate Base Course	25	TN	$ 40.00	$ 1,000.00
6	Bituminous Surface Course	10	TN	$ 85.00	$ 850.00
7	Masonary Drainage Endwalls	2	EA	$ 8,000.00	$ 16,000.00
8	12' x 5' Reinforced Concrete Box Culvert	140	LF	$ 1,800.00	$ 252,000.00
9	Remove/Dispose Excess Excavation	50	CY	$ 50.00	$ 2,500.00
10	Select Backfill/Unclassified Excavation	71	TN	$ 30.00	$ 2,116.80
11	Remove Existing Corrugated Metal Pipe	62	LF	$ 40.00	$ 2,480.00
12	Remove Existing Headwall	2	EA	$ 850.00	$ 1,700.00
13	Construction Staking	1	LS	$ 2,500.00	$ 2,500.00
14	Traffic Control	1	LS	$ 6,000.00	$ 6,000.00
15	Erosion Control	1	LS	$ 16,600.00	$ 16,600.00
				Subtotal	$406,950.00
	20% Contingency				$ 81,390.00
	Total Opinion of Probable Construction Cost[2]				$488,340.00
	Additional Items				
	Design, Permitting, and Administrative Costs[3]				$146,500.00
	Total Opinion of Probable Project Cost				**$634,840.00**

[1] *Cost for comprehensive grading includes, but is not limited to, roadway excavation, saw cutting, compaction of select material, sheeting, shoring, dewatering, permanent and temporary seeding and mulching, and geotechnical recommendations.*

[2] *The Engineer's opinions of probable construction costs are made on the basis of the Engineer's experience and qualifications and represent the Engineer's best judgment as a professional generally familiar with the construction industry. Since the Engineer has no control over the cost of labor, materials, equipment, or services furnished by others; over the contractors methods of determining prices; or over competitive bidding or marketing conditions, the Engineer's cannot and does not guarantee that proposal, bids or actual construction costs will not vary from opinions of probable construction costs prepared by the Engineer.*

[3] *Design, Permitting, and Administrative Costs includes, consultant planning & design costs, permitting, administrative costs, and easement acquisition (30% of total opinion of probable construction cost)*

Project: Maple Creek Tributary #1, Rocky Mount, NC
Location: Railroad Crossing
Project # : 80450.00.RA
Date: 03/18/2009

Item No.	Item Description	Quantity	Unit	Unit Cost	Total Cost
1	Mobilization (5% of total cost)	1	LS	$ 5,900.00	$ 5,900.00
2	Comprehensive Grading[1]	1	LS	$ 23,750.00	$ 23,750.00
3	Clearing and Grubbing	1	LS	$ 3,000.00	$ 3,000.00
4	Bedding Material, Pipe Culverts	0	TN	$ 30.00	$ -
5	Aggregate Base Course	0	TN	$ 30.00	$ -
6	Bituminous Surface Course	0	TN	$ 75.00	$ -
7	Masonary Drainage Endwalls	2	EA	$ 8,000.00	$ 16,000.00
8	Grout fill between existing pipe and sleeve	30	CY	$ 850.00	$ 25,500.00
9	54" Reinforced Concrete Pipe (Jack & Bore)	60	LF	$ 600.00	$ 36,000.00
10	Remove/Dispose Excess Excavation	30	CY	$ 20.00	$ 600.00
11	Select Backfill/Unclassified Excavation	20	TN	$ 40.00	$ 806.40
12	Construction Staking	1	LS	$ 2,500.00	$ 2,500.00
13	Traffic Control	1	LS	$ 1,000.00	$ 1,000.00
14	Erosion Control	1	LS	$ 9,100.00	$ 9,100.00
				Subtotal	$124,160.00
20% Contingency					$ 24,830.00
Total Opinion of Probable Construction Cost[2]					$148,990.00
Additional Items					
Design, Permitting, and Administrative Costs[3]					$44,700.00
Total Opinion of Probable Project Cost					**$193,690.00**

[1] *Cost for comprehensive grading includes, but is not limited to, roadway excavation, saw cutting, compaction of select material, sheeting, shoring, dewatering, permanent and temporary seeding and mulching, and geotechnical recommendations.*

[2] *The Engineer's opinions of probable construction costs are made on the basis of the Engineer's experience and qualifications and represent the Engineer's best judgment as a professional generally familiar with the construction industry. Since the Engineer has no control over the cost of labor, materials, equipment, or services furnished by others; over the contractors methods of determining prices; or over competitive bidding or marketing conditions, the Engineer's cannot and does not guarantee that proposal, bids or actual construction costs will not vary from opinions of probable construction costs prepared by the Engineer.*

[3] *Design, Permitting, and Administrative Costs includes, consultant planning & design costs, permitting, administrative costs, and easement acquisition (30% of total opinion of probable construction cost)*

Project: Maple Creek Tributary #1, Rocky Mount, NC
Location: Sheffield Drive
Project # : 80450.00.RA
Date: 03/18/2009

Item No.	Item Description	Quantity	Unit	Unit Cost	Total Cost
1	Mobilization (5% of total cost)	1	LS	$ 15,300.00	$ 15,300.00
2	Comprehensive Grading[1]	1	LS	$ 61,250.00	$ 61,250.00
3	Clearing and Grubbing	1	LS	$ 4,000.00	$ 4,000.00
4	Bedding Material, Pipe Culverts	100	TN	$ 30.00	$ 3,000.00
5	Aggregate Base Course	30	TN	$ 30.00	$ 900.00
6	Bituminous Surface Course	15	TN	$ 75.00	$ 1,125.00
7	Masonary Drainage Endwalls	2	EA	$ 8,000.00	$ 16,000.00
8	11' x 6' Reinforced Concrete Box Culvert	110	LF	$ 1,630.00	$ 179,300.00
9	Remove/Dispose Excess Excavation	90	CY	$ 50.00	$ 4,500.00
10	Select Backfill/Unclassified Excavation	60	TN	$ 30.00	$ 1,801.80
11	Remove Existing Corrugated Metal Pipe	102	LF	$ 40.00	$ 4,080.00
12	Remove Existing Endwall	2	EA	$ 1,000.00	$ 2,000.00
13	Construction Staking	1	LS	$ 3,000.00	$ 3,000.00
14	Traffic Control	1	LS	$ 10,000.00	$ 10,000.00
15	Erosion Control	1	LS	$ 15,000.00	$ 15,000.00
				Subtotal	$ 321,260.00
20% Contingency					$ 64,250.00
Total Opinion of Probable Construction Cost[2]					$ 385,510.00
Additional Items					
Design, Permitting, and Administrative Costs[3]					$115,650.00
Total Opinion of Probable Project Cost					**$501,160.00**

[1] *Cost for comprehensive grading includes, but is not limited to, roadway excavation, saw cutting, compaction of select material, sheeting, shoring, dewatering, permanent and temporary seeding and mulching, and geotechnical recommendations.*

[2] *The Engineer's opinions of probable construction costs are made on the basis of the Engineer's experience and qualifications and represent the Engineer's best judgment as a professional generally familiar with the construction industry. Since the Engineer has no control over the cost of labor, materials, equipment, or services furnished by others; over the contractors methods of determining prices; or over competitive bidding or marketing conditions, the Engineer's cannot and does not guarantee that proposal, bids or actual construction costs will not vary from opinions of probable construction costs prepared by the Engineer.*

[3] *Design, Permitting, and Administrative Costs includes, consultant planning & design costs, permitting, administrative costs, and easement acquisition (30% of total opinion of probable construction cost)*

Project: Maple Creek Tributary #1, Rocky Mount, NC
Location: Avondale Avenue
Project # : 80450.00.RA
Date: 03/18/2009

Item No.	Item Description	Quantity	Unit	Unit Cost	Total Cost
1	Mobilization (5% of total cost)	1	LS	$ 22,900.00	$ 22,900.00
2	Comprehensive Grading[1]	1	LS	$ 91,750.00	$ 91,750.00
3	Clearing and Grubbing	1	LS	$ 3,000.00	$ 3,000.00
4	Bedding Material, Pipe Culverts	100	TN	$ 30.00	$ 3,000.00
5	Aggregate Base Course	295	TN	$ 30.00	$ 8,850.00
6	Bituminous Surface Course	110	TN	$ 75.00	$ 8,250.00
7	Masonary Drainage Endwalls	2	EA	$ 8,000.00	$ 16,000.00
8	10' x 7' Reinforced Concrete Box Culvert	160	LF	$ 1,460.00	$ 233,600.00
9	Remove/Dispose Excess Excavation	210	CY	$ 50.00	$ 10,500.00
10	Select Backfill/Unclassified Excavation	2000	TN	$ 30.00	$ 60,000.00
11	Remove Existing Corrugated Metal Pipe	60	LF	$ 40.00	$ 2,400.00
12	Remove Existing Endwall	2	EA	$ 750.00	$ 1,500.00
13	Construction Staking	1	LS	$ 2,500.00	$ 2,500.00
14	Traffic Control	1	LS	$ 6,000.00	$ 6,000.00
15	Erosion Control	1	LS	$ 11,600.00	$ 11,600.00
				Subtotal	$481,850.00
	20% Contingency				$ 96,370.00
	Total Opinion of Probable Construction Cost[2]				$ 578,220.00
	Additional Items				
	Design, Permitting, and Administrative Costs[3]				$173,470.00
	Total Opinion of Probable Project Cost				**$751,690.00**

[1] *Cost for comprehensive grading includes, but is not limited to, roadway excavation, saw cutting, compaction of select material, sheeting, shoring, dewatering, permanent and temporary seeding and mulching, and geotechnical recommendations.*

[2] *The Engineer's opinions of probable construction costs are made on the basis of the Engineer's experience and qualifications and represent the Engineer's best judgment as a professional generally familiar with the construction industry. Since the Engineer has no control over the cost of labor, materials, equipment, or services furnished by others; over the contractors methods of determining prices; or over competitive bidding or marketing conditions, the Engineer's cannot and does not guarantee that proposal, bids or actual construction costs will not vary from opinions of probable construction costs prepared by the Engineer.*

[3] *Design, Permitting, and Administrative Costs includes, consultant planning & design costs, permitting, administrative costs, and easement acquisition (30% of total opinion of probable construction cost)*

Project: Maple Creek Tributary #1, Rocky Mount, NC
Location: Nottingham Road
Project # : 80450.00.RA
Date: 03/18/2009

Item No.	Item Description	Quantity	Unit	Unit Cost	Total Cost
1	Mobilization (5% of total cost)	1	LS	$ 8,600.00	$ 8,600.00
2	Comprehensive Grading[1]	1	LS	$ 34,250.00	$ 34,250.00
3	Clearing and Grubbing	1	LS	$ 3,000.00	$ 3,000.00
4	Bedding Material, Pipe Culverts	60	TN	$ 30.00	$ 1,800.00
5	Aggregate Base Course	25	TN	$ 30.00	$ 750.00
6	Bituminous Surface Course	10	TN	$ 75.00	$ 750.00
7	Masonary Drainage Endwalls	2	EA	$ 8,000.00	$ 16,000.00
8	8' x 6' Reinforced Concrete Box Culvert	90	LF	$ 960.00	$ 86,400.00
9	Remove/Dispose Excess Excavation	40	CY	$ 50.00	$ 2,000.00
10	Select Backfill/Unclassified Excavation	32	TN	$ 30.00	$ 972.00
11	Remove Existing Corrugated Metal Pipe	87	LF	$ 40.00	$ 3,480.00
12	Remove Existing Endwall	2	EA	$ 750.00	$ 1,500.00
13	Construction Staking	1	LS	$ 2,500.00	$ 2,500.00
14	Traffic Control	1	LS	$ 6,000.00	$ 6,000.00
15	Erosion Control	1	LS	$ 11,600.00	$ 11,600.00
				Subtotal	$179,600.00
	20% Contingency				$ 35,920.00
	Total Opinion of Probable Construction Cost[2]				$ 215,520.00
	Additional Items				
	Design, Permitting, and Administrative Costs[3]				$64,660.00
	Total Opinion of Probable Project Cost				**$280,180.00**

[1] *Cost for comprehensive grading includes, but is not limited to, roadway excavation, saw cutting, compaction of select material, sheeting, shoring, dewatering, permanent and temporary seeding and mulching, and geotechnical recommendations.*

[2] *The Engineer's opinions of probable construction costs are made on the basis of the Engineer's experience and qualifications and represent the Engineer's best judgment as a professional generally familiar with the construction industry. Since the Engineer has no control over the cost of labor, materials, equipment, or services furnished by others; over the contractors methods of determining prices; or over competitive bidding or marketing conditions, the Engineer's cannot and does not guarantee that proposal, bids or actual construction costs will not vary from opinions of probable construction costs prepared by the Engineer.*

[3] *Design, Permitting, and Administrative Costs includes, consultant planning & design costs, permitting, administrative costs, and easement acquisition (30% of total opinion of probable construction cost)*

Project: Maple Creek Tributary #1, Rocky Mount, NC
Location: Stream Grading
Project # : 80450.00.RA
Date: 03/18/2009

Item No.	Item Description	Quantity	Unit	Unit Cost	Total Cost
1	Mobilization (5% of total cost)	1	LS	$ 44,700.00	$ 44,700.00
2	Comprehensive Grading[1]	1	LS	$ 81,200.00	$ 81,200.00
3	Clearing and Grubbing	1	LS	$ 20,000.00	$ 20,000.00
4	Channel Grading (Upstream Sheffield)	1100	LF	$ 180.00	$ 198,000.00
5	Channel Grading (Downstream Sheffield)	2000	LF	$ 280.00	$ 560,000.00
6	Remove/Dispose Excess Excavation	300	CY	$ 50.00	$ 15,000.00
7	Construction Staking	1	LS	$ 4,000.00	$ 4,000.00
8	Erosion Control	1	LS	$ 15,000.00	$ 15,000.00
				Subtotal	$937,900.00
	20% Contingency				$ 187,580.00
	Total Opinion of Probable Construction Cost[2]				$ 1,125,480.00
	Additional Items				
	Design and Administrative Costs[3]				$337,640.00
	Permitting Cost				$330,000.00
	Total Opinion of Probable Project Cost				**$1,463,120.00**

[1] *Cost for comprehensive grading includes, but is not limited to, roadway excavation, saw cutting, compaction of select material, sheeting, shoring, dewatering, permanent and temporary seeding and mulching, and geotechnical recommendations.*

[2] *The Engineer's opinions of probable construction costs are made on the basis of the Engineer's experience and qualifications and represent the Engineer's best judgment as a professional generally familiar with the construction industry. Since the Engineer has no control over the cost of labor, materials, equipment, or services furnished by others; over the contractors methods of determining prices; or over competitive bidding or marketing conditions, the Engineer's cannot and does not guarantee that proposal, bids or actual construction costs will not vary from opinions of probable construction costs prepared by the Engineer.*

[3] *Design, Permitting, and Administrative Costs includes, consultant planning & design costs, permitting, administrative costs, and easement acquisition (30% of total opinion of probable construction cost)*

Project: Maple Creek Tributary #1, Rocky Mount, NC
Location: Mansfield Area Closed System #1 - Alternative #1 - Mansfield Drive to Hawthorne Road
Project # : 80450.00.RA
Date: 7/20/2009

Item No.	Item Description	Quantity	Unit	Unit Cost	Total Cost
1	Mobilization (5% of total cost)	1	LS	$ 63,300.00	$ 63,300.00
2	Comprehensive Grading[1]	1	LS	$ 120,000.00	$ 120,000.00
3	Select Backfill	800	TN	$ 25.00	$ 20,000.00
4	Topsoil	200	CY	$ 45.00	$ 9,000.00
5	Bedding Material, Pipe Culverts	1300	TN	$ 30.00	$ 39,000.00
6	Asphalt Surface Course SF9.5B	325	TN	$ 75.00	$ 24,375.00
7	Asphalt Base Course, I19.0B	1100	TN	$ 85.00	$ 93,500.00
8	Asphalt Binder for Plant Mix	78	TN	$ 500.00	$ 39,187.50
9	Mill Ex. Asphalt Pavement 2" (between Lochinvar and Hawthorne)	1289	SY	$ 8.00	$ 10,311.11
10	36" R.C. Pipe Culvert	1200	LF	$ 70.00	$ 84,000.00
11	42" R.C. Pipe Culvert	4500	LF	$ 115.00	$ 517,500.00
12	2'-6" Concrete Curb and Gutter	2550	LF	$ 25.00	$ 63,750.00
13	Catch Basin	15	EA	$ 1,500.00	$ 22,500.00
14	Drop Inlets/Manholes	20	EA	$ 1,500.00	$ 30,000.00
15	6" Concrete Driveways with Apron	7	EA	$ 1,800.00	$ 12,600.00
16	4" Concrete Sidewalk	500	LF	$ 25.00	$ 12,500.00
17	Construction Staking	1	LS	$ 10,000.00	$ 10,000.00
18	Traffic Control	1	LS	$ 20,000.00	$ 20,000.00
19	Erosion Control	1	LS	$ 35,000.00	$ 35,000.00
20	Water Meter Vertical and Horizontal Relocation	20	EA	$ 750.00	$ 15,000.00
21	Gas Meter Vertical and Horizontal Relocation	20	EA	$ 750.00	$ 15,000.00
22	Miscellaneous Water Line Relocation	600	LF	$ 70.00	$ 42,000.00
23	Miscellaneous Sanitary Sewer Line Relocation	450	LF	$ 70.00	$ 31,500.00
				Subtotal	$ 1,330,020.00
	20% Contingency				$ 266,000.00
	Total Opinion of Probable Construction Cost[2]				$1,596,020.00
	Additional Items				
	Design, Permitting, and Administrative Costs[3]				$478,810.00
	Total Opinion of Probable Project Cost				**$2,074,830.00**

[1] *Cost for comprehensive grading includes, but is not limited to, roadway excavation, saw cutting, compaction of select material, sheeting, shoring, dewatering, permanent and temporary measures needed for the project not included in any other unit costs, and geotechnical recommendations.*

[2] *The Engineer's opinions of probable construction costs are made on the basis of the Engineer's experience and qualifications and represent the Engineer's best judgment as a professional generally familiar with the construction industry. Since the Engineer has no control over the cost of labor, materials, equipment, or services furnished by others; over the contractors methods of determining prices; or over competitive bidding or marketing conditions, the Engineer's cannot and does not guarantee that proposal, bids or actual construction costs will not vary from opinions of probable construction costs prepared by the Engineer.*

[3] *Design, Permitting, and Administrative Costs includes, survey, consultant planning & design costs, permitting, administrative costs, and easement acquisition (30% of total opinion of probable construction cost)*

Project: Maple Creek Tributary #1, Rocky Mount, NC
Location:Mansfield Area Closed System #1 - Alternative #2 - Mansfield Drive to Railroad Right of Way
Project # : 80450.00.RA
Date: 7/20/2009

Item No.	Item Description	Quantity	Unit	Unit Cost	Total Cost
1	Mobilization (5% of total cost)	1	LS	$ 82,300.00	$ 82,300.00
2	Comprehensive Grading[1]	1	LS	$ 160,000.00	$ 160,000.00
3	Select Backfill	800	TN	$ 25.00	$ 20,000.00
4	Topsoil	200	CY	$ 35.00	$ 7,000.00
5	Bedding Material, Pipe Culverts	1400	TN	$ 30.00	$ 42,000.00
6	Asphalt Surface Course SF9.5B	325	TN	$ 75.00	$ 24,375.00
7	Asphalt Base Course, I19.0B	1100	TN	$ 85.00	$ 93,500.00
8	Asphalt Binder for Plant Mix	78	TN	$ 500.00	$ 39,187.50
9	Mill Ex. Asphalt Pavement 2" (between Lochinvar and Hawthorne)	1289	SY	$ 8.00	$ 10,311.11
10	24" R.C. Pipe Culvert	170	LF	$ 45.00	$ 7,650.00
11	30" R.C. Pipe Culvert	120	LF	$ 60.00	$ 7,200.00
12	36" R.C. Pipe Culvert	750	LF	$ 70.00	$ 52,500.00
13	42" R.C. Pipe Culvert	2400	LF	$ 100.00	$ 240,000.00
14	48" R.C. Pipe Culvert	3200	LF	$ 115.00	$ 368,000.00
15	66" R.C. Pipe Culvert	1600	LF	$ 150.00	$ 240,000.00
16	Jack & Bore 60" RCP	100	LF	$ 650.00	$ 65,000.00
17	2'-6" Concrete Curb and Gutter	1200	LF	$ 25.00	$ 30,000.00
18	Catch Basin	15	EA	$ 1,500.00	$ 22,500.00
19	Drop Inlets/Manholes	15	EA	$ 1,500.00	$ 22,500.00
20	6" Concrete Driveways with Apron	7	EA	$ 1,800.00	$ 12,600.00
21	4" Concrete Sidewalk	500	LF	$ 25.00	$ 12,500.00
22	Construction Staking	1	LS	$ 10,000.00	$ 10,000.00
23	Traffic Control	1	LS	$ 20,000.00	$ 20,000.00
24	Erosion Control	1	LS	$ 35,000.00	$ 35,000.00
25	Water Meter Vertical and Horizontal Relocation	20	EA	$ 750.00	$ 15,000.00
26	Gas Meter Vertical and Horizontal Relocation	20	EA	$ 750.00	$ 15,000.00
27	Miscellaneous Water Line Relocation	600	LF	$ 70.00	$ 42,000.00
28	Miscellaneous Sanitary Sewer Line Relocation	450	LF	$ 70.00	$ 31,500.00
				Subtotal	$ 1,727,620.00
	20% Contingency				$ 345,520.00
	Total Opinion of Probable Construction Cost[2]				$2,073,140.00
	Additional Items				
	Design, Permitting, and Administrative Costs[3]				$621,940.00
	Total Opinion of Probable Project Cost				**$2,695,080.00**

[1] *Cost for comprehensive grading includes, but is not limited to, roadway excavation, saw cutting, compaction of select material, sheeting, shoring, dewatering, permanent and temporary measures needed for the project not included in any other unit costs, and geotechnical recommendations.*

[2] *The Engineer's opinions of probable construction costs are made on the basis of the Engineer's experience and qualifications and represent the Engineer's best judgment as a professional generally familiar with the construction industry. Since the Engineer has no control over the cost of labor, materials, equipment, or services furnished by others; over the contractors methods of determining prices; or over competitive bidding or marketing conditions, the Engineer's cannot and does not guarantee that proposal, bids or actual construction costs will not vary from opinions of probable construction costs prepared by the Engineer.*

[3] *Design, Permitting, and Administrative Costs includes, survey, consultant planning & design costs, permitting, administrative costs, and easement acquisition (30% of total opinion of probable construction cost)*

Project: Maple Creek Tributary #1, Rocky Mount, NC
Location: Mansfield Area Closed System #2 - Sheffield Drive
Project # : 80450.00.RA
Date: 7/20/2009

Item No.	Item Description	Quantity	Unit	Unit Cost	Total Cost
1	Mobilization (5% of total cost)	1	LS	$ 25,900.00	$ 25,900.00
2	Comprehensive Grading[1]	1	LS	$ 50,000.00	$ 50,000.00
3	Select Backfill	200	TN	$ 25.00	$ 5,000.00
4	Topsoil	50	CY	$ 45.00	$ 2,250.00
5	Bedding Material, Pipe Culverts	500	TN	$ 30.00	$ 15,000.00
6	Asphalt Surface Course SF9.5B	380	TN	$ 75.00	$ 28,500.00
7	Asphalt Base Course, I19.0B	1360	TN	$ 85.00	$ 115,600.00
8	Asphalt Binder for Plant Mix	96	TN	$ 500.00	$ 47,850.00
9	18" R.C. Pipe Culvert	60	LF	$ 40.00	$ 2,400.00
10	24" R.C. Pipe Culvert	920	LF	$ 45.00	$ 41,400.00
11	36" R.C. Pipe Culvert	1420	LF	$ 70.00	$ 99,400.00
12	Masonry Catch Basin	8	EA	$ 2,800.00	$ 22,400.00
13	Drop Inlets	7	EA	$ 2,800.00	$ 19,600.00
14	6" Concrete Driveways with Apron	4	EA	$ 1,800.00	$ 7,200.00
15	6" Asphalt Driveways with Apron	1	TN	$ 75.00	$ 82.50
16	4" Concrete Sidewalk	100	LF	$ 25.00	$ 2,500.00
17	Construction Staking	1	LS	$ 5,000.00	$ 5,000.00
18	Traffic Control	1	LS	$ 10,000.00	$ 10,000.00
19	Erosion Control	1	LS	$ 15,000.00	$ 15,000.00
20	Water Meter Vertical and Horizontal Relocation	5	EA	$ 750.00	$ 3,750.00
21	Gas Meter Vertical and Horizontal Relocation	5	EA	$ 750.00	$ 3,750.00
22	Miscellaneous Water Line Relocation	200	LF	$ 70.00	$ 14,000.00
23	Miscellaneous Sanitary Sewer Line Relocation	100	LF	$ 70.00	$ 7,000.00
				Subtotal	$ 543,580.00
	20% Contingency				$ 108,720.00
	Total Opinion of Probable Construction Cost[2]				$652,300.00
	Additional Items				
	Design, Permitting, and Administrative Costs[3]				$195,690.00
	Total Opinion of Probable Project Cost				**$847,990.00**

[1] *Cost for comprehensive grading includes, but is not limited to, roadway excavation, saw cutting, compaction of select material, sheeting, shoring, dewatering, permanent and temporary measures needed for the project not included in any other unit costs, and geotechnical recommendations.*

[2] *The Engineer's opinions of probable construction costs are made on the basis of the Engineer's experience and qualifications and represent the Engineer's best judgment as a professional generally familiar with the construction industry. Since the Engineer has no control over the cost of labor, materials, equipment, or services furnished by others; over the contractors methods of determining prices; or over competitive bidding or marketing conditions, the Engineer's cannot and does not guarantee that proposal, bids or actual construction costs will not vary from opinions of probable construction costs prepared by the Engineer.*

[3] *Design, Permitting, and Administrative Costs includes, survey, consultant planning & design costs, permitting, administrative costs, and easement acquisition (30% of total opinion of probable construction cost)*

Project: Maple Creek Tributary #1, Rocky Mount, NC
Location: Mansfield Area Closed System #3 - Mansfield Drive and Jeremy Lane
Project # : 80450.00.RA
Date: 7/20/2009

Item No.	Item Description	Quantity	Unit	Unit Cost	Total Cost
1	Mobilization (5% of total cost)	1	LS	$ 17,900.00	$ 17,900.00
2	Comprehensive Grading[1]	1	LS	$ 30,000.00	$ 30,000.00
3	Select Backfill	100	TN	$ 25.00	$ 2,500.00
4	Topsoil	50	CY	$ 45.00	$ 2,250.00
5	Bedding Material, Pipe Culverts	500	TN	$ 30.00	$ 15,000.00
6	Asphalt Surface Course SF9.5B	224	TN	$ 75.00	$ 16,800.00
7	Asphalt Base Course, I19.0B	808	TN	$ 85.00	$ 68,680.00
8	Asphalt Binder for Plant Mix	57	TN	$ 500.00	$ 28,380.00
9	18" R.C. Pipe Culvert	855	LF	$ 40.00	$ 34,200.00
10	24" R.C. Pipe Culvert	120	LF	$ 45.00	$ 5,400.00
11	30" R.C. Pipe Culvert	130	LF	$ 60.00	$ 7,800.00
12	36" R.C. Pipe Culvert	880	LF	$ 70.00	$ 61,600.00
13	Masonry Catch Basin	5	EA	$ 1,500.00	$ 7,500.00
14	Drop Inlets	5	EA	$ 1,500.00	$ 7,500.00
15	Manholes	3	EA	$ 1,500.00	$ 4,500.00
16	6" Concrete Driveways with Apron	5	EA	$ 1,800.00	$ 9,000.00
17	4" Concrete Sidewalk	500	LF	$ 25.00	$ 12,500.00
18	Construction Staking	1	LS	$ 2,500.00	$ 2,500.00
19	Traffic Control	1	LS	$ 5,000.00	$ 5,000.00
20	Erosion Control	1	LS	$ 7,500.00	$ 7,500.00
21	Water Meter Vertical and Horizontal Relocation	10	EA	$ 750.00	$ 7,500.00
22	Gas Meter Vertical and Horizontal Relocation	10	EA	$ 750.00	$ 7,500.00
23	Miscellaneous Water Line Relocation	100	LF	$ 70.00	$ 7,000.00
24	Miscellaneous Sanitary Sewer Line Relocation	100	LF	$ 70.00	$ 7,000.00
				Subtotal	$ 375,510.00
	20% Contingency				$ 75,100.00
	Total Opinion of Probable Construction Cost[2]				$450,610.00
	Additional Items				
	Design, Permitting, and Administrative Costs[3]				$135,180.00
	Total Opinion of Probable Project Cost				**$585,790.00**

[1] *Cost for comprehensive grading includes, but is not limited to, roadway excavation, saw cutting, compaction of select material, sheeting, shoring, dewatering, permanent and temporary measures needed for the project not included in any other unit costs, and geotechnical recommendations.*

[2] *The Engineer's opinions of probable construction costs are made on the basis of the Engineer's experience and qualifications and represent the Engineer's best judgment as a professional generally familiar with the construction industry. Since the Engineer has no control over the cost of labor, materials, equipment, or services furnished by others; over the contractors methods of determining prices; or over competitive bidding or marketing conditions, the Engineer's cannot and does not guarantee that proposal, bids or actual construction costs will not vary from opinions of probable construction costs prepared by the Engineer.*

[3] *Design, Permitting, and Administrative Costs includes, survey, consultant planning & design costs, permitting, administrative costs, and easement acquisition (30% of total opinion of probable construction cost)*

Project: Maple Creek Tributary #1, Rocky Mount, NC
Location: Mansfield Area Closed System #4 - Mansfield Drive and Bristol Court
Project # : 80450.00.RA
Date: 7/20/2009

Item No.	Item Description	Quantity	Unit	Unit Cost	Total Cost
1	Mobilization (5% of total cost)	1	LS	$ 11,900.00	$ 11,900.00
2	Comprehensive Grading[1]	1	LS	$ 20,000.00	$ 20,000.00
3	Select Backfill	100	TN	$ 25.00	$ 2,500.00
4	Topsoil	50	CY	$ 45.00	$ 2,250.00
5	Bedding Material, Pipe Culverts	400	TN	$ 30.00	$ 12,000.00
6	Asphalt Surface Course SF9.5B	140	TN	$ 75.00	$ 10,500.00
7	Asphalt Base Course, I19.0B	490	TN	$ 85.00	$ 41,650.00
8	Asphalt Binder for Plant Mix	35	TN	$ 500.00	$ 17,325.00
9	24" R.C. Pipe Culvert	570	LF	$ 45.00	$ 25,650.00
10	36" R.C. Pipe Culvert	620	LF	$ 70.00	$ 43,400.00
11	Masonry Catch Basin	5	EA	$ 1,500.00	$ 7,500.00
12	Drop Inlets	4	EA	$ 1,500.00	$ 6,000.00
13	Manholes	3	EA	$ 1,500.00	$ 4,500.00
14	6" Concrete Driveways with Apron	4	EA	$ 1,800.00	$ 7,200.00
15	6" Asphalt Driveways with Apron	3	TN	$ 75.00	$ 225.00
16	4" Concrete Sidewalk	50	LF	$ 25.00	$ 1,250.00
17	Construction Staking	1	LS	$ 2,500.00	$ 2,500.00
18	Traffic Control	1	LS	$ 5,000.00	$ 5,000.00
19	Erosion Control	1	LS	$ 7,500.00	$ 7,500.00
20	Water Meter Vertical and Horizontal Relocation	5	EA	$ 750.00	$ 3,750.00
21	Gas Meter Vertical and Horizontal Relocation	5	EA	$ 750.00	$ 3,750.00
22	Miscellaneous Water Line Relocation	100	LF	$ 70.00	$ 7,000.00
23	Miscellaneous Sanitary Sewer Line Relocation	100	LF	$ 70.00	$ 7,000.00
				Subtotal	$ 250,350.00
	20% Contingency				$ 50,070.00
	Total Opinion of Probable Construction Cost[2]				$300,420.00
	Additional Items				
	Design, Permitting, and Administrative Costs[3]				$90,130.00
	Total Opinion of Probable Project Cost				**$390,550.00**

[1] *Cost for comprehensive grading includes, but is not limited to, roadway excavation, saw cutting, compaction of select material, sheeting, shoring, dewatering, permanent and temporary measures needed for the project not included in any other unit costs, and geotechnical recommendations.*

[2] *The Engineer's opinions of probable construction costs are made on the basis of the Engineer's experience and qualifications and represent the Engineer's best judgment as a professional generally familiar with the construction industry. Since the Engineer has no control over the cost of labor, materials, equipment, or services furnished by others; over the contractors methods of determining prices; or over competitive bidding or marketing conditions, the Engineer's cannot and does not guarantee that proposal, bids or actual construction costs will not vary from opinions of probable construction costs prepared by the Engineer.*

[3] *Design, Permitting, and Administrative Costs includes, survey, consultant planning & design costs, permitting, administrative costs, and easement acquisition (30% of total opinion of probable construction cost)*

Project: Maple Creek Tributary #1, Rocky Mount, NC
Location: Mansfield Area Closed System #1 - Proposed Detention Alternative
Project # : 80450.00.RA
Date: 5/29/2009

Item No.	Item Description	Quantity	Unit	Unit Cost	Total Cost
1	Mobilization (5% of total cost)	1	LS	$ 42,900.00	$ 42,900.00
2	Comprehensive Grading[1]	1	LS	$ 70,000.00	$ 70,000.00
3	Plantings	46500	SF	$ 0.50	$ 23,250.00
4	Remove/Dispose Excess Excavation at Newby Pond	9970	CY	$ 13.00	$ 129,610.00
5	Remove/Dispose Excess Excavation at Lochinvar Pond	20626	CY	$ 13.00	$ 268,138.00
6	Asphalt Base Course, I19.0B	3	TN	$ 85.00	$ 255.00
7	Asphalt Binder for Plant Mix	0.5	TN	$ 500.00	$ 250.00
8	18" R.C. Pipe Culvert	220	LF	$ 40.00	$ 8,800.00
8	24" R.C. Pipe Culvert	550	LF	$ 45.00	$ 24,750.00
9	Riser Structure	2	EA	$ 12,000.00	$ 24,000.00
10	Construction Staking	1	LS	$ 5,000.00	$ 5,000.00
11	Traffic Control	1	LS	$ 2,000.00	$ 2,000.00
12	Erosion Control	1	LS	$ 20,000.00	$ 20,000.00
13	Property value for Parcel 014582	1	EA	$ 4,875.00	$ 4,875.00
14	Property value for Parcel 032403	1	EA	$ 35,000.00	$ 35,000.00
13	Property value for Parcel 048719	1	EA	$ 29,990.00	$ 29,990.00
14	Property value for Parcel 008513	1	EA	$ 39,500.00	$ 39,500.00
15	Property value for Parcel 008514	1	EA	$ 39,210.00	$ 39,210.00
16	Water Meter Vertical and Horizontal Relocation	2	EA	$ 750.00	$ 1,500.00
17	Gas Meter Vertical and Horizontal Relocation	2	EA	$ 750.00	$ 1,500.00
18	Miscellaneous Water Line Relocation	50	LF	$ 70.00	$ 3,500.00
19	Miscellaneous Sanitary Sewer Line Relocation	50	LF	$ 70.00	$ 3,500.00
				Subtotal	$ 777,530.00
	20% Contingency				$ 155,510.00
	Total Opinion of Probable Construction Cost[2]				$ 933,040.00
	Additional Items				
	Design, Permitting, and Administrative Costs[3]				$233,260.00
	Total Opinion of Probable Project Cost				**$1,166,300.00**

[1] *Cost for comprehensive grading includes, but is not limited to, roadway excavation, saw cutting, compaction of select material, sheeting, shoring, dewatering, permanent and temporary measures needed for the project not included in any other unit costs, and geotechnical recommendations.*

[2] *The Engineer's opinions of probable construction costs are made on the basis of the Engineer's experience and qualifications and represent the Engineer's best judgment as a professional generally familiar with the construction industry. Since the Engineer has no control over the cost of labor, materials, equipment, or services furnished by others; over the contractors methods of determining prices; or over competitive bidding or marketing conditions, the Engineer's cannot and does not guarantee that proposal, bids or actual construction costs will not vary from opinions of probable construction costs prepared by the Engineer.*

[3] *Design, Permitting, and Administrative Costs includes, survey, consultant planning & design costs, permitting, administrative costs, and easement acquisition (25% of total opinion of probable construction cost)*

APPENDIX I

SCS Runoff Curve Number

Project: Maple Creek Tributary #1, Rocky Mount, NC
Prepared by: EVF
Checked by: DJK
Date: January 5, 2009

Sub-Basin: 1A

Landuse	Soil Group	RCN	Area (Acres)	Area (Sq. Mi.)	Product of RCN and Area
Residential MF (1/8 acre lots)	A	77		0.000	0
Residential MF (1/8 acre lots)	B	85	4.1	0.006	349
Residential MF (1/8 acre lots)	C	90		0.000	0
Residential MF (1/8 acre lots)	D	92	3.0	0.005	276
Residential SF (1/3 - 1/2 acre lots)	A	54		0.000	0
Residential SF (1/3 - 1/2 acre lots)	B	70	72.3	0.113	5061
Residential SF (1/3 - 1/2 acre lots)	C	80		0.000	0
Residential SF (1/3 - 1/2 acre lots)	D	85	49.4	0.077	4199
Commercial	A	89		0.000	0
Commercial	B	92		0.000	0
Commercial	C	94		0.000	0
Commercial	D	95		0.000	0
Office	A	89		0.000	0
Office	B	92	10.2	0.016	938
Office	C	94		0.000	0
Office	D	95	0.9	0.001	86
Industrial	A	81		0.000	0
Industrial	B	88		0.000	0
Industrial	C	91		0.000	0
Industrial	D	93		0.000	0
Undeveloped Land	A	25		0.000	0
Undeveloped Land	B	55		0.000	0
Undeveloped Land	C	70		0.000	0
Undeveloped Land	D	77		0.000	0
Agricultural	A	39		0.000	0
Agricultural	B	61		0.000	0
Agricultural	C	74		0.000	0
Agricultural	D	80		0.000	0
		Totals =	139.9	0.22	10908.4

Total (weighted) RCN = total product/total area = 77.97

RCN used = 78

SCS Runoff Curve Number

Project: Maple Creek Tributary #1, Rocky Mount, NC
Prepared by: EVF
Checked by: DJK
Date: January 5, 2009

Sub-Basin: 1B

Landuse	Soil Group	RCN	Area (Acres)	Area (Sq. Mi.)	Product of RCN and Area
Residential MF (1/8 acre lots)	A	77		0.000	0
Residential MF (1/8 acre lots)	B	85		0.000	0
Residential MF (1/8 acre lots)	C	90		0.000	0
Residential MF (1/8 acre lots)	D	92	11.8	0.018	1086
Residential SF (1/3 - 1/2 acre lots)	A	54		0.000	0
Residential SF (1/3 - 1/2 acre lots)	B	70	2.9	0.005	205
Residential SF (1/3 - 1/2 acre lots)	C	80		0.000	0
Residential SF (1/3 - 1/2 acre lots)	D	85	10.6	0.017	904
Commercial	A	89		0.000	0
Commercial	B	92	9.7	0.015	888
Commercial	C	94		0.000	0
Commercial	D	95		0.000	0
Office	A	89		0.000	0
Office	B	92	4.0	0.006	368
Office	C	94		0.000	0
Office	D	95	0.9	0.001	89
Industrial	A	81		0.000	0
Industrial	B	88		0.000	0
Industrial	C	91		0.000	0
Industrial	D	93		0.000	0
Split Use (i.e., churches, businesses, and residential)	A	25		0.000	0
Split Use (i.e., churches, businesses, and residential)	B	55		0.000	0
Split Use (i.e., churches, businesses, and residential)	C	70		0.000	0
Split Use (i.e., churches, businesses, and residential)	D	77		0.000	0
Agricultural	A	39		0.000	0
Agricultural	B	61		0.000	0
Agricultural	C	74		0.000	0
Agricultural	D	80		0.000	0
		Totals =	40.0	0.06	3540.2

Total (weighted) RCN = total product/total area = 88.59

RCN used = 89

SCS Runoff Curve Number

Project: Maple Creek Tributary #1, Rocky Mount, NC
Prepared by: EVF
Checked by: DJK
Date: January 5, 2009

Sub-Basin: 1C

Landuse	Soil Group	RCN	Area (Acres)	Area (Sq. Mi.)	Product of RCN and Area
Residential MF (1/8 acre lots)	A	77		0.000	0
Residential MF (1/8 acre lots)	B	85		0.000	0
Residential MF (1/8 acre lots)	C	90		0.000	0
Residential MF (1/8 acre lots)	D	92	0.1	0.000	9
Residential SF (1/3 - 1/2 acre lots)	A	54		0.000	0
Residential SF (1/3 - 1/2 acre lots)	B	70	8.8	0.014	616
Residential SF (1/3 - 1/2 acre lots)	C	80		0.000	0
Residential SF (1/3 - 1/2 acre lots)	D	85	30.9	0.048	2627
Commercial	A	89		0.000	0
Commercial	B	92		0.000	0
Commercial	C	94		0.000	0
Commercial	D	95		0.000	0
Office	A	89		0.000	0
Office	B	92		0.000	0
Office	C	94		0.000	0
Office	D	95		0.000	0
Industrial	A	81		0.000	0
Industrial	B	88		0.000	0
Industrial	C	91		0.000	0
Industrial	D	93		0.000	0
Split Use (i.e., churches, businesses, and residential)	A	25		0.000	0
Split Use (i.e., churches, businesses, and residential)	B	55		0.000	0
Split Use (i.e., churches, businesses, and residential)	C	70		0.000	0
Split Use (i.e., churches, businesses, and residential)	D	77		0.000	0
Agricultural	A	39		0.000	0
Agricultural	B	61		0.000	0
Agricultural	C	74		0.000	0
Agricultural	D	80		0.000	0
		Totals =	39.8	0.06	3251.7

Total (weighted) RCN = total product/total area = 81.70

RCN used = 82

SCS Runoff Curve Number

Project: Maple Creek Tributary #1, Rocky Mount, NC
Prepared by: EVF
Checked by: DJK
Date: January 5, 2009

Sub-Basin: 1D

Landuse	Soil Group	RCN	Area (Acres)	Area (Sq. Mi.)	Product of RCN and Area
Residential MF (1/8 acre lots)	A	77		0.000	0
Residential MF (1/8 acre lots)	B	85		0.000	0
Residential MF (1/8 acre lots)	C	90		0.000	0
Residential MF (1/8 acre lots)	D	92		0.000	0
Residential SF (1/3 - 1/2 acre lots)	A	54		0.000	0
Residential SF (1/3 - 1/2 acre lots)	B	70	40.2	0.063	2814
Residential SF (1/3 - 1/2 acre lots)	C	80		0.000	0
Residential SF (1/3 - 1/2 acre lots)	D	85	16.2	0.025	1377
Commercial	A	89		0.000	0
Commercial	B	92		0.000	0
Commercial	C	94		0.000	0
Commercial	D	95		0.000	0
Office	A	89		0.000	0
Office	B	92	1.2	0.002	110
Office	C	94		0.000	0
Office	D	95	0.9	0.001	86
Industrial	A	81		0.000	0
Industrial	B	88		0.000	0
Industrial	C	91		0.000	0
Industrial	D	93		0.000	0
Split Use (i.e., churches, businesses, and residential)	A	25		0.000	0
Split Use (i.e., churches, businesses, and residential)	B	55		0.000	0
Split Use (i.e., churches, businesses, and residential)	C	70		0.000	0
Split Use (i.e., churches, businesses, and residential)	D	77		0.000	0
Agricultural	A	39		0.000	0
Agricultural	B	61		0.000	0
Agricultural	C	74		0.000	0
Agricultural	D	80		0.000	0
		Totals =	58.5	0.09	4386.9

Total (weighted) RCN = total product/total area = 74.99

RCN used = 75

SCS Runoff Curve Number

Project: Maple Creek Tributary #1, Rocky Mount, NC
Prepared by: EVF
Checked by: DJK
Date: January 5, 2009

Sub-Basin: 2A-1

Landuse	Soil Group	RCN	Area (Acres)	Area (Sq. Mi.)	Product of RCN and Area
Residential MF (1/8 acre lots)	A	80		0.000	0
Residential MF (1/8 acre lots)	B	85		0.000	0
Residential MF (1/8 acre lots)	C	90		0.000	0
Residential MF (1/8 acre lots)	D	92		0.000	0
Residential SF (1/3 - 1/2 acre lots)	A	61		0.000	0
Residential SF (1/3 - 1/2 acre lots)	B	75	18.7	0.029	1403
Residential SF (1/3 - 1/2 acre lots)	C	83		0.000	0
Residential SF (1/3 - 1/2 acre lots)	D	87	1.3	0.002	113
Commercial	A	98		0.000	0
Commercial	B	98		0.000	0
Commercial	C	98		0.000	0
Commercial	D	98		0.000	0
Office	A	96		0.000	0
Office	B	97		0.000	0
Office	C	98		0.000	0
Office	D	98		0.000	0
Industrial	A	98		0.000	0
Industrial	B	98		0.000	0
Industrial	C	98		0.000	0
Industrial	D	98		0.000	0
Split Use (i.e., churches, businesses, and residential)	A	25		0.000	0
Split Use (i.e., churches, businesses, and residential)	B	55		0.000	0
Split Use (i.e., churches, businesses, and residential)	C	70		0.000	0
Split Use (i.e., churches, businesses, and residential)	D	77		0.000	0
Agricultural	A	39		0.000	0
Agricultural	B	61		0.000	0
Agricultural	C	74		0.000	0
Agricultural	D	80		0.000	0
		Totals =	20.0	0.03	1515.6

Total (weighted) RCN = total product/total area = 75.78

RCN used = 76

SCS Runoff Curve Number

Project: Maple Creek Tributary #1, Rocky Mount, NC
Prepared by: EVF
Checked by: DJK
Date: January 5, 2009

Sub-Basin: 2A

Landuse	Soil Group	RCN	Area (Acres)	Area (Sq. Mi.)	Product of RCN and Area
Residential MF (1/8 acre lots)	A	80		0.000	0
Residential MF (1/8 acre lots)	B	85		0.000	0
Residential MF (1/8 acre lots)	C	90		0.000	0
Residential MF (1/8 acre lots)	D	92		0.000	0
Residential SF (1/3 - 1/2 acre lots)	A	61		0.000	0
Residential SF (1/3 - 1/2 acre lots)	B	75	28.5	0.044	2135
Residential SF (1/3 - 1/2 acre lots)	C	83		0.000	0
Residential SF (1/3 - 1/2 acre lots)	D	87	11.8	0.018	1024
Commercial	A	98		0.000	0
Commercial	B	98		0.000	0
Commercial	C	98		0.000	0
Commercial	D	98		0.000	0
Office	A	96		0.000	0
Office	B	97		0.000	0
Office	C	98		0.000	0
Office	D	98		0.000	0
Industrial	A	98		0.000	0
Industrial	B	98		0.000	0
Industrial	C	98		0.000	0
Industrial	D	98		0.000	0
Split Use (i.e., churches, businesses, and residential)	A	25		0.000	0
Split Use (i.e., churches, businesses, and residential)	B	55		0.000	0
Split Use (i.e., churches, businesses, and residential)	C	70		0.000	0
Split Use (i.e., churches, businesses, and residential)	D	77		0.000	0
Agricultural	A	39		0.000	0
Agricultural	B	61		0.000	0
Agricultural	C	74		0.000	0
Agricultural	D	80		0.000	0
		Totals =	40.2	0.06	3159.2

Total (weighted) RCN = total product/total area = 78.51

RCN used = 79

SCS Runoff Curve Number

Project: Maple Creek Tributary #1, Rocky Mount, NC
Prepared by: EVF
Checked by: DJK
Date: January 5, 2009

Sub-Basin: 2B

Landuse	Soil Group	RCN	Area (Acres)	Area (Sq. Mi.)	Product of RCN and Area
Residential MF (1/8 acre lots)	A	80		0.000	0
Residential MF (1/8 acre lots)	B	85		0.000	0
Residential MF (1/8 acre lots)	C	90		0.000	0
Residential MF (1/8 acre lots)	D	92		0.000	0
Residential SF (1/3 - 1/2 acre lots)	A	61		0.000	0
Residential SF (1/3 - 1/2 acre lots)	B	75	47.9	0.075	3596
Residential SF (1/3 - 1/2 acre lots)	C	83		0.000	0
Residential SF (1/3 - 1/2 acre lots)	D	87	7.1	0.011	618
Commercial	A	98		0.000	0
Commercial	B	98		0.000	0
Commercial	C	98		0.000	0
Commercial	D	98		0.000	0
Office	A	96		0.000	0
Office	B	97		0.000	0
Office	C	98		0.000	0
Office	D	98		0.000	0
Industrial	A	98		0.000	0
Industrial	B	98		0.000	0
Industrial	C	98		0.000	0
Industrial	D	98		0.000	0
Split Use (i.e., churches, businesses, and residential)	A	25		0.000	0
Split Use (i.e., churches, businesses, and residential)	B	55		0.000	0
Split Use (i.e., churches, businesses, and residential)	C	70		0.000	0
Split Use (i.e., churches, businesses, and residential)	D	77		0.000	0
Agricultural	A	39		0.000	0
Agricultural	B	61		0.000	0
Agricultural	C	74		0.000	0
Agricultural	D	80		0.000	0
		Totals =	55.0	0.09	4213.2

Total (weighted) RCN = total product/total area = 76.55

RCN used = 77

SCS Runoff Curve Number

Project: Maple Creek Tributary #1, Rocky Mount, NC
Prepared by: EVF
Checked by: DJK
Date: January 5, 2009

Sub-Basin: 2C

Landuse	Soil Group	RCN	Area (Acres)	Area (Sq. Mi.)	Product of RCN and Area
Residential MF (1/8 acre lots)	A	80		0.000	0
Residential MF (1/8 acre lots)	B	85		0.000	0
Residential MF (1/8 acre lots)	C	90		0.000	0
Residential MF (1/8 acre lots)	D	92		0.000	0
Residential SF (1/3 - 1/2 acre lots)	A	61		0.000	0
Residential SF (1/3 - 1/2 acre lots)	B	75	32.2	0.050	2418
Residential SF (1/3 - 1/2 acre lots)	C	83		0.000	0
Residential SF (1/3 - 1/2 acre lots)	D	87	45.6	0.071	3964
Commercial	A	98		0.000	0
Commercial	B	98		0.000	0
Commercial	C	98		0.000	0
Commercial	D	98		0.000	0
Office	A	96		0.000	0
Office	B	97		0.000	0
Office	C	98		0.000	0
Office	D	98		0.000	0
Industrial	A	98		0.000	0
Industrial	B	98		0.000	0
Industrial	C	98		0.000	0
Industrial	D	98		0.000	0
Split Use (i.e., churches, businesses, and residential)	A	25		0.000	0
Split Use (i.e., churches, businesses, and residential)	B	55		0.000	0
Split Use (i.e., churches, businesses, and residential)	C	70		0.000	0
Split Use (i.e., churches, businesses, and residential)	D	77		0.000	0
Agricultural	A	39		0.000	0
Agricultural	B	61		0.000	0
Agricultural	C	74		0.000	0
Agricultural	D	80		0.000	0
		Totals =	77.8	0.12	6381.7

Total (weighted) RCN = total product/total area = 82.03

RCN used = 82

SCS Runoff Curve Number

Project: Maple Creek Tributary #1, Rocky Mount, NC
Prepared by: EVF
Checked by: DJK
Date: January 5, 2009

Sub-Basin: 2D

Landuse	Soil Group	RCN	Area (Acres)	Area (Sq. Mi.)	Product of RCN and Area
Residential MF (1/8 acre lots)	A	80		0.000	0
Residential MF (1/8 acre lots)	B	85		0.000	0
Residential MF (1/8 acre lots)	C	90		0.000	0
Residential MF (1/8 acre lots)	D	92		0.000	0
Residential SF (1/3 - 1/2 acre lots)	A	61		0.000	0
Residential SF (1/3 - 1/2 acre lots)	B	75	6.6	0.010	491
Residential SF (1/3 - 1/2 acre lots)	C	83		0.000	0
Residential SF (1/3 - 1/2 acre lots)	D	87	3.3	0.005	286
Commercial	A	98		0.000	0
Commercial	B	98		0.000	0
Commercial	C	98		0.000	0
Commercial	D	98		0.000	0
Office	A	96		0.000	0
Office	B	97		0.000	0
Office	C	98		0.000	0
Office	D	98		0.000	0
Industrial	A	98		0.000	0
Industrial	B	98		0.000	0
Industrial	C	98		0.000	0
Industrial	D	98		0.000	0
Split Use (i.e., churches, businesses, and residential)	A	25		0.000	0
Split Use (i.e., churches, businesses, and residential)	B	55		0.000	0
Split Use (i.e., churches, businesses, and residential)	C	70		0.000	0
Split Use (i.e., churches, businesses, and residential)	D	77		0.000	0
Agricultural	A	39		0.000	0
Agricultural	B	61		0.000	0
Agricultural	C	74		0.000	0
Agricultural	D	80		0.000	0
		Totals =	9.8	0.02	777.5

Total (weighted) RCN = total product/total area = 79.01

RCN used = 79

SCS Runoff Curve Number

Project: Maple Creek Tributary #1, Rocky Mount, NC
Prepared by: EVF
Checked by: DJK
Date: January 5, 2009

Sub-Basin: 2E

Landuse	Soil Group	RCN	Area (Acres)	Area (Sq. Mi.)	Product of RCN and Area
Residential MF (1/8 acre lots)	A	80		0.000	0
Residential MF (1/8 acre lots)	B	85		0.000	0
Residential MF (1/8 acre lots)	C	90		0.000	0
Residential MF (1/8 acre lots)	D	92		0.000	0
Residential SF (1/3 - 1/2 acre lots)	A	61		0.000	0
Residential SF (1/3 - 1/2 acre lots)	B	75	38.0	0.059	2853
Residential SF (1/3 - 1/2 acre lots)	C	83		0.000	0
Residential SF (1/3 - 1/2 acre lots)	D	87	22.1	0.035	1925
Commercial	A	98		0.000	0
Commercial	B	98		0.000	0
Commercial	C	98		0.000	0
Commercial	D	98		0.000	0
Office	A	96		0.000	0
Office	B	97		0.000	0
Office	C	98		0.000	0
Office	D	98		0.000	0
Industrial	A	98		0.000	0
Industrial	B	98		0.000	0
Industrial	C	98		0.000	0
Industrial	D	98		0.000	0
Split Use (i.e., churches and residential)	A	25		0.000	0
Split Use (i.e., churches and residential)	B	55	14.5	0.023	798
Split Use (i.e., churches and residential)	C	70		0.000	0
Split Use (i.e., churches and residential)	D	77	4.0	0.006	310
Agricultural	A	39		0.000	0
Agricultural	B	61		0.000	0
Agricultural	C	74		0.000	0
Agricultural	D	80		0.000	0
		Totals =	78.7	0.12	5886.7

Total (weighted) RCN = total product/total area = 74.79

RCN used = 75

SCS Runoff Curve Number

Project: Maple Creek Tributary #1, Rocky Mount, NC
Prepared by: EVF
Checked by: DJK
Date: January 5, 2009

Sub-Basin: 3A

Landuse	Soil Group	RCN	Area (Acres)	Area (Sq. Mi.)	Product of RCN and Area
Residential MF (1/8 acre lots)	A	80		0.000	0
Residential MF (1/8 acre lots)	B	85		0.000	0
Residential MF (1/8 acre lots)	C	90		0.000	0
Residential MF (1/8 acre lots)	D	92		0.000	0
Residential SF (1/3 - 1/2 acre lots)	A	61		0.000	0
Residential SF (1/3 - 1/2 acre lots)	B	75	21.80	0.034	1635
Residential SF (1/3 - 1/2 acre lots)	C	83		0.000	0
Residential SF (1/3 - 1/2 acre lots)	D	87	5.6	0.009	489
Commercial	A	98		0.000	0
Commercial	B	98		0.000	0
Commercial	C	98		0.000	0
Commercial	D	98		0.000	0
Office	A	96		0.000	0
Office	B	97		0.000	0
Office	C	98		0.000	0
Office	D	98		0.000	0
Industrial	A	98		0.000	0
Industrial	B	98		0.000	0
Industrial	C	98		0.000	0
Industrial	D	98		0.000	0
Split Use (i.e., churches, businesses, and residential)	A	25		0.000	0
Split Use (i.e., churches, businesses, and residential)	B	55		0.000	0
Split Use (i.e., churches, businesses, and residential)	C	70		0.000	0
Split Use (i.e., churches, businesses, and residential)	D	77		0.000	0
Agricultural	A	39		0.000	0
Agricultural	B	61	7.7	0.012	472
Agricultural	C	74		0.000	0
Agricultural	D	80	4.0	0.006	323
		Totals =	39.2	0.06	2918.7

Total (weighted) RCN = total product/total area = 74.47

RCN used = 74

SCS Runoff Curve Number

Project: Maple Creek Tributary #1, Rocky Mount, NC
Prepared by: EVF
Checked by: DJK
Date: January 5, 2009

Sub-Basin: 3B

Landuse	Soil Group	RCN	Area (Acres)	Area (Sq. Mi.)	Product of RCN and Area
Residential MF (1/8 acre lots)	A	80		0.000	0
Residential MF (1/8 acre lots)	B	85		0.000	0
Residential MF (1/8 acre lots)	C	90		0.000	0
Residential MF (1/8 acre lots)	D	92		0.000	0
Residential SF (1/3 - 1/2 acre lots)	A	61		0.000	0
Residential SF (1/3 - 1/2 acre lots)	B	75	117.91	0.184	8843
Residential SF (1/3 - 1/2 acre lots)	C	83		0.000	0
Residential SF (1/3 - 1/2 acre lots)	D	87	8.4	0.013	731
Commercial	A	98		0.000	0
Commercial	B	98		0.000	0
Commercial	C	98		0.000	0
Commercial	D	98		0.000	0
Office	A	96		0.000	0
Office	B	97	7.6	0.012	739
Office	C	98		0.000	0
Office	D	98	1.1	0.002	109
Industrial	A	98		0.000	0
Industrial	B	98		0.000	0
Industrial	C	98		0.000	0
Industrial	D	98		0.000	0
Split Use (i.e., churches, businesses, and residential)	A	25		0.000	0
Split Use (i.e., churches, businesses, and residential)	B	55		0.000	0
Split Use (i.e., churches, businesses, and residential)	C	70		0.000	0
Split Use (i.e., churches, businesses, and residential)	D	77		0.000	0
Agricultural	A	39		0.000	0
Agricultural	B	61	5.4	0.008	326
Agricultural	C	74		0.000	0
Agricultural	D	80	1.1	0.002	89
		Totals =	141.5	0.22	10837.1

Total (weighted) RCN = total product/total area = 76.59

RCN used = 77

SCS Runoff Curve Number

Project: Maple Creek Tributary #1, Rocky Mount, NC
Prepared by: EVF
Checked by: DJK
Date: January 5, 2009

Entire Project

Landuse	Soil Group	RCN	Area (Acres)	Area (Sq. Mi.)	Product of RCN and Area
Residential MF (1/8 acre lots)	A	80	0.0	0.000	0
Residential MF (1/8 acre lots)	B	85	7.5	0.012	635
Residential MF (1/8 acre lots)	C	90	0.0	0.000	0
Residential MF (1/8 acre lots)	D	92	15.9	0.025	1463
Residential SF (1/3 - 1/2 acre lots)	A	61	0.0	0.000	0
Residential SF (1/3 - 1/2 acre lots)	B	75	396.2	0.619	29711
Residential SF (1/3 - 1/2 acre lots)	C	83	0.0	0.000	0
Residential SF (1/3 - 1/2 acre lots)	D	87	211.2	0.330	18371
Commercial	A	98	0.0	0.000	0
Commercial	B	98	9.7	0.015	946
Commercial	C	98	0.0	0.000	0
Commercial	D	98	0.0	0.000	0
Office	A	96	0.0	0.000	0
Office	B	97	27.6	0.043	2673
Office	C	98	0.0	0.000	0
Office	D	98	2.7	0.004	262
Industrial	A	98	0.0	0.000	0
Industrial	B	98	0.0	0.000	0
Industrial	C	98	0.0	0.000	0
Industrial	D	98	0.0	0.000	0
Split Use (i.e., churches, businesses, and residential)	A	25	0.0	0.000	0
Split Use (i.e., churches, businesses, and residential)	B	55	31.8	0.050	1747
Split Use (i.e., churches, businesses, and residential)	C	70	0.0	0.000	0
Split Use (i.e., churches, businesses, and residential)	D	77	20.0	0.031	1542
Agricultural	A	39	0.0	0.000	0
Agricultural	B	61	13.1	0.020	798
Agricultural	C	74	0.0	0.000	0
Agricultural	D	80	5.2	0.008	412
		Totals =	740.6	1.16	58559.6

Total (weighted) RCN = total product/total area = 79.07

RCN used = 79

APPENDIX J

Project: Maple Creek Tributary #1, Rocky Mount, NC
Prepared by: EVF
Checked by: DJK
Date: January 5, 2009

Time of Concentration - Existing Conditions

Sub-basin	Sheet Flow						Shallow Concentration					Channel Flow									
	Description	n	Flow Length	P-2	Land Slope	Tt	Surface Description	Flow Length	Slope	Velocity	Tt	Channel Area	Channel Perimeter	Hydraulic Radius	Slope	n	Velocity	Flow Length	Tt	Tc	Lag
	Grass/Pavement		(ft)	(in)	(ft/ft)	(min)	0--Unpaved/1-Paved	(ft)	(ft/ft)	(ft/s)	(min)	(ft2)	(ft)	(ft)	(ft/ft)		(ft/s)	(ft)	(min)	(min)	(hr)
1A	Grass	0.24	150	3.6	0.010	24.56	0	304	0.009	1.52	3.33	8	7.7	1.04	0.002	0.04	1.86	2017	18.03	59.6	**0.60**
												Pipe			0.003	0.013	5.00	2301	7.67		
												16.5	10.7	1.54	0.004	0.04	3.34	1202	6.00		
1B	Grass	0.24	150	3.6	0.015	20.95	0	273	0.005	1.19	3.82	Pipe			0.001	0.013	5.00	1160	3.87	28.6	**0.29**
1C	Grass	0.24	150	3.6	0.010	24.56	0	250	0.010	1.61	2.58	8	7.7	1.04	0.003	0.035	2.51	600	3.99	37.1	**0.37**
												Pipe			0.002	0.013	5.00	1800	6.00		
1D	Grass	0.24	150	3.6	0.033	15.17	0	250	0.040	3.23	1.29	8	7.7	1.04	0.002	0.035	2.12	1700	13.38	32.5	**0.33**
												6.72	7.3	0.92	0.007	0.013	9.00	1450	2.68		
2A	Grass	0.24	150	3.6	0.011	23.64	1	345	0.008	1.82	3.16	16.5	10.7	1.54	0.037	0.04	9.62	403	0.70	33.0	**0.33**
												48	18.39	2.61	0.004	0.04	4.67	1536	5.48		
2A-1	Grass	0.24	150	3.6	0.004	34.74	1	128	0.005	1.43	1.50	Pipe			0.002	0.013	5.00	1612	5.37	41.6	**0.42**
2B	Grass	0.24	150	3.6	0.023	17.46	0	230	0.008	1.40	2.73	16.5	10.7	1.54	0.012	0.045	4.92	1182	4.00	24.2	**0.24**
2C	Grass	0.24	150	3.6	0.019	19.02	0	304	0.010	1.64	3.09	16.5	10.7	1.54	0.003	0.03	3.67	3344	15.19	37.3	**0.37**
2D	Grass	0.24	150	3.6	0.017	20.02	0	157	0.063	4.06	0.64	16.5	10.7	1.54	0.013	0.04	5.76	413	1.19	21.9	**0.22**
2E	Grass	0.24	150	3.6	0.006	29.35	0	234	0.017	2.08	1.87	16.5	10.7	1.54	0.014	0.04	5.88	1635	4.63	36.9	**0.37**
												48	18.39	2.61	0.006	0.04	5.29	330	1.04		
3A	Grass	0.24	150	3.6	0.005	32.75	0	420	0.085	4.71	1.49	16.5	10.7	1.54	0.002	0.04	1.95	2326	19.85	56.1	**0.56**
												48	18.39	2.61	0.001	0.04	2.65	321	2.02		
3B	Grass	0.24	150	3.6	0.006	29.99	1	272	0.003	1.16	3.92	16.5	10.7	1.54	0.018	0.045	5.97	1152	3.21	38.0	**0.38**
												48	18.39	2.61	0.010	0.045	7.00	363	0.86		

Project: Maple Creek Tributary #1, Rocky Mount, NC
Prepared by: EVF
Checked by: DJK
Date: January 5, 2009

Time of Concentration - Proposed Conditions

Sub-basin	Sheet Flow						Shallow Concentration					Channel Flow									
	Description	n	Flow Length	P-2	Land Slope	Tt	Surface Description	Flow Length	Slope	Velocity	Tt	Channel Area	Channel Perimeter	Hydraulic Radius	Slope	n	Velocity	Flow Length	Tt	Tc	Lag
	Grass/Pavement		(ft)	(in)	(ft/ft)	(min)	0--Unpaved/1-Paved	(ft)	(ft/ft)	(ft/s)	(min)	(ft2)	(ft)	(ft)	(ft/ft)		(ft/s)	(ft)	(min)	(min)	(hr)
1A	Grass	0.24	150	3.6	0.010	24.56	0	304	0.009	1.52	3.33	8	7.7	1.04	0.002	0.04	1.86	2017	18.03	53.5	**0.53**
												Pipe			0.008	0.013	5.00	950	3.17		
												Pipe			0.003	0.013	7.50	1966	4.37		
1B	Grass	0.24	150	3.6	0.015	20.95	0	273	0.005	1.19	3.82	Pipe			0.001	0.013	5.00	1160	3.87	28.6	**0.29**
1C	Grass	0.24	150	3.6	0.010	24.56	0	250	0.010	1.61	2.58	8	7.7	1.04	0.003	0.035	2.51	600	3.99	37.1	**0.37**
												Pipe			0.002	0.013	5.00	1800	6.00		
1D	Grass	0.24	150	3.6	0.033	15.17	0	250	0.040	3.23	1.29	8	7.7	1.04	0.002	0.035	2.12	1700	13.38	32.5	**0.33**
												6.72	7.3	0.92	0.007	0.013	9.00	1450	2.68		
2A	Grass	0.24	150	3.6	0.011	23.64	1	345	0.008	1.82	3.16	16.5	10.7	1.54	0.037	0.04	9.62	403	0.70	33.0	**0.33**
												48	18.39	2.61	0.004	0.04	4.67	1536	5.48		
2A-1	Grass	0.24	150	3.6	0.004	34.74	1	128	0.005	1.43	1.50	Pipe			0.002	0.013	5.00	1612	5.37	41.6	**0.42**
2B	Grass	0.24	150	3.6	0.023	17.46	0	230	0.008	1.40	2.73	16.5	10.7	1.54	0.012	0.045	4.92	1182	4.00	24.2	**0.24**
2C	Grass	0.24	150	3.6	0.019	19.02	0	304	0.010	1.64	3.09	16.5	10.7	1.54	0.003	0.03	3.67	3344	15.19	37.3	**0.37**
2D	Grass	0.24	150	3.6	0.017	20.02	0	157	0.063	4.06	0.64	16.5	10.7	1.54	0.013	0.04	5.76	413	1.19	21.9	**0.22**
2E	Grass	0.24	150	3.6	0.006	29.35	0	234	0.017	2.08	1.87	16.5	10.7	1.54	0.014	0.04	5.88	1635	4.63	36.9	**0.37**
												48	18.39	2.61	0.006	0.04	5.29	330	1.04		
3A	Grass	0.24	150	3.6	0.005	32.75	0	420	0.085	4.71	1.49	16.5	10.7	1.54	0.002	0.04	1.95	2326	19.85	56.1	**0.56**
												48	18.39	2.61	0.001	0.04	2.65	321	2.02		
3B	Grass	0.24	150	3.6	0.006	29.99	1	272	0.003	1.16	3.92	16.5	10.7	1.54	0.018	0.045	5.97	1152	3.21	38.0	**0.38**
												48	18.39	2.61	0.010	0.045	7.00	363	0.86		

APPENDIX K

EXISTING CONDITIONS WITH ROUTING

```
1****************************************                                                  ****************************************
 *                                      *                                                  *                                      *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *                                                  *    U.S. ARMY CORPS OF ENGINEERS      *
 *              JUN   1998              *                                                  *    HYDROLOGIC ENGINEERING CENTER     *
 *           VERSION 4.1                *                                                  *          609 SECOND STREET           *
 *                                      *                                                  *       DAVIS, CALIFORNIA 95616        *
 *  RUN DATE   12MAR09  TIME  11:27:51  *                                                  *           (916) 756-1104             *
 *                                      *                                                  *                                      *
 ****************************************                                                  ****************************************
```

```
X     X  XXXXXXX   XXXXX          X
X     X  X        X     X        XX
X     X  X        X               X
XXXXXXX  XXXX     X        XXXXX  X
X     X  X        X               X
X     X  X        X     X         X
X     X  XXXXXXX   XXXXX         XXX
```

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

```
  1          ID  HEC-1 ANALYSIS -- MANSFIELD DRIVE -- ROCKY MOUNT, NC
  2          ID  EXISTING CONDITIONS -- 10 YEAR STORM EVENT, 6 HOUR DURATION
  3          ID  EXISTING CONDITIONS LANDUSE WITH ROUTING
  4          ID  CREATED JANUARY 07, 2009 BY EVF
             *DIAGRAM
  5          IT       5 07JAN09       0     300
  6          IO       4
             * ******************************************************

  7          KK   BSN1A
  8          KM  RUNOFF FROM BASIN 1A TO CONFLUENCE WITH BASIN 1C - Neglect Basin 1B
  9          KO       0       0       0       0      22
 10          BA   0.218
```

```
11          KM  2-YR RAINFALL
12          KM  0 0 0.49 1.05 1.8 2.25 2.45 2.9
13          KM  5-YR RAINFALL
14          KM  0 0 0.55 1.22 2.26 2.85 3.15 3.7
15          KM  10-YR RAINFALL
16          KM  0 0 0.61 1.34 2.58 3.3 3.65 4.25
17          KM  25-YR RAINFALL
18          PH       0       0    0.69    1.54     3.3    3.85     4.2       5
19          KM  50-YR RAINFALL
20          KM  0 0 0.76 1.69 3.65 4.4 4.7 5.6
21          KM  100-YR RAINFALL
22          KM  0 0 0.82 1.84 3.75 4.75 5.2 6.4
23          LS       0      78       0
24          UD    0.53
            * ******************************************************

25          KK   RT-1A
26          KM  STORAGE ROUTING FOR BSN1A
            * ROUTE THROUGH BSN 1A
            * CHANGE SQ & SE AFTER HEC-RAS RUN -- 01/15/09
27          RS       1    STOR      -1
28          SA    3.53    7.22   11.08    15.1   19.28   23.64   28.15   32.84   37.69    42.7
29          SE   123.3   123.6   123.9   124.1   124.4   124.7     125   125.3   125.6   125.9
30          SQ       0   20.19   35.58   41.14   46.09   50.53   54.61   96.35  259.15  489.61
31          SE   124.7   124.9   125.1   125.3   125.5   125.7   125.9   126.1   126.3   126.5
            * ******************************************************

32          KK   BSN1C
33          KM  RUNOFF FROM BASIN 1C TO CONFLUENCE WITH BASIN 1A
34          KO       0       0       0       0      22
35          BA   0.062
36          LS       0      82       0
37          UD    0.37
            * ******************************************************

38          KK   ADD1A
39          KM  COMBINE FLOWS FROM BSN1A AND 1C
40          KO       0       0       0       0      22
41          HC       2


42          KK  B1A-RT
43          KM  ROUTING ABOVE WINSTEAD ROAD
            * ROUTE THROUGH WINSTEAD ROAD CULVERT
            * CHANGE SQ & SE AFTER HEC-RAS RUN -- 01/15/09
44          RS       1    STOR      -1
45          SA    0.76    4.76    7.23   12.27    24.3   44.19
46          SE     126     128     130     132     134     136
47          SQ     100     200     300     400     500     750    1000    2000    5000
48          SE  124.84  126.51  127.02  125.06   128.4  128.66  128.85  129.09  129.68
            * ******************************************************
```

```
49          KK   BSN1D
50          KM  RUNOFF FROM BASIN 1D
51          KO       0       0       0       0      22
52          BA   0.092
53          LS       0      75       0
54          UD    0.33
            * ******************************************************

55          KK   ADD1B
56          KM  COMBINE FLOWS FROM MAIN STREAM AND BSN1D
57          KO       0       0       0       0      22
58          HC       2
            * ******************************************************

59          KK   B1-RT
60          KM  ROUTING ABOVE RAILROAD CULVERT
            * ROUTE THROUGH RAILROAD CULVERT
            * CHANGE SQ & SE AFTER HEC-RAS RUN -- 01/15/09
61          RS       1    STOR      -1
62          SA    1.92    6.69   16.96   40.06    80.2  129.61
63          SE     126     128     130     132     134     136
64          SQ     100     150     200     250     300     400     500     600     700
65          SE  124.04  125.59  126.81  128.05  128.39  128.64   158.8  128.97  129.17
            * ******************************************************

66          KK     RT1
67          KM  CHANNEL ROUTING FROM RR CULVERT TO SHEFFIELD DRIVE - ASSUME LENGTH IS 100
68          KO       0       0       0       0      22
69          RD
70          RC    0.03   0.035    0.03     100   0.005
71          RX     264  270.11  271.08  273.48  276.48  286.02     291  335.04
72          RY     126  121.37     121     120     120     122     126     126
            * ******************************************************

73          KK   B2-RT
74          KM  ROUTING ABOVE SHEFFIELD DRIVE
            * ROUTE THROUGH SHEFFIELD DRIVE CULVERT
            * CHANGE SQ & SE AFTER HEC-RAS RUN -- 01/15/09
75          RS       1    STOR      -1
76          SA    0.49    0.91    1.22    1.78     6.1   10.96
77          SE     126     128     130     132     134     136
78          SQ     100     200     300     400     500     750    1000    2000    5000
79          SE  123.22  124.44  124.83  125.01  125.21  125.64  125.94  126.74  128.34
            * ******************************************************

80          KK     RT2
81          KM  CHANNEL ROUTING FROM SHEFFIELD DRIVE
82          KO       0       0       0       0      22
83          RD
84          RC    0.03   0.035    0.03    1680   0.013
```

```
RX     264  270.11  271.08  273.48  276.48  286.02     291  335.04
RY     126  121.37     121     120     120     122     126     126
* ******************************************************

KK   BSN2A
KM  RUNOFF FROM BSN2A
KO       0       0       0       0      22
BA   0.063
LS       0      79       0
UD    0.33
* ******************************************************

KK  BSN2A-       1
KM  RUNOFF FROM BSN2A-1
KO       0       0       0       0      22
BA   0.031
LS       0      76       0
UD    0.42
* ******************************************************

KK    ADD1
KM  COMBINE FLOWS FROM BSN2A, BSN2A-1, AND MAIN STREAM
KO       0       0       0       0      22
HC       3
* ******************************************************

KK   BSN2C
KM  RUNOFF FROM BSN2C TO NOTTINGHAM REACH 1
KO       0       0       0       0      22
BA   0.122
LS       0      82       0
UD    0.37
* ******************************************************

KK  NT-RT1
KM  CHANNEL ROUTING FROM NOTTINGHAM REACH 1 TO NOTTINGHAM CULVERT
KO       0       0       0       0      22
RD
RC     0.1   0.055     0.1     822   0.012
RX  195.71  196.28  205.68  212.29  216.29  223.94  239.94  244.14
RY     125     125     124     117     117   124.5     124     124
* ******************************************************

KK   BSN2B
KM  RUNOFF FROM BSN2B TO NOTTINGHAM CULVERT
KO       0       0       0       0      22
BA   0.086
LS       0      77       0
UD    0.24
* ******************************************************
```

```
KK   JCTN1
KM  COMBINE FLOWS FROM BSN2C AND BSN2B
KO       0       0       0       0      22
HC       2
* ******************************************************

KK   B3-RT
KM  ROUTING ABOVE NOTTINGHAM ROAD
* ROUTE THROUGH NOTTINGHAM ROAD CULVERT
* CHANGE SQ & SE AFTER HEC-RAS RUN -- 01/15/09
RS       1    STOR      -1
SA    0.22    0.69    2.39    4.06     6.9
SE     116     118     122     124     126
SQ     100     200     300     400     500     750    1000    1250    1500
SE     114  117.98  118.99  119.53  119.88  120.53  121.02  121.37  121.69
* ******************************************************

KK  NT-RT2
KM  CHANNEL ROUTING FROM NOTTINGHAM CULVERT TO NOTTINGHAM REACH 2
KO       0       0       0       0      22
RD
RC     0.1   0.045    0.05     558   0.011
RX  348.31  352.17  377.39  388.39  392.39  394.39  409.35  418.88
RY     114     114   113.5     108     108   113.5     114     115
* ******************************************************

KK   BSN2D
KM  RUNOFF FROM BSN2D
KO       0       0       0       0      22
BA   0.015
LS       0      79       0
UD    0.22
* ******************************************************

KK    ADD3
KM  COMBINE FLOWS FROM BSN2B AND BSN2D
KO       0       0       0       0      22
HC       2
* ******************************************************

KK    ADD4
KM  COMBINE FLOWS FROM NOTTINGHAM STREAM AND MAIN STREAM
KO       0       0       0       0      22
HC       2
* ******************************************************

KK     RT3
KM  CHANNEL ROUTING FROM CONFLUENCE POINT
KO       0       0       0       0      22
RD
RC    0.07   0.035    0.04    1385    0.01
```

```
RX  199.57  204.96  284.25  292.21  300.21  304.59  326.21  342.86
RY     112     111     111     103     103  108.25     108     108
* ******************************************************


KK   BSN2E
KM  RUNOFF FROM BSN2E
KO       0       0       0       0      22
BA   0.123
LS       0      75       0
UD    0.37
* ******************************************************

KK    ADD5
KM  COMBINE FLOWS FROM BSN2E AND MAIN STREAM REACH 5
KO       0       0       0       0      22
HC       2
* ******************************************************

KK   B4-RT
KM  ROUTING ABOVE SOUTH WINSTEAD AVENUE
* ROUTE THROUGH SOUTH WINSTEAD AVENUE CULVERT
* CHANGE SQ & SE AFTER HEC-RAS RUN -- 01/15/09
RS       1    STOR      -1
SA     0.6     2.4    5.09    8.69   12.75   17.58   25.33
SE     104     106     108     110     112     114     116
SQ     100     200     300     400     500     750    1000    2000    5000
SE   102.3   103.7  104.68  105.59  106.35  108.64  109.64  110.97   112.5
* ******************************************************

KK     RT4
KM  CHANNEL ROUTING MAIN STREAM REACH 6
KO       0       0       0       0      22
RD
RC    0.07   0.045    0.05    1355   0.008
RX  411.94  426.78  467.67  475.45  479.44  487.69  541.11   594.6
RY     101     101     101      96      96     101     101     101
* ******************************************************

KK   BSN3B
KM  RUNOFF FROM BSN3B
KO       0       0       0       0      22
BA   0.221
LS       0      77       0
UD    0.38
* ******************************************************

KK    ADD6
KM  COMBINE FLOWS FROM BSN3B AND BSN3A
KO       0       0       0       0      22
HC       2
```

```
                    * ******************************************************

195                 KK   B5-RT
196                 KM  ROUTING ABOVE AVONDALE AVENUE
                    * ROUTE THROUGH AVONDALE AVENUE CULVERT
                    * CHANGE SQ & SE AFTER HEC-RAS RUN -- 01/15/09
197                 RS       1    STOR      -1
198                 SA    0.08    0.55    5.36    8.26

199                 SE      96      98     102     104
200                 SQ     100     200     300     400     500     750    1000    2000    5000
201                 SE   97.41   99.07  100.48  100.99  101.19  101.57  101.85   102.7  104.21
                    * ******************************************************

202                 KK     RT5
203                 KM  CHANNEL ROUTING MAIN STREAM REACH 7
204                 KO       0       0       0       0      22
205                 RD
206                 RC    0.05   0.045    0.05    1355   0.012
207                 RX  655.17  663.67  670.85     675     682     688  691.71  707.49
208                 RY    94.7      94      94      92      92      94      95      95
                    * ******************************************************

209                 KK   BSN3A
210                 KM  RUNOFF FROM BSN3A
211                 KO       0       0       0       0      22
212                 BA   0.061
213                 LS       0      74       0
214                 UD    0.56
                    * ******************************************************

215                 KK    ADD7
216                 KM  COMBINE FLOWS FROM MAIN STREAM AND MAPLE CREEK
217                 KO       0       0       0       0      22
218                 HC       2
                    * ******************************************************

219                 KK       1
220                 KO       0       0       0       0      22
221                 RN      1R
222                 ZZ


 SCHEMATIC DIAGRAM OF STREAM NETWORK
INPUT
 LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

  NO.      (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

    7       BSN1A
                V
```

```
             V
 25       RT-1A
             .
             .
 32          .       BSN1C
             .           .
             .           .
 38       ADD1A...........
             V
             V
 42      B1A-RT
             .
             .
 49          .       BSN1D
             .           .
             .           .
 55       ADD1B...........
             V
             V
 59       B1-RT
             V
             V
 66         RT1
             V
             V
 73       B2-RT
             V
             V
 80         RT2
             .
             .
 87          .       BSN2A
             .           .
             .           .
 93          .           .      BSN2A-
             .           .           .
             .           .           .
 99        ADD1......................
             .
             .
103          .       BSN2C
             .           V
             .           V
109          .      NT-RT1
             .           .
             .           .
116          .           .       BSN2B
             .           .           .
             .           .           .
122          .       JCTN1...........
             .           V
```

```
             .           V
126          .       B3-RT
             .           V
             .           V
133          .      NT-RT2
             .           .
             .           .
140          .           .       BSN2D
             .           .           .
             .           .           .
146          .        ADD3............
             .           .
             .           .
150       ADD4............
             V
             V
154        RT3
             .
             .
161          .       BSN2E
             .           .
             .           .
167       ADD5............
             V
             V
171      B4-RT
             V
             V
178        RT4
             .
             .
185          .       BSN3B
             .           .
             .           .
191       ADD6............
             V
             V
195      B5-RT
             V
             V
202        RT5
             .
             .
209          .       BSN3A
             .           .
             .           .
215       ADD7............
             V
             V
219          1
```

2-YEAR

***

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

	OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
+	HYDROGRAPH AT	BSN1A	111.	3.67	25.	6.	6.	.22		
+	ROUTED TO	RT-1A	14.	6.08	10.	3.	3.	.22		
+									124.84	6.08
+	HYDROGRAPH AT	BSN1C	49.	3.50	9.	2.	2.	.06		
+	2 COMBINED AT	ADD1A	49.	3.50	17.	5.	5.	.28		
+	ROUTED TO	B1A-RT	49.	3.50	17.	5.	5.	.28		
+									125.66	3.50
+	HYDROGRAPH AT	BSN1D	51.	3.42	9.	2.	2.	.09		
+	2 COMBINED AT	ADD1B	100.	3.42	26.	7.	7.	.37		
+	ROUTED TO	B1-RT	167.	3.25	27.	8.	7.	.37		
+									126.00	3.25
+	ROUTED TO	RT1	159.	3.25	27.	8.	7.	.37		
+	ROUTED TO	B2-RT	159.	3.25	27.	8.	7.	.37		
+									124.67	3.25
+	ROUTED TO	RT2	141.	3.33	27.	8.	7.	.37		

```
          HYDROGRAPH AT
+                        BSN2A        45.    3.42           8.          2.          2.        .06

          HYDROGRAPH AT
+                       BSN2A-        16.    3.58           3.          1.          1.        .03

          3 COMBINED AT
+                         ADD1       194.    3.33          38.         10.         10.        .47

          HYDROGRAPH AT
+                        BSN2C        97.    3.50          17.          4.          4.        .12

          ROUTED TO
+                       NT-RT1        97.    3.50          17.          4.          4.        .12

          HYDROGRAPH AT
+                        BSN2B        65.    3.33           9.          2.          2.        .09

          2 COMBINED AT
+                        JCTN1       151.    3.42          26.          7.          6.        .21

          ROUTED TO
+                        B3-RT       153.    3.17          27.          7.          7.        .21
+                                                                                          116.13        3.17

          ROUTED TO
+                       NT-RT2       147.    3.42          28.          7.          7.        .21

          HYDROGRAPH AT
+                        BSN2D        13.    3.33           2.          0.          0.        .01

          2 COMBINED AT
+                         ADD3       159.    3.42          29.          7.          7.        .22

          2 COMBINED AT
+                         ADD4       339.    3.33          67.         18.         17.        .69

          ROUTED TO
+                          RT3       327.    3.42          67.         18.         17.        .69

          HYDROGRAPH AT
+                        BSN2E        64.    3.50          12.          3.          3.        .12

          2 COMBINED AT
+                         ADD5       389.    3.42          79.         21.         20.        .81

          ROUTED TO
+                        B4-RT       356.    3.58          80.         21.         20.        .81
+                                                                                          105.19        3.58
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          ROUTED TO
+                            RT4       355.    3.67          80.         21.         20.        .81

          HYDROGRAPH AT
+                          BSN3B       130.    3.50          24.          6.          6.        .22

          2 COMBINED AT
+                           ADD6       472.    3.58         103.         27.         26.       1.03

          ROUTED TO
+                          B5-RT       415.    3.83         147.        112.        111.       1.03
+                                                                                                     101.02        3.83

          ROUTED TO
+                            RT5       411.    3.92         147.        112.        111.       1.03

          HYDROGRAPH AT
+                          BSN3A        23.    3.75           6.          1.          1.        .06

          2 COMBINED AT
+                           ADD7       432.    3.92         153.        113.        112.       1.09

          ROUTED TO
+                              1       432.    3.92         153.        113.        112.       1.09
1
                                       SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING
                                           (FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)
                                                                                   INTERPOLATED TO
                                                                                COMPUTATION INTERVAL
            ISTAQ    ELEMENT      DT       PEAK    TIME TO     VOLUME      DT       PEAK    TIME TO     VOLUME
                                                      PEAK                                   PEAK

                                (MIN)     (CFS)      (MIN)     (IN)     (MIN)     (CFS)     (MIN)       (IN)

                RT1  MANE          .32    160.87    195.15       .77      5.00    158.72    195.00         .77

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .1523E+02 EXCESS= .0000E+00 OUTFLOW= .1523E+02 BASIN STORAGE= .6319E-04 PERCENT ERROR=    .0

                RT2  MANE         3.25    148.72    201.50       .77      5.00    140.70    200.00         .77

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .1530E+02 EXCESS= .0000E+00 OUTFLOW= .1531E+02 BASIN STORAGE= .6883E-03 PERCENT ERROR=   -.1

             NT-RT1  MANE         2.93     96.80    210.68      1.30      5.00     96.55    210.00        1.30

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .8459E+01 EXCESS= .0000E+00 OUTFLOW= .8460E+01 BASIN STORAGE= .1834E-03 PERCENT ERROR=    .0
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```
            NT-RT2  MANE         1.62    149.59    206.30      1.23      5.00    147.50    205.00        1.23

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1364E+02 EXCESS= .0000E+00 OUTFLOW= .1363E+02 BASIN STORAGE= .9336E-04 PERCENT ERROR=    .0

               RT3  MANE         2.72    332.33    203.99       .95      5.00    327.42    205.00         .95

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3506E+02 EXCESS= .0000E+00 OUTFLOW= .3507E+02 BASIN STORAGE= .4719E-03 PERCENT ERROR=    .0

               RT4  MANE         3.58    356.25    218.63       .95      5.00    354.88    220.00         .95

CONTINUITY SUMMARY (AC-FT) - INFLOW= .4134E+02 EXCESS= .0000E+00 OUTFLOW= .4136E+02 BASIN STORAGE= .1051E-02 PERCENT ERROR=   -.1

               RT5  MANE         2.00    412.91    234.00      4.14      5.00    410.61    235.00        4.15

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2291E+03 EXCESS= .0000E+00 OUTFLOW= .2284E+03 BASIN STORAGE= .7170E+00 PERCENT ERROR=    .0


*** NORMAL END OF HEC-1 ***
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10-YEAR

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RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

	OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
+	HYDROGRAPH AT	BSN1A	217.	3.67	49.	12.	12.	.22		
+	ROUTED TO	RT-1A	36.	5.25	28.	9.	9.	.22		
+									125.11	5.25
+	HYDROGRAPH AT	BSN1C	87.	3.42	16.	4.	4.	.06		
+	2 COMBINED AT	ADD1A	87.	3.42	42.	13.	13.	.28		
+	ROUTED TO	B1A-RT	171.	3.33	43.	13.	13.	.28		
+									126.03	3.33
+	HYDROGRAPH AT	BSN1D	105.	3.42	18.	5.	4.	.09		
+	2 COMBINED AT	ADD1B	269.	3.33	61.	18.	17.	.37		
+	ROUTED TO	B1-RT	178.	3.58	62.	18.	17.	.37		
+									126.26	3.58
+	ROUTED TO	RT1	178.	3.58	62.	18.	17.	.37		
+	ROUTED TO	B2-RT	178.	3.58	62.	18.	17.	.37		
+									124.74	3.58
+	ROUTED TO	RT2	178.	3.50	62.	18.	17.	.37		

```
          HYDROGRAPH AT
+                       BSN2A        85.    3.42          15.          4.          4.        .06

          HYDROGRAPH AT
+                      BSN2A-        32.    3.50           6.          2.          2.        .03

          3 COMBINED AT
+                        ADD1       291.    3.50          82.         23.         23.        .47

          HYDROGRAPH AT
+                       BSN2C       172.    3.42          32.          8.          8.        .12

          ROUTED TO
+                      NT-RT1       171.    3.50          32.          8.          8.        .12

          HYDROGRAPH AT
+                       BSN2B       123.    3.33          19.          5.          4.        .09

          2 COMBINED AT
+                       JCTN1       278.    3.42          50.         13.         12.        .21

          ROUTED TO
+                        B3-RT      245.    3.58          51.         13.         12.        .21
+                                                                                          118.44        3.58

          ROUTED TO
+                      NT-RT2       242.    3.58          51.         13.         12.        .21

          HYDROGRAPH AT
+                       BSN2D        24.    3.25           3.          1.          1.        .01

          2 COMBINED AT
+                        ADD3       256.    3.58          54.         14.         13.        .22

          2 COMBINED AT
+                        ADD4       537.    3.58         136.         37.         36.        .69

          ROUTED TO
+                         RT3       535.    3.58         136.         37.         36.        .69

          HYDROGRAPH AT
+                       BSN2E       131.    3.50          25.          6.          6.        .12

          2 COMBINED AT
+                        ADD5       658.    3.58         161.         43.         42.        .81

          ROUTED TO
+                        B4-RT      566.    3.83         161.         43.         42.        .81
+                                                                                          106.95        3.83

          ROUTED TO
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+                          RT4       565.    3.83         161.         43.         42.        .81

         HYDROGRAPH AT
+                        BSN3B       254.    3.50          48.         12.         11.        .22

         2 COMBINED AT
+                         ADD6       762.    3.58         209.         55.         53.       1.03

         ROUTED TO
+                        B5-RT       751.    3.75         235.        134.        132.       1.03
+                                                                                                  101.57        3.75

         ROUTED TO
+                          RT5       748.    3.75         235.        134.        132.       1.03

         HYDROGRAPH AT
+                        BSN3A        49.    3.67          12.          3.          3.        .06

         2 COMBINED AT
+                         ADD7       797.    3.75         246.        137.        135.       1.09

         ROUTED TO
+                            1       797.    3.75         246.        137.        135.       1.09
1
                                     SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING
                                         (FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)
                                                                                INTERPOLATED TO
                                                                             COMPUTATION INTERVAL
           ISTAQ    ELEMENT      DT       PEAK    TIME TO     VOLUME      DT       PEAK    TIME TO     VOLUME
                                                    PEAK                                     PEAK

                                (MIN)     (CFS)      (MIN)     (IN)     (MIN)     (CFS)     (MIN)       (IN)

               RT1  MANE          .31    177.60    214.95      1.81      5.00    177.60    215.00        1.81

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .3588E+02 EXCESS= .0000E+00 OUTFLOW= .3588E+02 BASIN STORAGE= .1938E-03 PERCENT ERROR=    .0

               RT2  MANE         4.16    181.84    208.22      1.81      5.00    177.98    210.00        1.81

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .3589E+02 EXCESS= .0000E+00 OUTFLOW= .3590E+02 BASIN STORAGE= .2150E-02 PERCENT ERROR=    .0

            NT-RT1  MANE         2.52    171.28    208.81      2.42      5.00    170.81    210.00        2.42

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .1573E+02 EXCESS= .0000E+00 OUTFLOW= .1573E+02 BASIN STORAGE= .1285E-03 PERCENT ERROR=    .0
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            NT-RT2  MANE         1.44    243.75    216.15      2.28      5.00    242.26    215.00        2.28

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2524E+02 EXCESS= .0000E+00 OUTFLOW= .2524E+02 BASIN STORAGE= .8179E-04 PERCENT ERROR=    .0

               RT3  MANE         2.40    535.58    215.74      2.00      5.00    534.60    215.00        2.00

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7337E+02 EXCESS= .0000E+00 OUTFLOW= .7338E+02 BASIN STORAGE= .1440E-02 PERCENT ERROR=    .0

               RT4  MANE         3.19    565.58    232.54      1.98      5.00    565.40    230.00        1.98

CONTINUITY SUMMARY (AC-FT) - INFLOW= .8584E+02 EXCESS= .0000E+00 OUTFLOW= .8587E+02 BASIN STORAGE= .3185E-02 PERCENT ERROR=    .0

               RT5  MANE         2.25    750.30    227.25      4.93      5.00    747.85    225.00        4.93

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2723E+03 EXCESS= .0000E+00 OUTFLOW= .2716E+03 BASIN STORAGE= .7170E+00 PERCENT ERROR=    .0


*** NORMAL END OF HEC-1 ***
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25-YEAR

***

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

	OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
+	HYDROGRAPH AT	BSN1A	298.	3.67	64.	16.	15.	.22		
+	ROUTED TO	RT-1A	41.	5.42	36.	13.	12.	.22		
+									125.28	5.42
+	HYDROGRAPH AT	BSN1C	115.	3.42	21.	5.	5.	.06		
+	2 COMBINED AT	ADD1A	116.	3.58	53.	18.	17.	.28		
+	ROUTED TO	B1A-RT	172.	3.25	54.	18.	17.	.28		
+									126.05	3.25
+	HYDROGRAPH AT	BSN1D	144.	3.42	24.	6.	6.	.09		
+	2 COMBINED AT	ADD1B	284.	3.25	78.	24.	23.	.37		
+	ROUTED TO	B1-RT	202.	3.75	79.	24.	23.	.37		
+									126.86	3.75
+	ROUTED TO	RT1	202.	3.75	79.	24.	23.	.37		
+	ROUTED TO	B2-RT	202.	3.75	79.	24.	23.	.37		
+									124.83	3.75
+	ROUTED TO	RT2	201.	3.83	79.	24.	23.	.37		

```
          HYDROGRAPH AT
+                       BSN2A       114.    3.42          19.          5.          5.        .06

          HYDROGRAPH AT
+                      BSN2A-        45.    3.50           8.          2.          2.        .03

          3 COMBINED AT
+                        ADD1       344.    3.50         105.         31.         30.        .47

          HYDROGRAPH AT
+                       BSN2C       227.    3.42          40.         10.         10.        .12

          ROUTED TO
+                      NT-RT1       226.    3.50          40.         10.         10.        .12

          HYDROGRAPH AT
+                       BSN2B       165.    3.33          24.          6.          6.        .09

          2 COMBINED AT
+                       JCTN1       373.    3.42          65.         16.         16.        .21

          ROUTED TO
+                       B3-RT       351.    3.50          65.         16.         16.        .21
+                                                                                          119.26        3.50

          ROUTED TO
+                      NT-RT2       346.    3.58          65.         16.         16.        .21

          HYDROGRAPH AT
+                       BSN2D        31.    3.33           5.          1.          1.        .01

          2 COMBINED AT
+                        ADD3       365.    3.58          70.         17.         17.        .22

          2 COMBINED AT
+                        ADD4       709.    3.50         174.         49.         47.        .69

          ROUTED TO
+                         RT3       706.    3.58         174.         49.         47.        .69

          HYDROGRAPH AT
+                       BSN2E       183.    3.50          32.          8.          8.        .12

          2 COMBINED AT
+                        ADD5       879.    3.58         207.         57.         55.        .81

          ROUTED TO
+                       B4-RT       700.    3.83         207.         57.         55.        .81
+                                                                                          108.18        3.83

          ROUTED TO
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+                          RT4       698.    3.92         207.         57.         55.        .81

         HYDROGRAPH AT
+                        BSN3B       348.    3.50          62.         16.         15.        .22

         2 COMBINED AT
+                         ADD6       954.    3.67         269.         72.         70.       1.03

         ROUTED TO
+                        B5-RT       946.    3.75         290.        147.        145.       1.03
+                                                                                                  101.79        3.75

         ROUTED TO
+                          RT5       940.    3.83         290.        147.        145.       1.03

         HYDROGRAPH AT
+                        BSN3A        70.    3.67          16.          4.          4.        .06

         2 COMBINED AT
+                         ADD7      1008.    3.75         305.        151.        149.       1.09

         ROUTED TO
+                            1      1008.    3.75         305.        151.        149.       1.09
1
                                      SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING
                                          (FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)
                                                                                  INTERPOLATED TO
                                                                               COMPUTATION INTERVAL
           ISTAQ    ELEMENT      DT       PEAK    TIME TO     VOLUME      DT       PEAK    TIME TO     VOLUME
                                                    PEAK                                     PEAK

                                (MIN)     (CFS)      (MIN)     (IN)     (MIN)     (CFS)     (MIN)       (IN)

               RT1  MANE          .29    201.85    225.00      2.43      5.00    201.85    225.00        2.43

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .4816E+02 EXCESS= .0000E+00 OUTFLOW= .4816E+02 BASIN STORAGE= .3525E-03 PERCENT ERROR=    .0

               RT2  MANE         3.98    201.70    226.84      2.43      5.00    201.41    230.00        2.43

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .4818E+02 EXCESS= .0000E+00 OUTFLOW= .4818E+02 BASIN STORAGE= .3875E-02 PERCENT ERROR=    .0

            NT-RT1  MANE         2.34    226.75    208.62      3.08      5.00    226.38    210.00        3.08

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .2002E+02 EXCESS= .0000E+00 OUTFLOW= .2002E+02 BASIN STORAGE= .1637E-03 PERCENT ERROR=    .0
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```
            NT-RT2  MANE         1.32    349.34    211.82      2.91      5.00    345.97    215.00        2.92

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3231E+02 EXCESS= .0000E+00 OUTFLOW= .3231E+02 BASIN STORAGE= .1015E-03 PERCENT ERROR=    .0

               RT3  MANE         2.23    706.39    214.18      2.62      5.00    705.76    215.00        2.62

CONTINUITY SUMMARY (AC-FT) - INFLOW= .9636E+02 EXCESS= .0000E+00 OUTFLOW= .9635E+02 BASIN STORAGE= .2588E-02 PERCENT ERROR=    .0

               RT4  MANE         3.02    699.91    232.71      2.60      5.00    697.64    235.00        2.60

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1127E+03 EXCESS= .0000E+00 OUTFLOW= .1127E+03 BASIN STORAGE= .5769E-02 PERCENT ERROR=    .0

               RT5  MANE         2.50    947.62    227.50      5.43      5.00    940.17    230.00        5.43

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2998E+03 EXCESS= .0000E+00 OUTFLOW= .2991E+03 BASIN STORAGE= .7170E+00 PERCENT ERROR=    .0


*** NORMAL END OF HEC-1 ***
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50-YEAR

***

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

	OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
+	HYDROGRAPH AT	BSN1A	351.	3.67	76.	19.	18.	.22		
+	ROUTED TO	RT-1A	44.	5.50	41.	16.	15.	.22		
+									125.42	5.50
+	HYDROGRAPH AT	BSN1C	134.	3.42	24.	6.	6.	.06		
+	2 COMBINED AT	ADD1A	140.	3.50	60.	22.	21.	.28		
+	ROUTED TO	B1A-RT	171.	3.17	62.	22.	21.	.28		
+									126.02	3.17
+	HYDROGRAPH AT	BSN1D	172.	3.42	29.	7.	7.	.09		
+	2 COMBINED AT	ADD1B	306.	3.50	90.	29.	28.	.37		
+	ROUTED TO	B1-RT	215.	3.83	90.	29.	28.	.37		
+									127.18	3.83
+	ROUTED TO	RT1	215.	3.83	90.	29.	28.	.37		
+	ROUTED TO	B2-RT	215.	3.83	90.	29.	28.	.37		
+									124.86	3.83
+	ROUTED TO	RT2	215.	3.83	90.	29.	28.	.37		

```
          HYDROGRAPH AT
+                       BSN2A       133.    3.42          23.          6.          5.        .06

          HYDROGRAPH AT
+                      BSN2A-        53.    3.50          10.          3.          2.        .03

          3 COMBINED AT
+                        ADD1       379.    3.50         122.         38.         36.        .47

          HYDROGRAPH AT
+                       BSN2C       263.    3.42          47.         12.         11.        .12

          ROUTED TO
+                      NT-RT1       263.    3.50          47.         12.         11.        .12

          HYDROGRAPH AT
+                       BSN2B       194.    3.33          29.          7.          7.        .09

          2 COMBINED AT
+                       JCTN1       435.    3.42          76.         19.         18.        .21

          ROUTED TO
+                       B3-RT       422.    3.50          77.         19.         19.        .21
+                                                                                          119.61        3.50

          ROUTED TO
+                      NT-RT2       417.    3.50          77.         19.         19.        .21

          HYDROGRAPH AT
+                       BSN2D        37.    3.25           5.          1.          1.        .01

          2 COMBINED AT
+                        ADD3       444.    3.50          82.         21.         20.        .22

          2 COMBINED AT
+                        ADD4       823.    3.50         203.         58.         56.        .69

          ROUTED TO
+                         RT3       815.    3.58         203.         58.         56.        .69

          HYDROGRAPH AT
+                       BSN2E       217.    3.50          39.         10.          9.        .12

          2 COMBINED AT
+                        ADD5      1020.    3.58         242.         68.         65.        .81

          ROUTED TO
+                       B4-RT       792.    3.83         243.         68.         66.        .81
+                                                                                          108.81        3.83

          ROUTED TO
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+                          RT4       788.    3.92         243.         68.         66.        .81

         HYDROGRAPH AT
+                        BSN3B       409.    3.50          74.         19.         18.        .22

         2 COMBINED AT
+                         ADD6      1075.    3.67         317.         87.         83.       1.03

         ROUTED TO
+                        B5-RT      1070.    3.75         335.        159.        156.       1.03
+                                                                                                  101.91        3.75

         ROUTED TO
+                          RT5      1070.    3.75         335.        159.        156.       1.03

         HYDROGRAPH AT
+                        BSN3A        84.    3.67          19.          5.          5.        .06

         2 COMBINED AT
+                         ADD7      1153.    3.75         353.        163.        160.       1.09

         ROUTED TO
+                            1      1153.    3.75         353.        163.        160.       1.09
1
                                        SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING
                                            (FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)
                                                                                  INTERPOLATED TO
                                                                                COMPUTATION INTERVAL
           ISTAQ    ELEMENT      DT       PEAK    TIME TO     VOLUME      DT       PEAK    TIME TO     VOLUME
                                                     PEAK                                     PEAK

                                (MIN)     (CFS)      (MIN)     (IN)     (MIN)     (CFS)     (MIN)       (IN)

               RT1  MANE          .29    214.88    230.03      2.94      5.00    214.87    230.00        2.94

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .5831E+02 EXCESS= .0000E+00 OUTFLOW= .5831E+02 BASIN STORAGE= .5656E-03 PERCENT ERROR=    .0

               RT2  MANE         3.85    214.65    230.80      2.94      5.00    214.53    230.00        2.94

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .5833E+02 EXCESS= .0000E+00 OUTFLOW= .5833E+02 BASIN STORAGE= .6206E-02 PERCENT ERROR=    .0

            NT-RT1  MANE         2.26    262.90    209.96      3.62      5.00    262.85    210.00        3.62

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .2355E+02 EXCESS= .0000E+00 OUTFLOW= .2355E+02 BASIN STORAGE= .1653E-03 PERCENT ERROR=    .0
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            NT-RT2  MANE         1.26    419.95    210.89      3.43      5.00    416.98    210.00        3.44

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3810E+02 EXCESS= .0000E+00 OUTFLOW= .3810E+02 BASIN STORAGE= .8832E-04 PERCENT ERROR=    .0

               RT3  MANE         2.15    817.34    214.54      3.14      5.00    815.26    215.00        3.14

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1153E+03 EXCESS= .0000E+00 OUTFLOW= .1153E+03 BASIN STORAGE= .4165E-02 PERCENT ERROR=    .0

               RT4  MANE         2.92    789.23    233.89      3.12      5.00    787.96    235.00        3.12

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1349E+03 EXCESS= .0000E+00 OUTFLOW= .1350E+03 BASIN STORAGE= .9193E-02 PERCENT ERROR=    .0

               RT5  MANE         2.75   1071.46    225.50      5.83      5.00   1069.76    225.00        5.83

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3218E+03 EXCESS= .0000E+00 OUTFLOW= .3212E+03 BASIN STORAGE= .7170E+00 PERCENT ERROR=    .0


*** NORMAL END OF HEC-1 ***
```

100-YEAR

***

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

	OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
+	HYDROGRAPH AT	BSN1A	393.	3.67	92.	23.	22.	.22		
+	ROUTED TO	RT-1A	48.	6.00	45.	20.	19.	.22		
+									125.60	6.08
+	HYDROGRAPH AT	BSN1C	149.	3.42	29.	7.	7.	.06		
+	2 COMBINED AT	ADD1A	163.	3.50	68.	27.	26.	.28		
+	ROUTED TO	B1A-RT	172.	3.17	70.	27.	26.	.28		
+									126.05	3.17
+	HYDROGRAPH AT	BSN1D	196.	3.42	36.	9.	9.	.09		
+	2 COMBINED AT	ADD1B	352.	3.42	104.	36.	35.	.37		
+	ROUTED TO	B1-RT	228.	3.83	104.	36.	35.	.37		
+									127.50	3.83
+	ROUTED TO	RT1	228.	3.83	105.	36.	35.	.37		
+	ROUTED TO	B2-RT	228.	3.83	105.	36.	35.	.37		
+									124.88	3.83
+	ROUTED TO	RT2	228.	3.92	104.	36.	35.	.37		

```
          HYDROGRAPH AT
+                        BSN2A       149.    3.42          27.          7.          7.        .06

          HYDROGRAPH AT
+                       BSN2A-        60.    3.50          12.          3.          3.        .03

          3 COMBINED AT
+                         ADD1       409.    3.50         143.         46.         45.        .47

          HYDROGRAPH AT
+                        BSN2C       293.    3.42          57.         14.         14.        .12

          ROUTED TO
+                       NT-RT1       290.    3.50          57.         14.         14.        .12

          HYDROGRAPH AT
+                        BSN2B       220.    3.33          35.          9.          9.        .09

          2 COMBINED AT
+                        JCTN1       485.    3.42          93.         23.         22.        .21

          ROUTED TO
+                        B3-RT       470.    3.50          94.         23.         23.        .21
+                                                                                          119.78        3.50

          ROUTED TO
+                       NT-RT2       469.    3.50          94.         23.         23.        .21

          HYDROGRAPH AT
+                        BSN2D        42.    3.25           7.          2.          2.        .01

          2 COMBINED AT
+                         ADD3       498.    3.50         100.         25.         24.        .22

          2 COMBINED AT
+                         ADD4       907.    3.50         241.         71.         69.        .69

          ROUTED TO
+                          RT3       895.    3.50         241.         71.         69.        .69

          HYDROGRAPH AT
+                        BSN2E       246.    3.42          48.         12.         12.        .12

          2 COMBINED AT
+                         ADD5      1140.    3.50         289.         83.         80.        .81

          ROUTED TO
+                        B4-RT       878.    3.83         290.         83.         80.        .81
+                                                                                          109.15        3.83

          ROUTED TO
```

```
+                          RT4       874.    3.83         290.         83.         80.        .81

         HYDROGRAPH AT
+                        BSN3B       461.    3.50          91.         23.         22.        .22

         2 COMBINED AT
+                         ADD6      1185.    3.75         380.        106.        102.       1.03

         ROUTED TO
+                        B5-RT      1181.    3.75         393.        173.        170.       1.03
+                                                                                          102.00        3.75

         ROUTED TO
+                          RT5      1178.    3.83         393.        173.        170.       1.03

         HYDROGRAPH AT
+                        BSN3A        96.    3.67          23.          6.          6.        .06

         2 COMBINED AT
+                         ADD7      1268.    3.83         416.        179.        176.       1.09

         ROUTED TO
+                            1      1268.    3.83         416.        179.        176.       1.09
1
                                    SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING
                                        (FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)
                                                                          INTERPOLATED TO
                                                                       COMPUTATION INTERVAL
           ISTAQ    ELEMENT      DT       PEAK    TIME TO     VOLUME      DT       PEAK    TIME TO     VOLUME
                                                    PEAK                                     PEAK

                                (MIN)     (CFS)      (MIN)     (IN)     (MIN)     (CFS)     (MIN)       (IN)

               RT1  MANE          .28    227.76    230.12      3.63      5.00    227.75    230.00        3.63

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .7207E+02 EXCESS= .0000E+00 OUTFLOW= .7207E+02 BASIN STORAGE= .1045E-02 PERCENT ERROR=    .0

               RT2  MANE         3.72    227.65    234.59      3.63      5.00    227.58    235.00        3.63

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .7203E+02 EXCESS= .0000E+00 OUTFLOW= .7203E+02 BASIN STORAGE= .1142E-01 PERCENT ERROR=    .0

            NT-RT1  MANE         2.20    291.85    208.68      4.35      5.00    289.91    210.00        4.35

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .2834E+02 EXCESS= .0000E+00 OUTFLOW= .2833E+02 BASIN STORAGE= .1316E-03 PERCENT ERROR=    .0
```

```
            NT-RT2  MANE         1.22    469.47    211.30      4.18      5.00    469.18    210.00        4.18

CONTINUITY SUMMARY (AC-FT) - INFLOW= .4638E+02 EXCESS= .0000E+00 OUTFLOW= .4638E+02 BASIN STORAGE= .8310E-04 PERCENT ERROR=    .0

               RT3  MANE         2.09    899.71    211.59      3.85      5.00    894.76    210.00        3.85

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1413E+03 EXCESS= .0000E+00 OUTFLOW= .1413E+03 BASIN STORAGE= .7659E-02 PERCENT ERROR=    .0

               RT4  MANE         2.84    876.34    232.61      3.82      5.00    874.35    230.00        3.82

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1655E+03 EXCESS= .0000E+00 OUTFLOW= .1655E+03 BASIN STORAGE= .1684E-01 PERCENT ERROR=    .0

               RT5  MANE         3.21   1180.90    227.95      6.35      5.00   1178.31    230.00        6.36

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3508E+03 EXCESS= .0000E+00 OUTFLOW= .3501E+03 BASIN STORAGE= .7170E+00 PERCENT ERROR=    .0


*** NORMAL END OF HEC-1 ***
```

PROPOSED CONDITIONS WITHOUT ROUTING

```
1****************************************                                    ****************************************
 *                                      *                                    *                                      *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *                                    *    U.S. ARMY CORPS OF ENGINEERS      *
 *               JUN   1998             *                                    *    HYDROLOGIC ENGINEERING CENTER     *
 *            VERSION 4.1               *                                    *          609 SECOND STREET           *
 *                                      *                                    *       DAVIS, CALIFORNIA 95616        *
 *  RUN DATE   12MAR09  TIME  12:22:55  *                                    *           (916) 756-1104             *
 *                                      *                                    *                                      *
 ****************************************                                    ****************************************

                                          X     X  XXXXXXX   XXXXX          X
                                          X     X  X        X     X        XX
                                          X     X  X        X              X
                                          XXXXXXX  XXXX     X        XXXXX  X
                                          X     X  X        X              X
                                          X     X  X        X     X        X
                                          X     X  XXXXXXX   XXXXX        XXX


THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL   LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM


  1          ID  HEC-1 ANALYSIS -- MANSFIELD DRIVE -- ROCKY MOUNT, NC
  2          ID  PROPOSED CONDITIONS -- 10 YEAR STORM EVENT, 6 HOUR DURATION
  3          ID  PROPOSED CONDITIONS LANDUSE WITH NO ROUTING
  4          ID  CREATED JANUARY 07, 2009 BY EVF
             *DIAGRAM
  5          IT       1 07JAN09       0     300
  6          IO       4
             * *******************************************************

  7          KK   BSN1A
  8          KM  RUNOFF FROM BASIN 1A TO CONFLUENCE WITH BASIN 1C - Neglect Basin 1B
  9          KO       0       0       0       0      22
 10          BA   0.218
```

```
KM  2-YR RAINFALL
KM  0 0 0.49 1.05 1.8 2.25 2.45 2.9
KM  5-YR RAINFALL
KM  0 0 0.55 1.22 2.26 2.85 3.15 3.7
KM  10-YR RAINFALL
KM  0 0 0.61 1.34 2.58 3.30 3.65 4.25
KM  25-YR RAINFALL
PH       0       0    0.69    1.54     3.3    3.85     4.2       5
KM  50-YR RAINFALL
KM  0 0 0.76 1.69 3.65 4.4 4.7 5.6
KM  100-YR RAINFALL
KM  0 0 0.82 1.84 3.75 4.75 5.2 6.4
LS       0      78       0
UD    0.53
* ******************************************************

KK   RT-1A
KM  ROUTING ABOVE STREAM FROM MANSFIELD ALONG HAWTHORNE
* ROUTE THROUGH DOUBLE 48" PIPES
* CHANGE SQ & SE AFTER HEC-RAS RUN -- 01/15/09
RS       1    STOR      -1
SA    7.54   22.23
SE     134     136
SQ     100     200     300     400     500     750    1000    2000    5000
SE   125.3  126.62  127.13  128.09  128.43   128.7   128.9  129.26  130.13
* ******************************************************

KK   BSN1C
KM  RUNOFF FROM BASIN 1B TO CONFLUENCE WITH BASIN 1A
KO       0       0       0       0      22
BA   0.062
LS       0      82       0
UD    0.37
* ******************************************************

KK   ADD1A
KM  COMBINE FLOWS FROM BSN1A AND 1C
KO       0       0       0       0      22
HC       2
* ******************************************************

KK  B1A-RT
KM  ROUTING ABOVE WINSTEAD ROAD
* ROUTE THROUGH WINSTEAD ROAD CULVERT
* CHANGE SQ & SE AFTER HEC-RAS RUN -- 01/15/09
RS       1    STOR      -1
SA    0.76    4.76    7.23   12.27   16.76   21.96
SE     126     128     130     132     134     136
SQ     100     200     300     400     500     750    1000    2000    5000
SE  124.84  126.51  127.02  125.06   128.4  128.66  128.85  129.09  129.68
* ******************************************************
```

```
49          KK   BSN1D
50          KM  RUNOFF FROM BASIN 1D
51          KO       0       0       0       0      22
52          BA   0.092
53          LS       0      75       0
54          UD    0.33
            * ******************************************************

55          KK   ADD1B
56          KM  COMBINE FLOWS FROM MAIN STREAM AND BSN1D
57          KO       0       0       0       0      22
58          HC       2
            * ******************************************************

59          KK   B1-RT
60          KM  ROUTING ABOVE RAILROAD CULVERT
            * ROUTE THROUGH RAILROAD CULVERT
            * CHANGE SQ & SE AFTER HEC-RAS RUN -- 01/15/09
61          RS       1    STOR      -1
62          SA    1.92    6.69   16.96   40.06    80.2  129.61
63          SE     126     128     130     132     134     136
64          SQ     100     150     200     250     300     400     500     600     700
65          SE  124.04  125.59  126.81  128.05  128.39  128.64   158.8  128.97  129.17
            * ******************************************************

66          KK     RT1
67          KM  CHANNEL ROUTING FROM RR CULVERT TO SHEFFIELD DRIVE - ASSUME LENGTH IS 100
68          KO       0       0       0       0      22
69          RD
70          RC    0.03   0.035    0.03     100   0.005
71          RX     264  270.11  271.08  273.48  276.48  286.02     291  335.04
72          RY     126  121.37     121     120     120     122     126     126
            * ******************************************************

73          KK   B2-RT
74          KM  ROUTING ABOVE SHEFFIELD DRIVE
            * ROUTE THROUGH SHEFFIELD DRIVE CULVERT
            * CHANGE SQ & SE AFTER HEC-RAS RUN -- 01/15/09
75          RS       1    STOR      -1
76          SA    0.49    0.91    1.22    1.78     6.1   10.96
77          SE     126     128     130     132     134     136
78          SQ     100     200     300     400     500     750    1000    2000    5000
79          SE  123.22  124.44  124.83  125.01  125.21  125.64  125.94  126.74  128.34
            * ******************************************************

80          KK     RT2
81          KM  CHANNEL ROUTING FROM SHEFFIELD DRIVE
82          KO       0       0       0       0      22
83          RD
84          RC    0.03   0.035    0.03    1680   0.013
```

```
RX     264  270.11  271.08  273.48  276.48  286.02     291  335.04
RY     126  121.37     121     120     120     122     126     126
* ******************************************************

KK   BSN2A
KM  RUNOFF FROM BSN2A
KO       0       0       0       0      22
BA   0.063
LS       0      79       0
UD    0.33
* ******************************************************

KK  BSN2A-       1
KM  RUNOFF FROM BSN2A-1
KO       0       0       0       0      22
BA   0.031
LS       0      76       0
UD    0.42
* ******************************************************

KK    ADD1
KM  COMBINE FLOWS FROM BSN2A, BSN2A-1, AND MAIN STREAM
KO       0       0       0       0      22
HC       3
* ******************************************************

KK   BSN2C
KM  RUNOFF FROM BSN2C TO NOTTINGHAM REACH 1
KO       0       0       0       0      22
BA   0.122
LS       0      82       0
UD    0.37
* ******************************************************

KK  NT-RT1
KM  CHANNEL ROUTING FROM NOTTINGHAM REACH 1 TO NOTTINGHAM CULVERT
KO       0       0       0       0      22
RD
RC     0.1   0.055     0.1     822   0.012
RX  195.71  196.28  205.68  212.29  216.29  223.94  239.94  244.14
RY     125     125     124     117     117   124.5     124     124
* ******************************************************

KK   BSN2B
KM  RUNOFF FROM BSN2B TO NOTTINGHAM CULVERT
KO       0       0       0       0      22
BA   0.086
LS       0      77       0
UD    0.24
* ******************************************************
```

```
KK   JCTN1
KM  COMBINE FLOWS FROM BSN2C AND BSN2B
KO       0       0       0       0      22
HC       2
* ******************************************************

KK   B3-RT
KM  ROUTING ABOVE NOTTINGHAM ROAD
* ROUTE THROUGH NOTTINGHAM ROAD CULVERT
* CHANGE SQ & SE AFTER HEC-RAS RUN -- 01/15/09
RS       1    STOR      -1
SA    0.22    0.69    2.39    4.06     6.9
SE     116     118     122     124     126
SQ     100     200     300     400     500     750    1000    1250    1500
SE     114  117.98  118.99  119.53  119.88  120.53  121.02  121.37  121.69
* ******************************************************

KK  NT-RT2
KM  CHANNEL ROUTING FROM NOTTINGHAM CULVERT TO NOTTINGHAM REACH 2
KO       0       0       0       0      22
RD
RC     0.1   0.045    0.05     558   0.011
RX  348.31  352.17  377.39  388.39  392.39  394.39  409.35  418.88
RY     114     114   113.5     108     108   113.5     114     115
* ******************************************************

KK   BSN2D
KM  RUNOFF FROM BSN2D
KO       0       0       0       0      22
BA   0.015
LS       0      79       0
UD    0.22
* ******************************************************

KK    ADD3
KM  COMBINE FLOWS FROM BSN2B AND BSN2D
KO       0       0       0       0      22
HC       2
* ******************************************************

KK    ADD4
KM  COMBINE FLOWS FROM NOTTINGHAM STREAM AND MAIN STREAM
KO       0       0       0       0      22
HC       2
* ******************************************************

KK     RT3
KM  CHANNEL ROUTING FROM CONFLUENCE POINT
KO       0       0       0       0      22
RD
RC    0.07   0.035    0.04    1385    0.01
```

```
RX  199.57  204.96  284.25  292.21  300.21  304.59  326.21  342.86
RY     112     111     111     103     103  108.25     108     108
* ******************************************************

KK   BSN2E
KM  RUNOFF FROM BSN2E
KO       0       0       0       0      22
BA   0.123
LS       0      75       0
UD    0.37
* ******************************************************

KK    ADD5
KM  COMBINE FLOWS FROM BSN2E AND MAIN STREAM REACH 5
KO       0       0       0       0      22
HC       2
* ******************************************************

KK   B4-RT
KM  ROUTING ABOVE SOUTH WINSTEAD AVENUE
* ROUTE THROUGH SOUTH WINSTEAD AVENUE CULVERT
* CHANGE SQ & SE AFTER HEC-RAS RUN -- 01/15/09
RS       1    STOR      -1
SA     0.6     2.4    5.09    8.69   12.75   17.58   25.33
SE     104     106     108     110     112     114     116
SQ     100     200     300     400     500     750    1000    2000    5000
SE   102.3   103.7  104.68  105.59  106.35  108.64  109.64  110.97   112.5
* ******************************************************

KK     RT4
KM  CHANNEL ROUTING MAIN STREAM REACH 6
KO       0       0       0       0      22
RD
RC    0.07   0.045    0.05    1355   0.008
RX  411.94  426.78  467.67  475.45  479.44  487.69  541.11   594.6
RY     101     101     101      96      96     101     101     101
* ******************************************************

KK   BSN3B
KM  RUNOFF FROM BSN3B
KO       0       0       0       0      22
BA   0.221
LS       0      77       0
UD    0.38
* ******************************************************

KK    ADD6
KM  COMBINE FLOWS FROM BSN3B AND BSN3A
KO       0       0       0       0      22
HC       2
* ******************************************************
```

```
195          KK   B5-RT
196          KM  ROUTING ABOVE AVONDALE AVENUE
             * ROUTE THROUGH AVONDALE AVENUE CULVERT
             * CHANGE SQ & SE AFTER HEC-RAS RUN -- 01/15/09
197          RS       1    STOR      -1
198          SA    0.08    0.55    5.36    8.26

199          SE      96      98     102     104
200          SQ     100     200     300     400     500     750    1000    2000    5000
201          SE   97.41   99.07  100.48  100.99  101.19  101.57  101.85   102.7  104.21
             * *******************************************************

202          KK     RT5
203          KM  CHANNEL ROUTING MAIN STREAM REACH 7
204          KO       0       0       0       0      22
205          RD
206          RC    0.05   0.045    0.05    1355   0.012
207          RX  655.17  663.67  670.85     675     682     688  691.71  707.49
208          RY    94.7      94      94      92      92      94      95      95
             * *******************************************************

209          KK   BSN3A
210          KM  RUNOFF FROM BSN3A
211          KO       0       0       0       0      22
212          BA   0.061
213          LS       0      74       0
214          UD    0.56
             * *******************************************************

215          KK    ADD7
216          KM  COMBINE FLOWS FROM MAIN STREAM AND MAPLE CREEK
217          KO       0       0       0       0      22
218          HC       2
             * *******************************************************

219          KK       1
220          KO       0       0       0       0      22
221          RN      1R
222          ZZ
1
                 SCHEMATIC DIAGRAM OF STREAM NETWORK
 INPUT
  LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

   NO.      (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

     7       BSN1A
                 V
                 V
    25       RT-1A
```

```
             .
             .
 32          .       BSN1C
             .           .
             .           .
 38      ADD1A...........
             V
             V
 42     B1A-RT
             .
             .
 49          .       BSN1D
             .           .
             .           .
 55      ADD1B...........
             V
             V
 59      B1-RT
             V
             V
 66        RT1
             V
             V
 73      B2-RT
             V
             V
 80        RT2
             .
             .
 87          .       BSN2A
             .           .
             .           .
 93          .           .      BSN2A-
             .           .           .
             .           .           .
 99       ADD1......................
             .
             .
103          .       BSN2C
             .           V
             .           V
109          .      NT-RT1
             .           .
             .           .
116          .           .       BSN2B
             .           .           .
             .           .           .
122          .       JCTN1...........
             .           V
             .           V
126          .       B3-RT
```

```
             .          V
             .          V
133          .      NT-RT2
             .           .
             .           .
140          .           .       BSN2D
             .           .           .
             .           .           .
146          .        ADD3............
             .           .
             .           .
150       ADD4............
             V
             V
154        RT3
             .
             .
161          .       BSN2E
             .           .
             .           .
167       ADD5............
             V
             V
171      B4-RT
             V
             V
178        RT4
             .
             .
185          .       BSN3B
             .           .
             .           .
191       ADD6............
             V
             V
195      B5-RT
             V
             V
202        RT5
             .
             .
209          .       BSN3A
             .           .
             .           .
215       ADD7............
             V
             V
219          1
```

2-YEAR

***

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

	OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
+	HYDROGRAPH AT	BSN1A	109.	3.13	25.	25.	25.	.22		
+	ROUTED TO	RT-1A	109.	3.13	25.	25.	25.	.22		
+									126.67	3.13
+	HYDROGRAPH AT	BSN1C	50.	2.93	9.	9.	9.	.06		
+	2 COMBINED AT	ADD1A	151.	3.07	34.	34.	34.	.28		
+	ROUTED TO	B1A-RT	170.	2.73	35.	35.	35.	.28		
+									126.00	2.73
+	HYDROGRAPH AT	BSN1D	51.	2.92	9.	9.	9.	.09		
+	2 COMBINED AT	ADD1B	204.	2.73	44.	44.	44.	.37		
+	ROUTED TO	B1-RT	204.	2.73	44.	44.	44.	.37		
+									126.00	2.67
+	ROUTED TO	RT1	196.	3.02	44.	44.	44.	.37		
+	ROUTED TO	B2-RT	196.	3.02	44.	44.	44.	.37		
+									124.81	3.02
+	ROUTED TO	RT2	196.	3.07	44.	44.	44.	.37		

```
          HYDROGRAPH AT
+                       BSN2A        46.    2.90           8.          8.          8.        .06

          HYDROGRAPH AT
+                      BSN2A-        16.    3.02           3.          3.          3.        .03

          3 COMBINED AT
+                        ADD1       250.    3.03          55.         55.         55.        .47

          HYDROGRAPH AT
+                       BSN2C        98.    2.93          18.         18.         18.        .12

          ROUTED TO
+                      NT-RT1        98.    2.97          18.         18.         18.        .12

          HYDROGRAPH AT
+                       BSN2B        66.    2.80          10.         10.         10.        .09

          2 COMBINED AT
+                       JCTN1       151.    2.90          28.         28.         28.        .21

          ROUTED TO
+                       B3-RT       151.    2.90          28.         28.         28.        .21
+                                                                                          116.01        2.63

          ROUTED TO
+                      NT-RT2       151.    2.92          28.         28.         28.        .21

          HYDROGRAPH AT
+                       BSN2D        14.    2.77           2.          2.          2.        .01

          2 COMBINED AT
+                        ADD3       161.    2.90          30.         30.         30.        .22

          2 COMBINED AT
+                        ADD4       402.    2.98          85.         85.         85.        .69

          ROUTED TO
+                         RT3       402.    3.02          84.         84.         84.        .69

          HYDROGRAPH AT
+                       BSN2E        63.    2.95          12.         12.         12.        .12

          2 COMBINED AT
+                        ADD5       464.    3.02          96.         96.         96.        .81

          ROUTED TO
+                       B4-RT       419.    3.17          96.         96.         96.        .81
+                                                                                          105.73        3.17

          ROUTED TO
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```
+                          RT4       419.    3.20          95.         95.         95.        .81

         HYDROGRAPH AT
+                        BSN3B       129.    2.97          25.         25.         25.        .22

         2 COMBINED AT
+                         ADD6       520.    3.13         120.        120.        120.       1.03

         ROUTED TO
+                        B5-RT       481.    3.33         172.        172.        172.       1.03
+                                                                                                  101.15        3.33

         ROUTED TO
+                          RT5       481.    3.38         171.        171.        171.       1.03

         HYDROGRAPH AT
+                        BSN3A        23.    3.20           5.          5.          5.        .06

         2 COMBINED AT
+                         ADD7       501.    3.38         176.        176.        176.       1.09

         ROUTED TO
+                            1       501.    3.38         176.        176.        176.       1.09
1
                                        SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING
                                            (FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)
                                                                                  INTERPOLATED TO
                                                                                COMPUTATION INTERVAL
           ISTAQ    ELEMENT      DT       PEAK    TIME TO     VOLUME      DT       PEAK    TIME TO     VOLUME
                                                     PEAK                                     PEAK

                                (MIN)     (CFS)      (MIN)     (IN)     (MIN)     (CFS)     (MIN)       (IN)

               RT1  MANE          .29    196.14    180.85       .92      1.00    196.13    181.00         .92

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .1825E+02 EXCESS= .0000E+00 OUTFLOW= .1823E+02 BASIN STORAGE= .2382E-01 PERCENT ERROR=    .0

               RT2  MANE         1.00    196.02    184.00       .90      1.00    196.02    184.00         .90

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .1824E+02 EXCESS= .0000E+00 OUTFLOW= .1795E+02 BASIN STORAGE= .2884E+00 PERCENT ERROR=    .0

            NT-RT1  MANE         1.00     98.11    178.00      1.13      1.00     98.11    178.00        1.13

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .7465E+01 EXCESS= .0000E+00 OUTFLOW= .7390E+01 BASIN STORAGE= .8076E-01 PERCENT ERROR=   -.1
```

```
            NT-RT2  MANE         1.00    150.64    175.00      1.04      1.00    150.64    175.00        1.04

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1158E+02 EXCESS= .0000E+00 OUTFLOW= .1152E+02 BASIN STORAGE= .6972E-01 PERCENT ERROR=   -.1

               RT3  MANE         1.00    401.65    181.00       .94      1.00    401.65    181.00         .94

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3491E+02 EXCESS= .0000E+00 OUTFLOW= .3454E+02 BASIN STORAGE= .3822E+00 PERCENT ERROR=    .0

               RT4  MANE         1.00    418.66    192.00       .90      1.00    418.66    192.00         .90

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3965E+02 EXCESS= .0000E+00 OUTFLOW= .3919E+02 BASIN STORAGE= .5324E+00 PERCENT ERROR=   -.2

               RT5  MANE         1.00    480.99    203.00      1.28      1.00    480.99    203.00        1.28

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7107E+02 EXCESS= .0000E+00 OUTFLOW= .7038E+02 BASIN STORAGE= .7170E+00 PERCENT ERROR=    .0


*** NORMAL END OF HEC-1 ***
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10-YEAR

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RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

	OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
+	HYDROGRAPH AT	BSN1A	217.	3.12	52.	52.	52.	.22		
+	ROUTED TO	RT-1A	217.	3.12	52.	52.	52.	.22		
+									127.30	3.12
+	HYDROGRAPH AT	BSN1C	90.	2.92	18.	18.	18.	.06		
+	2 COMBINED AT	ADD1A	294.	3.05	69.	69.	69.	.28		
+	ROUTED TO	B1A-RT	276.	3.20	69.	69.	69.	.28		
+									126.90	3.20
+	HYDROGRAPH AT	BSN1D	106.	2.90	20.	20.	20.	.09		
+	2 COMBINED AT	ADD1B	349.	3.13	89.	89.	89.	.37		
+	ROUTED TO	B1-RT	242.	2.73	89.	89.	89.	.37		
+									127.70	3.58
+	ROUTED TO	RT1	236.	3.58	89.	89.	89.	.37		
+	ROUTED TO	B2-RT	236.	3.58	89.	89.	89.	.37		
+									124.89	3.58
+	ROUTED TO	RT2	236.	3.63	88.	88.	88.	.37		

```
          HYDROGRAPH AT
+                       BSN2A        86.    2.88          16.         16.         16.        .06

          HYDROGRAPH AT
+                      BSN2A-        33.    3.00           7.          7.          7.        .03

          3 COMBINED AT
+                        ADD1       319.    2.78         111.        111.        111.        .47

          HYDROGRAPH AT
+                       BSN2C       176.    2.92          35.         35.         35.        .12

          ROUTED TO
+                      NT-RT1       176.    2.95          34.         34.         34.        .12

          HYDROGRAPH AT
+                       BSN2B       127.    2.78          20.         20.         20.        .09

          2 COMBINED AT
+                       JCTN1       282.    2.87          55.         55.         55.        .21

          ROUTED TO
+                       B3-RT       258.    3.00          55.         55.         55.        .21
+                                                                                          118.57        3.00

          ROUTED TO
+                      NT-RT2       258.    3.02          55.         55.         55.        .21

          HYDROGRAPH AT
+                       BSN2D        25.    2.75           4.          4.          4.        .01

          2 COMBINED AT
+                        ADD3       272.    3.02          59.         59.         59.        .22

          2 COMBINED AT
+                        ADD4       579.    3.02         170.        170.        170.        .69

          ROUTED TO
+                         RT3       578.    3.07         169.        169.        169.        .69

          HYDROGRAPH AT
+                       BSN2E       133.    2.93          26.         26.         26.        .12

          2 COMBINED AT
+                        ADD5       703.    3.03         195.        195.        195.        .81

          ROUTED TO
+                       B4-RT       594.    3.28         195.        195.        195.        .81
+                                                                                          107.21        3.28

          ROUTED TO
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+                          RT4       594.    3.33         193.        193.        193.        .81

         HYDROGRAPH AT
+                        BSN3B       257.    2.95          51.         51.         51.        .22

         2 COMBINED AT
+                         ADD6       780.    3.10         245.        245.        245.       1.03

         ROUTED TO
+                        B5-RT       769.    3.22         288.        288.        288.       1.03
+                                                                                                  101.59        3.22

         ROUTED TO
+                          RT5       769.    3.27         285.        285.        285.       1.03

         HYDROGRAPH AT
+                        BSN3A        49.    3.17          12.         12.         12.        .06

         2 COMBINED AT
+                         ADD7       817.    3.27         297.        297.        297.       1.09

         ROUTED TO
+                            1       817.    3.27         297.        297.        297.       1.09
1
                                     SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING
                                         (FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)
                                                                                  INTERPOLATED TO
                                                                                COMPUTATION INTERVAL
           ISTAQ    ELEMENT      DT       PEAK    TIME TO     VOLUME      DT       PEAK    TIME TO     VOLUME
                                                    PEAK                                      PEAK

                                (MIN)     (CFS)      (MIN)     (IN)     (MIN)     (CFS)     (MIN)       (IN)

               RT1  MANE          .27    237.38    163.92      1.85      1.00    235.88    215.00        1.85

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .3681E+02 EXCESS= .0000E+00 OUTFLOW= .3678E+02 BASIN STORAGE= .3425E-01 PERCENT ERROR=    .0

               RT2  MANE         1.00    235.88    218.00      1.83      1.00    235.88    218.00        1.83

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .3681E+02 EXCESS= .0000E+00 OUTFLOW= .3640E+02 BASIN STORAGE= .4149E+00 PERCENT ERROR=    .0

            NT-RT1  MANE         1.00    175.82    177.00      2.17      1.00    175.82    177.00        2.17

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .1424E+02 EXCESS= .0000E+00 OUTFLOW= .1414E+02 BASIN STORAGE= .1084E+00 PERCENT ERROR=    .0
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```
            NT-RT2  MANE         1.00    257.78    181.00      2.03      1.00    257.78    181.00        2.03

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2262E+02 EXCESS= .0000E+00 OUTFLOW= .2253E+02 BASIN STORAGE= .9548E-01 PERCENT ERROR=    .0

               RT3  MANE         1.00    578.49    184.00      1.89      1.00    578.49    184.00        1.89

CONTINUITY SUMMARY (AC-FT) - INFLOW= .6994E+02 EXCESS= .0000E+00 OUTFLOW= .6948E+02 BASIN STORAGE= .5322E+00 PERCENT ERROR=   -.1

               RT4  MANE         1.00    593.94    200.00      1.84      1.00    593.94    200.00        1.84

CONTINUITY SUMMARY (AC-FT) - INFLOW= .8038E+02 EXCESS= .0000E+00 OUTFLOW= .7969E+02 BASIN STORAGE= .7661E+00 PERCENT ERROR=   -.1

               RT5  MANE         1.00    769.20    196.00      2.13      1.00    769.20    196.00        2.13

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1187E+03 EXCESS= .0000E+00 OUTFLOW= .1173E+03 BASIN STORAGE= .1390E+01 PERCENT ERROR=    .0


*** NORMAL END OF HEC-1 ***
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25-YEAR

***

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

	OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
+	HYDROGRAPH AT	BSN1A	298.	3.12	66.	66.	66.	.22		
+	ROUTED TO	RT-1A	298.	3.12	66.	66.	66.	.22		
+									128.07	3.12
+	HYDROGRAPH AT	BSN1C	118.	2.93	22.	22.	22.	.06		
+	2 COMBINED AT	ADD1A	401.	3.07	89.	89.	89.	.28		
+	ROUTED TO	B1A-RT	364.	3.23	89.	89.	89.	.28		
+									127.35	3.23
+	HYDROGRAPH AT	BSN1D	145.	2.90	26.	26.	26.	.09		
+	2 COMBINED AT	ADD1B	465.	3.12	115.	115.	115.	.37		
+	ROUTED TO	B1-RT	326.	3.57	115.	115.	115.	.37		
+									128.46	3.57
+	ROUTED TO	RT1	326.	3.57	115.	115.	115.	.37		
+	ROUTED TO	B2-RT	326.	3.57	115.	115.	115.	.37		
+									125.06	3.57
+	ROUTED TO	RT2	326.	3.60	114.	114.	114.	.37		

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          HYDROGRAPH AT
+                       BSN2A       115.    2.90          20.         20.         20.        .06

          HYDROGRAPH AT
+                      BSN2A-        45.    3.00           9.          9.          9.        .03

          3 COMBINED AT
+                        ADD1       373.    3.55         143.        143.        143.        .47

          HYDROGRAPH AT
+                       BSN2C       232.    2.93          44.         44.         44.        .12

          ROUTED TO
+                      NT-RT1       232.    2.97          43.         43.         43.        .12

          HYDROGRAPH AT
+                       BSN2B       169.    2.78          26.         26.         26.        .09

          2 COMBINED AT
+                       JCTN1       378.    2.88          70.         70.         70.        .21

          ROUTED TO
+                       B3-RT       358.    2.98          70.         70.         70.        .21
+                                                                                          119.31        2.98

          ROUTED TO
+                      NT-RT2       358.    3.00          70.         70.         70.        .21

          HYDROGRAPH AT
+                       BSN2D        33.    2.77           5.          5.          5.        .01

          2 COMBINED AT
+                        ADD3       380.    2.98          75.         75.         75.        .22

          2 COMBINED AT
+                        ADD4       743.    3.00         218.        218.        218.        .69

          ROUTED TO
+                         RT3       742.    3.05         216.        216.        216.        .69

          HYDROGRAPH AT
+                       BSN2E       184.    2.95          34.         34.         34.        .12

          2 COMBINED AT
+                        ADD5       917.    3.03         251.        251.        251.        .81

          ROUTED TO
+                       B4-RT       721.    3.35         251.        251.        251.        .81
+                                                                                          108.37        3.35

          ROUTED TO
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```
+                          RT4       721.    3.38         248.        248.        248.        .81

         HYDROGRAPH AT
+                        BSN3B       350.    2.95          66.         66.         66.        .22

         2 COMBINED AT
+                         ADD6       972.    3.15         314.        314.        314.       1.03

         ROUTED TO
+                        B5-RT       962.    3.22         350.        350.        350.       1.03
+                                                                                          101.81        3.22

         ROUTED TO
+                          RT5       962.    3.27         345.        345.        345.       1.03

         HYDROGRAPH AT
+                        BSN3A        70.    3.17          16.         16.         16.        .06

         2 COMBINED AT
+                         ADD7      1030.    3.25         361.        361.        361.       1.09

         ROUTED TO
+                            1      1030.    3.25         361.        361.        361.       1.09
1
                                     SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING
                                         (FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)
                                                                          INTERPOLATED TO
                                                                       COMPUTATION INTERVAL
           ISTAQ    ELEMENT      DT       PEAK    TIME TO     VOLUME      DT       PEAK    TIME TO     VOLUME
                                                   PEAK                                     PEAK

                                (MIN)     (CFS)     (MIN)     (IN)     (MIN)     (CFS)     (MIN)       (IN)

               RT1  MANE          .24    326.22    213.92      2.38      1.00    326.21    214.00        2.39

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .4736E+02 EXCESS= .0000E+00 OUTFLOW= .4731E+02 BASIN STORAGE= .4214E-01 PERCENT ERROR=    .0

               RT2  MANE         1.00    326.08    216.00      2.36      1.00    326.08    216.00        2.36

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .4737E+02 EXCESS= .0000E+00 OUTFLOW= .4689E+02 BASIN STORAGE= .5062E+00 PERCENT ERROR=   -.1

            NT-RT1  MANE         1.00    231.94    178.00      2.74      1.00    231.94    178.00        2.74

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .1798E+02 EXCESS= .0000E+00 OUTFLOW= .1786E+02 BASIN STORAGE= .1339E+00 PERCENT ERROR=   -.1
```

```
            NT-RT2  MANE         1.00    358.16    180.00      2.59      1.00    358.16    180.00        2.59

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2884E+02 EXCESS= .0000E+00 OUTFLOW= .2873E+02 BASIN STORAGE= .1190E+00 PERCENT ERROR=    .0

               RT3  MANE         1.00    741.91    183.00      2.42      1.00    741.91    183.00        2.42

CONTINUITY SUMMARY (AC-FT) - INFLOW= .8978E+02 EXCESS= .0000E+00 OUTFLOW= .8918E+02 BASIN STORAGE= .6573E+00 PERCENT ERROR=   -.1

               RT4  MANE         1.00    720.59    204.00      2.36      1.00    720.59    204.00        2.36

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1035E+03 EXCESS= .0000E+00 OUTFLOW= .1023E+03 BASIN STORAGE= .1285E+01 PERCENT ERROR=   -.1

               RT5  MANE         1.00    961.58    196.00      2.58      1.00    961.58    196.00        2.58

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1443E+03 EXCESS= .0000E+00 OUTFLOW= .1424E+03 BASIN STORAGE= .1892E+01 PERCENT ERROR=    .0


*** NORMAL END OF HEC-1 ***
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50-YEAR

***

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

	OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
+	HYDROGRAPH AT	BSN1A	352.	3.12	80.	80.	80.	.22		
+	ROUTED TO	RT-1A	352.	3.12	80.	80.	80.	.22		
+									128.27	3.12
+	HYDROGRAPH AT	BSN1C	137.	2.92	26.	26.	26.	.06		
+	2 COMBINED AT	ADD1A	472.	3.05	106.	106.	106.	.28		
+	ROUTED TO	B1A-RT	423.	3.25	106.	106.	106.	.28		
+									127.66	3.25
+	HYDROGRAPH AT	BSN1D	173.	2.90	31.	31.	31.	.09		
+	2 COMBINED AT	ADD1B	541.	3.13	137.	137.	137.	.37		
+	ROUTED TO	B1-RT	400.	3.55	137.	137.	137.	.37		
+									128.68	3.55
+	ROUTED TO	RT1	400.	3.55	137.	137.	137.	.37		
+	ROUTED TO	B2-RT	400.	3.55	137.	137.	137.	.37		
+									125.21	3.55
+	ROUTED TO	RT2	400.	3.45	135.	135.	135.	.37		

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          HYDROGRAPH AT
+                       BSN2A       135.    2.88          24.         24.         24.        .06

          HYDROGRAPH AT
+                      BSN2A-        54.    3.00          11.         11.         11.        .03

          3 COMBINED AT
+                        ADD1       479.    3.43         170.        170.        170.        .47

          HYDROGRAPH AT
+                       BSN2C       270.    2.92          51.         51.         51.        .12

          ROUTED TO
+                      NT-RT1       269.    2.95          51.         51.         51.        .12

          HYDROGRAPH AT
+                       BSN2B       199.    2.78          32.         32.         32.        .09

          2 COMBINED AT
+                       JCTN1       442.    2.87          83.         83.         83.        .21

          ROUTED TO
+                       B3-RT       426.    2.95          83.         83.         83.        .21
+                                                                                          119.62        2.95

          ROUTED TO
+                      NT-RT2       426.    2.98          83.         83.         83.        .21

          HYDROGRAPH AT
+                       BSN2D        38.    2.75           6.          6.          6.        .01

          2 COMBINED AT
+                        ADD3       452.    2.97          88.         88.         88.        .22

          2 COMBINED AT
+                        ADD4       853.    2.98         258.        258.        258.        .69

          ROUTED TO
+                         RT3       851.    3.03         256.        256.        256.        .69

          HYDROGRAPH AT
+                       BSN2E       219.    2.95          42.         42.         42.        .12

          2 COMBINED AT
+                        ADD5      1063.    3.02         297.        297.        297.        .81

          ROUTED TO
+                       B4-RT       837.    3.43         297.        297.        297.        .81
+                                                                                          108.99        3.43

          ROUTED TO
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+                          RT4       837.    3.47         293.        293.        293.        .81

         HYDROGRAPH AT
+                        BSN3B       414.    2.95          80.         80.         80.        .22

         2 COMBINED AT
+                         ADD6      1090.    3.22         372.        372.        372.       1.03

         ROUTED TO
+                        B5-RT      1087.    3.25         404.        404.        404.       1.03
+                                                                                          101.92        3.25

         ROUTED TO
+                          RT5      1087.    3.30         399.        399.        399.       1.03

         HYDROGRAPH AT
+                        BSN3A        84.    3.17          19.         19.         19.        .06

         2 COMBINED AT
+                         ADD7      1167.    3.28         419.        419.        419.       1.09

         ROUTED TO
+                            1      1167.    3.28         419.        419.        419.       1.09
1
                                    SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING
                                        (FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)
                                                                          INTERPOLATED TO
                                                                       COMPUTATION INTERVAL
           ISTAQ    ELEMENT      DT       PEAK    TIME TO     VOLUME      DT       PEAK    TIME TO     VOLUME
                                                   PEAK                                     PEAK

                                (MIN)     (CFS)     (MIN)     (IN)     (MIN)     (CFS)     (MIN)       (IN)

               RT1  MANE          .23    400.14    213.56      2.85      1.00    400.14    214.00        2.85

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .5654E+02 EXCESS= .0000E+00 OUTFLOW= .5648E+02 BASIN STORAGE= .5681E-01 PERCENT ERROR=    .0

               RT2  MANE         1.00    400.15    207.00      2.80      1.00    400.15    207.00        2.80

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .5655E+02 EXCESS= .0000E+00 OUTFLOW= .5562E+02 BASIN STORAGE= .9923E+00 PERCENT ERROR=   -.1

            NT-RT1  MANE         1.00    269.14    177.00      3.24      1.00    269.14    177.00        3.24

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .2121E+02 EXCESS= .0000E+00 OUTFLOW= .2107E+02 BASIN STORAGE= .1462E+00 PERCENT ERROR=   -.1
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            NT-RT2  MANE         1.00    425.80    179.00      3.07      1.00    425.80    179.00        3.07

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3416E+02 EXCESS= .0000E+00 OUTFLOW= .3403E+02 BASIN STORAGE= .1311E+00 PERCENT ERROR=    .0

               RT3  MANE         1.00    850.93    182.00      2.87      1.00    850.93    182.00        2.87

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1066E+03 EXCESS= .0000E+00 OUTFLOW= .1055E+03 BASIN STORAGE= .1077E+01 PERCENT ERROR=    .0

               RT4  MANE         1.00    837.48    208.00      2.78      1.00    837.48    208.00        2.78

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1224E+03 EXCESS= .0000E+00 OUTFLOW= .1207E+03 BASIN STORAGE= .1643E+01 PERCENT ERROR=    .0

               RT5  MANE         1.00   1087.09    198.00      2.99      1.00   1087.09    198.00        2.99

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1668E+03 EXCESS= .0000E+00 OUTFLOW= .1648E+03 BASIN STORAGE= .2095E+01 PERCENT ERROR=    .0


*** NORMAL END OF HEC-1 ***
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100-YEAR

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RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

	OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
+	HYDROGRAPH AT	BSN1A	396.	3.10	95.	95.	95.	.22		
+	ROUTED TO	RT-1A	396.	3.10	95.	95.	95.	.22		
+									128.42	3.10
+	HYDROGRAPH AT	BSN1C	152.	2.92	31.	31.	31.	.06		
+	2 COMBINED AT	ADD1A	529.	3.03	126.	126.	126.	.28		
+	ROUTED TO	B1A-RT	471.	3.23	126.	126.	126.	.28		
+									127.91	3.23
+	HYDROGRAPH AT	BSN1D	198.	2.88	38.	38.	38.	.09		
+	2 COMBINED AT	ADD1B	601.	3.12	164.	164.	164.	.37		
+	ROUTED TO	B1-RT	401.	3.65	157.	157.	157.	.37		
+									128.92	3.65
+	ROUTED TO	RT1	401.	3.65	157.	157.	157.	.37		
+	ROUTED TO	B2-RT	401.	3.65	157.	157.	157.	.37		
+									125.21	3.65
+	ROUTED TO	RT2	401.	3.68	154.	154.	154.	.37		

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          HYDROGRAPH AT
+                       BSN2A       152.    2.87          29.         29.         29.        .06

          HYDROGRAPH AT
+                      BSN2A-        61.    2.98          13.         13.         13.        .03

          3 COMBINED AT
+                        ADD1       521.    3.27         196.        196.        196.        .47

          HYDROGRAPH AT
+                       BSN2C       300.    2.92          61.         61.         61.        .12

          ROUTED TO
+                      NT-RT1       299.    2.93          61.         61.         61.        .12

          HYDROGRAPH AT
+                       BSN2B       227.    2.77          38.         38.         38.        .09

          2 COMBINED AT
+                       JCTN1       495.    2.85          99.         99.         99.        .21

          ROUTED TO
+                       B3-RT       480.    2.93          99.         99.         99.        .21
+                                                                                          119.81        2.93

          ROUTED TO
+                      NT-RT2       479.    2.95          98.         98.         98.        .21

          HYDROGRAPH AT
+                       BSN2D        43.    2.75           7.          7.          7.        .01

          2 COMBINED AT
+                        ADD3       509.    2.95         105.        105.        105.        .22

          2 COMBINED AT
+                        ADD4       940.    2.95         302.        302.        302.        .69

          ROUTED TO
+                         RT3       939.    3.00         299.        299.        299.        .69

          HYDROGRAPH AT
+                       BSN2E       250.    2.93          50.         50.         50.        .12

          2 COMBINED AT
+                        ADD5      1182.    2.98         349.        349.        349.        .81

          ROUTED TO
+                       B4-RT       940.    3.38         346.        346.        346.        .81
+                                                                                          109.40        3.38

          ROUTED TO
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+                          RT4       940.    3.43         341.        341.        341.        .81

         HYDROGRAPH AT
+                        BSN3B       469.    2.93          96.         96.         96.        .22

         2 COMBINED AT
+                         ADD6      1216.    3.20         437.        437.        437.       1.03

         ROUTED TO
+                        B5-RT      1210.    3.27         463.        463.        463.       1.03
+                                                                                          102.03        3.27

         ROUTED TO
+                          RT5      1210.    3.30         456.        456.        456.       1.03

         HYDROGRAPH AT
+                        BSN3A        95.    3.15          23.         23.         23.        .06

         2 COMBINED AT
+                         ADD7      1299.    3.28         480.        480.        480.       1.09

         ROUTED TO
+                            1      1299.    3.28         480.        480.        480.       1.09
1
                                    SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING
                                        (FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)
                                                                          INTERPOLATED TO
                                                                       COMPUTATION INTERVAL
           ISTAQ    ELEMENT      DT       PEAK    TIME TO     VOLUME      DT       PEAK    TIME TO     VOLUME
                                                    PEAK                                     PEAK

                                (MIN)     (CFS)     (MIN)     (IN)     (MIN)     (CFS)     (MIN)       (IN)

               RT1  MANE          .23    400.94    219.75      3.26      1.00    400.94    220.00        3.26

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .6484E+02 EXCESS= .0000E+00 OUTFLOW= .6474E+02 BASIN STORAGE= .9332E-01 PERCENT ERROR=    .0

               RT2  MANE         1.00    400.94    222.00      3.20      1.00    400.94    222.00        3.20

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .6487E+02 EXCESS= .0000E+00 OUTFLOW= .6369E+02 BASIN STORAGE= .1157E+01 PERCENT ERROR=    .0

            NT-RT1  MANE         1.00    299.11    176.00      3.83      1.00    299.11    176.00        3.83

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .2513E+02 EXCESS= .0000E+00 OUTFLOW= .2496E+02 BASIN STORAGE= .1832E+00 PERCENT ERROR=   -.1
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            NT-RT2  MANE         1.00    479.46    177.00      3.65      1.00    479.46    177.00        3.65

CONTINUITY SUMMARY (AC-FT) - INFLOW= .4072E+02 EXCESS= .0000E+00 OUTFLOW= .4056E+02 BASIN STORAGE= .1645E+00 PERCENT ERROR=    .0

               RT3  MANE         1.00    938.93    180.00      3.35      1.00    938.93    180.00        3.35

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1245E+03 EXCESS= .0000E+00 OUTFLOW= .1233E+03 BASIN STORAGE= .1255E+01 PERCENT ERROR=    .0

               RT4  MANE         1.00    939.70    206.00      3.25      1.00    939.70    206.00        3.25

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1428E+03 EXCESS= .0000E+00 OUTFLOW= .1408E+03 BASIN STORAGE= .1993E+01 PERCENT ERROR=    .0

               RT5  MANE         1.00   1209.56    198.00      3.41      1.00   1209.56    198.00        3.41

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1908E+03 EXCESS= .0000E+00 OUTFLOW= .1883E+03 BASIN STORAGE= .2557E+01 PERCENT ERROR=    .0


*** NORMAL END OF HEC-1 ***
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APPENDIX L

DIGITAL COPY OF HEC-RAS AND HEC-1 MODELS WILL BE INCLUDED IN FINAL REPORT