



McClure

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PRELIMINARY MICRO STORM WATER DRAINAGE STUDY

Pathways at Kensington Farms

(1140 SW Whitby Drive in Lee's Summit, Cass County, Missouri)

Lee's Summit, MO

Section 01, Township 46N, Range 32W

Prepared by:

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GENERAL INFORMATION:

The proposed Pathways at Kensington Farm development will be constructed southeast of the intersection of E Cass Jackson Road and N Prairie Lane in Lee's Summit, Missouri. The site is in Section 1, Township 49N, and Range 32W. Refer to **Appendix A-1** for the project location map. The property is currently undeveloped and is grassland within the existing Kensington Farms development, which consists of single-family homes. The overall Kensington Farms development is 193.24 acres. The proposed development will be constructed in three (3) phases, with phase 1 consisting of single-family homes, and phases 2 and 3 consisting of multifamily homes.

The existing undeveloped site drains south and east, enters on-site storm water basins and then drains east to Raintree Lake, which is within the Middle Big Creek watershed.

The site soils are largely classified as below, and the soils map can be seen in **Appendix A-2**.

Greenton silty clay loam, hydrologic soil rating C/D

Sampsel silty clay loam, hydrologic soil rating C/D

Arisburg silt loam, hydrologic soil rating C

There is an existing macro storm water report for the entire Kensington Farms development, by Archer Engineers dated November 18, 2005 (see **Appendix A-6**).

This storm water report will detail what is proposed with this development, calculations for the 100%, 10%, and 1% storms, and perform an analysis of the existing detention basins (Basins 1, 2, and 3 per the **Plat Map** exhibit in **Appendix A-6**) to determine if they can adequately detain the proposed development's storm water runoff and release it at a rate that is equal to or less than the existing peak runoff rate for the 1-, 2-, 10- and 100-year storm events as determined by the 2005 Macro Storm Water Report by Archer Engineers.

METHODOLOGY:

The stormwater management design criteria consist of the City of Lee's Summit's currently adopted APWA Standard Specifications and Design Criteria Section 5600 and the MARC BMP Manual. Runoff volumes and hydrographs were generated using the SCS TR-55 method within Bentley's PondPack. Rainfall rates match those noted in NOAA ATLAS-14, which stipulates the 24hr rainfall amount to be 3.0 inches for the 100% (1-year) storm, 3.6 inches for the 50% (2-year) storm, 5.4 inches for the 10% (10-year) storm and 8.6 inches for the 1% (100-year) storm.

EXISTING CONDITION ANALYSIS:

As previously indicated, the proposed site is currently undeveloped with grassland, surrounded by the previous Kensington Farm development. The existing condition peak flow rates will be referenced from the 2005 storm water report.

PROPOSED CONDITION ANALYSIS:

The proposed project will consist of three phases of residential developments, with phase 1 consisting of single-family homes and phases 2 and 3 consisting of multi-family homes. The existing on-site detention basins have been determined to have capacity for the proposed development's runoff while remaining below the pre-development 10- and 100-year peak flow rates and volume, as well as reducing any potential impacts to downstream bodies of water. This was previously determined in the 2005 macro study done by Archer Engineers. Basins #1 and #2 need maintenance for the basins to function as extended dry detention basins – they currently have standing water in the basins; thus they are not functioning as originally designed.

There will be one proposed extended wet detention basin added with this development, located in the southwest corner – Basin A. This basin will help relieve some of the area that was going to be routed to Basin #1. It will have a designed control structure to release rates at the required flow and will outfall to the same Middle Big Creek tributary that Basin #1 outfalls to.

Proposed curve number calculations are in **Appendix A-5**.

The table below shows the proposed peak runoff flows from the drainage areas shown in **Appendix A-4**. These peak flow rates will be reduced to below existing rates once routed through their applicable detention basins. The PondPack report can be found in **Appendix A-3**.

	PROPOSED PEAK DRAINAGE AREA RUNOFF			
	DA BASIN A	DA 1A	DA 2A+2B+2C	DA 3A
Design Storm	(cfs)		(cfs)	(cfs)
1 Year	36.73	175.64	39.31	15.41
2 Year	45.93	220.92	49.80	19.38
10 Year	75.89	369.04	84.28	32.32
100 Year	129.24	633.70	146.14	55.42

Required Detention:

Due to the increase in runoff from the developed condition, detention is required and was provided and constructed with the earlier phases of Kensington Farms as determined by the 2005 Macro Storm Water Study for Kensington Farms. From a preliminary analysis, there is adequate storage available to meet the development's needs per the 2005 study, as the proposed development is similar in characteristics used to size the detention basins originally.

A proposed basin, Basin A, will be added to the southwest corner to reduce the amount of area that will go to existing Basin #1.

CORPS OF ENGINEERS REQUIREMENTS:

N/A

FEMA REQUIREMENTS:

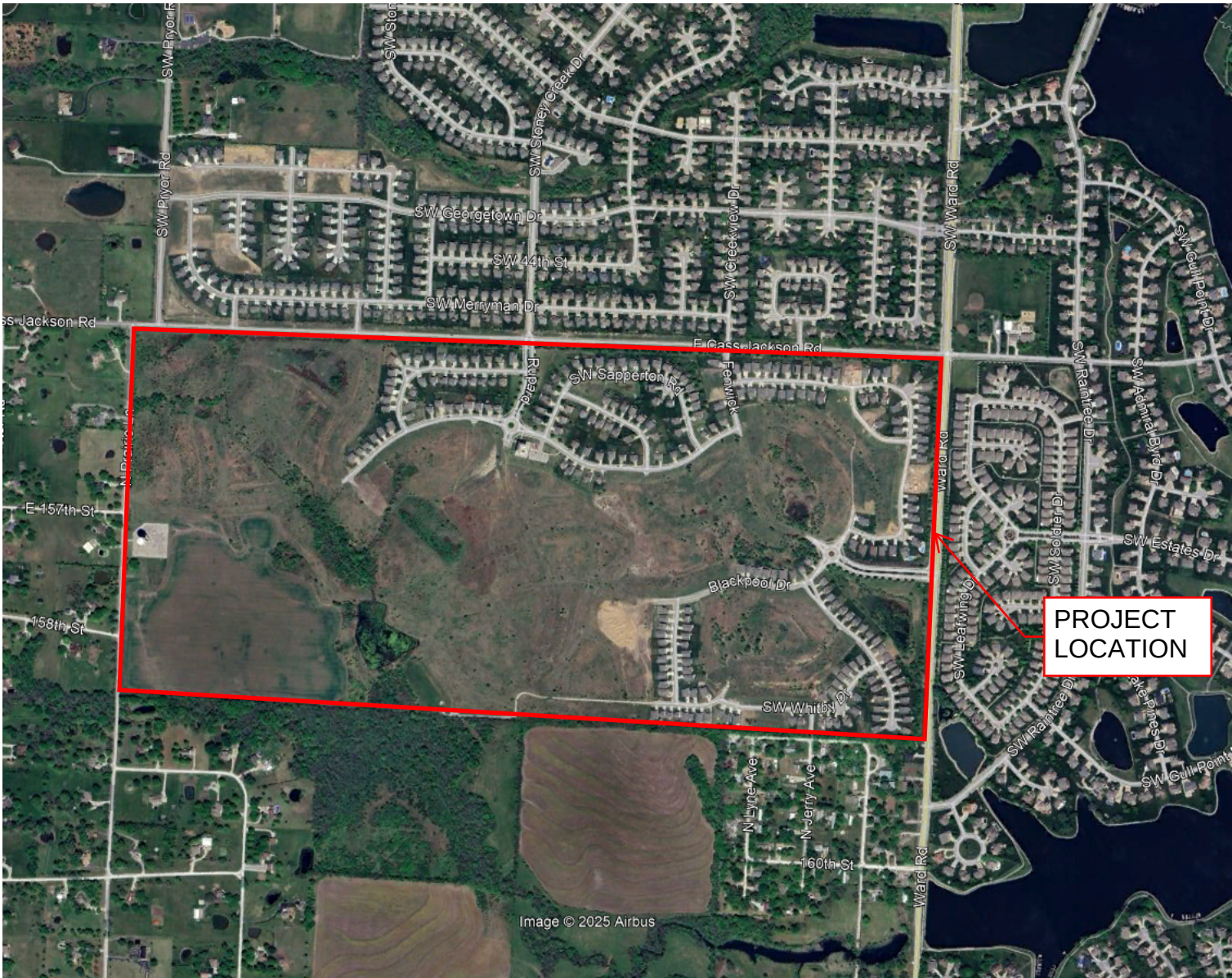
Per FEMA map 29095C0535G dated January 20, 2017, this site does not lie within a FEMA established floodplain or floodway.

SUMMARY & CONCLUSION:

The proposed Pathway at Kensington Farm development will be constructed southeast of the intersection of E Cass Jackson Road and N Prairie Lane in Lee's Summit, Missouri. The proposed development will be constructed in three (3) phases, with phase 1 consisting of single-family homes, and phases 2 and 3 consisting of multifamily homes.

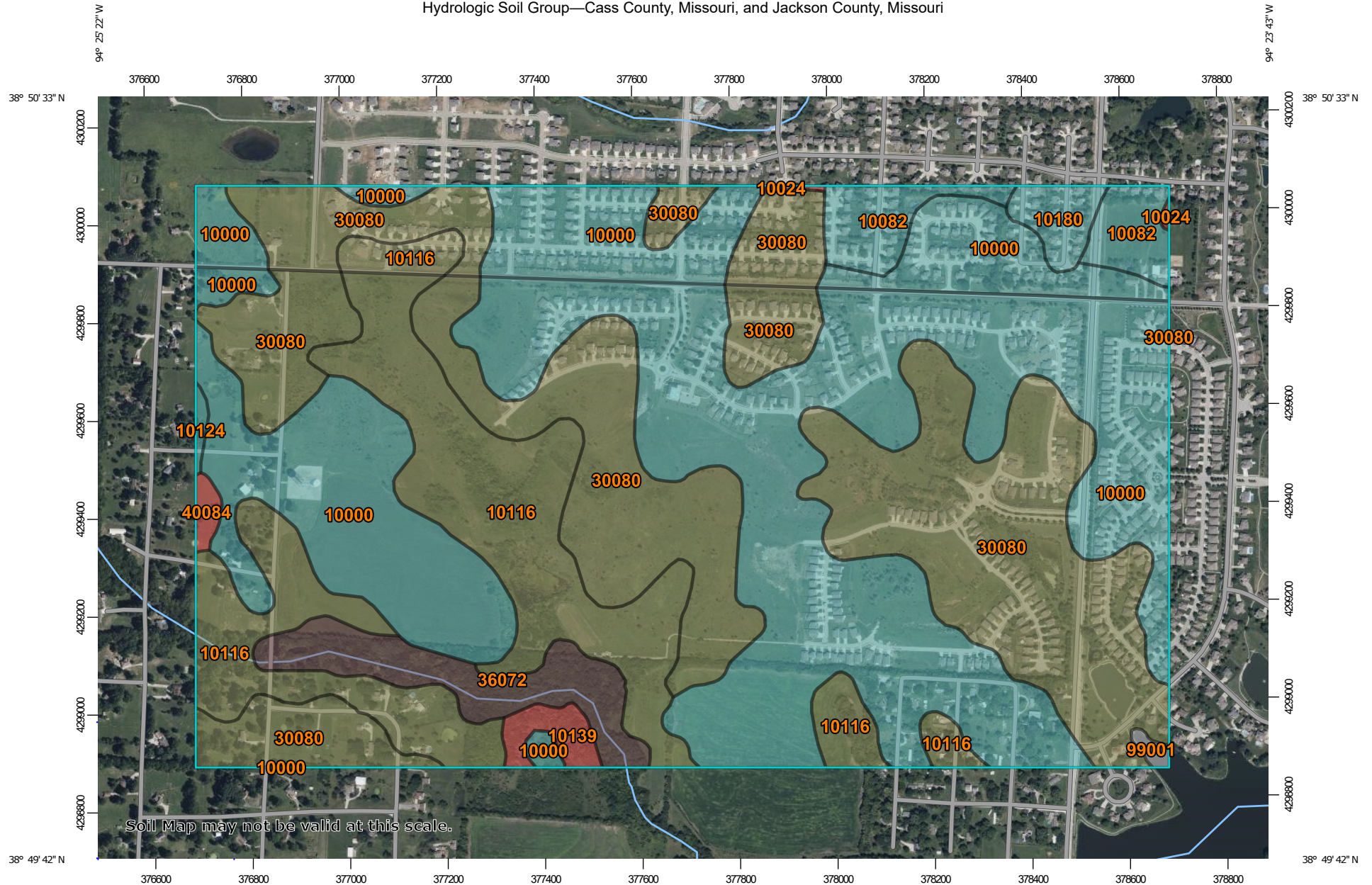
Stormwater runoff from the proposed development will be controlled utilized the three existing on-site detention basins, Basin #1, Basin #2, and Basin #3. The basins have been determined in a preliminary analysis to have storage capacity for the development's increase in runoff. The basins were previously sized as shown in the 2005 Macro storm water study done by Archer Engineers to account for this area to be developed in a similar way and routed through the basins. There will be an additional extended wet detention basin (Basin A) added to relieve some of the drainage area towards Basin #1. The basin's control structure will be designed to control the 1-, 2-, 10-, and 100-year storm events peak release rates per the City's requirements.

APPENDIX A-1
PROJECT LOCATION MAP



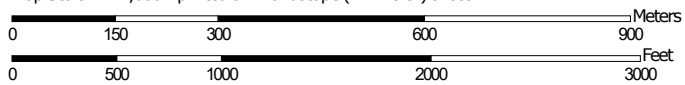
APPENDIX A-2
SOILS MAP

Hydrologic Soil Group—Cass County, Missouri, and Jackson County, Missouri



Soil Map may not be valid at this scale.

Map Scale: 1:11,000 if printed on A landscape (11" x 8.5") sheet.



Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 15N WGS84



**Natural Resources
Conservation Service**

Web Soil Survey
National Cooperative Soil Survey

4/20/2025
Page 1 of 5

MAP LEGEND

Area of Interest (AOI)

 Area of Interest (AOI)

Soils

Soil Rating Polygons

 A
 A/D
 B
 B/D
 C
 C/D
 D
 Not rated or not available

Soil Rating Lines

 A
 A/D
 B
 B/D
 C
 C/D
 D
 Not rated or not available

Soil Rating Points

 A
 A/D
 B
 B/D

 C
 C/D
 D
 Not rated or not available

Water Features

 Streams and Canals

Transportation

 Rails
 Interstate Highways
 US Routes
 Major Roads
 Local Roads

Background

 Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
 Web Soil Survey URL:
 Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Cass County, Missouri
 Survey Area Data: Version 28, Aug 27, 2024

Soil Survey Area: Jackson County, Missouri
 Survey Area Data: Version 27, Aug 27, 2024

Your area of interest (AOI) includes more than one soil survey area. These survey areas may have been mapped at different scales, with a different land use in mind, at different times, or at different levels of detail. This may result in map unit symbols, soil properties, and interpretations that do not completely agree across soil survey area boundaries.

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Aug 30, 2022—Sep 8, 2022

MAP LEGEND

MAP INFORMATION

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
10000	Arisburg silt loam, 1 to 5 percent slopes	C	212.1	36.0%
10116	Sampsel silty clay loam, 2 to 5 percent slopes	C/D	90.7	15.4%
10124	Sharpsburg silty clay loam, loess hill, 2 to 5 percent slopes	C	0.8	0.1%
10139	Snead silty clay loam, 5 to 14 percent slopes	D	4.4	0.7%
30080	Greenton silty clay loam, 5 to 9 percent slopes	C/D	159.5	27.1%
36072	Blackoar silt loam, 1 to 4 percent slopes, frequently flooded	B/D	20.2	3.4%
40084	Oska silty clay loam, 5 to 9 percent slopes	D	1.6	0.3%
99001	Water		0.9	0.2%
Subtotals for Soil Survey Area			490.3	83.2%
Totals for Area of Interest			589.2	100.0%

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
10000	Arisburg silt loam, 1 to 5 percent slopes	C	45.8	7.8%
10024	Greenton-Urban land complex, 5 to 9 percent slopes	D	0.5	0.1%
10082	Arisburg-Urban land complex, 1 to 5 percent slopes	C	15.6	2.7%
10116	Sampsel silty clay loam, 2 to 5 percent slopes	C/D	4.5	0.8%
10180	Udarents-Urban land-Sampsel complex, 2 to 5 percent slopes	C	5.6	1.0%
30080	Greenton silty clay loam, 5 to 9 percent slopes	C/D	26.9	4.6%
Subtotals for Soil Survey Area			98.9	16.8%
Totals for Area of Interest			589.2	100.0%

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

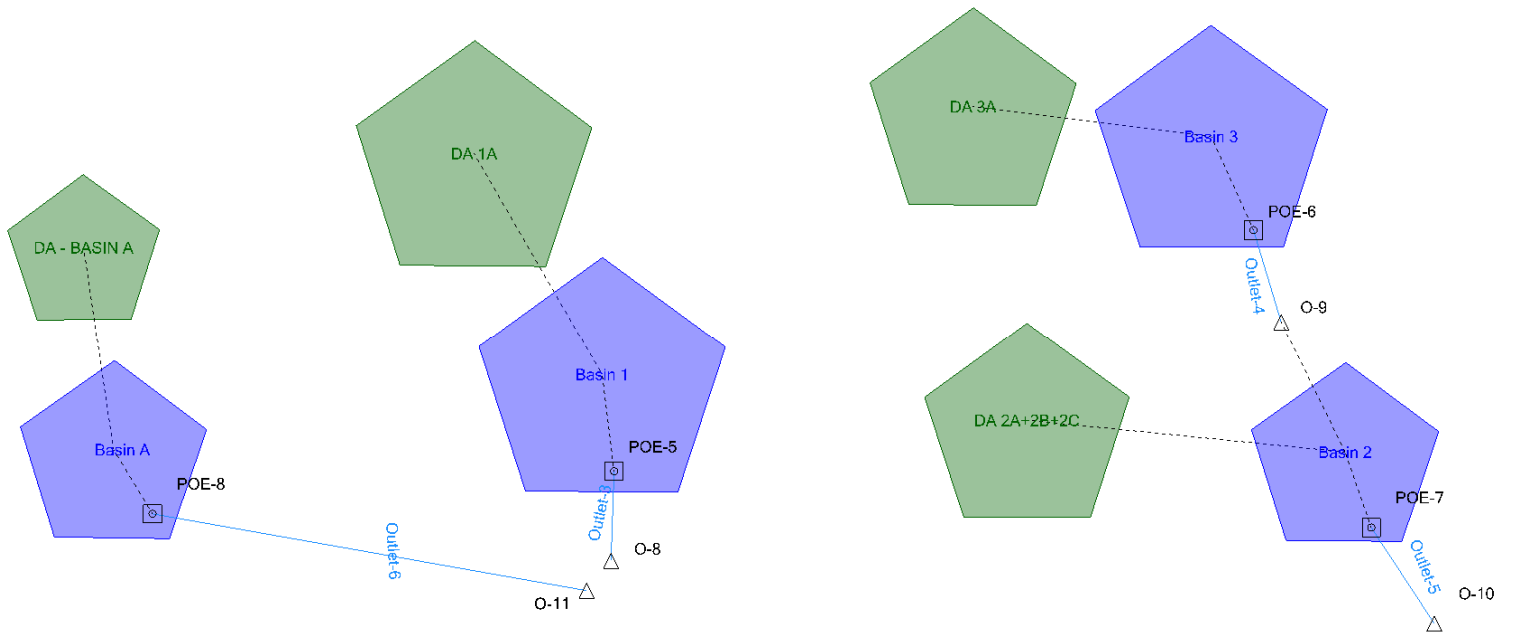
Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

APPENDIX A-3
PONDPACK OUTPUT

PRELIMINARY PONDPACK MODEL EXHIBIT – PROPOSED



Kensington Farms - Preliminary Analysis

Project Summary
Title
Engineer
Company
Date

Notes

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Kensington Farms - Preliminary Analysis

Subsection: Master Network Summary

Catchments Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (min)	Peak Flow (ft ³ /s)
DA 1A	1 Year	1	13.641	723.0	175.64
DA 1A	2 Year	2	17.229	723.0	220.92
DA 1A	10 Year	10	29.300	723.0	369.04
DA 1A	100 Year	100	51.721	723.0	633.70
DA 3A	1 Year	1	0.849	714.0	15.41
DA 3A	2 Year	2	1.073	714.0	19.38
DA 3A	10 Year	10	1.824	714.0	32.32
DA 3A	100 Year	100	3.219	714.0	55.42
DA 2A+2B+2C	1 Year	1	3.612	729.0	39.31
DA 2A+2B+2C	2 Year	2	4.591	729.0	49.80
DA 2A+2B+2C	10 Year	10	7.900	729.0	84.28
DA 2A+2B+2C	100 Year	100	14.076	729.0	146.14
DA - BASIN A	1 Year	1	2.027	714.0	36.73
DA - BASIN A	2 Year	2	2.549	714.0	45.93
DA - BASIN A	10 Year	10	4.300	714.0	75.89
DA - BASIN A	100 Year	100	7.540	714.0	129.24

Node Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (min)	Peak Flow (ft ³ /s)
O-8	1 Year	1	13.631	744.0	57.41
O-8	2 Year	2	17.217	744.0	64.73
O-8	10 Year	10	29.270	744.0	111.43
O-8	100 Year	100	51.656	738.0	276.22
O-10	1 Year	1	0.000	0.0	0.00
O-10	2 Year	2	0.000	0.0	0.00
O-10	10 Year	10	1.837	981.0	3.90
O-10	100 Year	100	9.346	753.0	59.37
O-11	1 Year	1	0.542	924.0	0.93
O-11	2 Year	2	1.062	762.0	3.22
O-11	10 Year	10	2.805	726.0	24.50
O-11	100 Year	100	6.031	726.0	43.43

Pond Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (min)	Peak Flow (ft ³ /s)	Maximum Water Surface Elevation (ft)	Maximum Pond Storage (ac-ft)
Basin 1 (IN)	1 Year	1	13.641	723.0	175.64	(N/A)	(N/A)

Kensington Farms - Preliminary Analysis

Subsection: Master Network Summary

Pond Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (min)	Peak Flow (ft ³ /s)	Maximum Water Surface Elevation (ft)	Maximum Pond Storage (ac-ft)
Basin 1 (OUT)	1 Year	1	13.631	744.0	57.41	975.89	3.982
Basin 1 (IN)	2 Year	2	17.229	723.0	220.92	(N/A)	(N/A)
Basin 1 (OUT)	2 Year	2	17.217	744.0	64.73	976.51	5.384
Basin 1 (IN)	10 Year	10	29.300	723.0	369.04	(N/A)	(N/A)
Basin 1 (OUT)	10 Year	10	29.270	744.0	111.43	978.42	9.960
Basin 1 (IN)	100 Year	100	51.721	723.0	633.70	(N/A)	(N/A)
Basin 1 (OUT)	100 Year	100	51.656	738.0	276.22	980.64	15.755
Basin 3 (IN)	1 Year	1	0.849	714.0	15.41	(N/A)	(N/A)
Basin 3 (OUT)	1 Year	1	0.832	729.0	3.36	991.25	0.342
Basin 3 (IN)	2 Year	2	1.073	714.0	19.38	(N/A)	(N/A)
Basin 3 (OUT)	2 Year	2	1.051	726.0	4.26	991.32	0.435
Basin 3 (IN)	10 Year	10	1.824	714.0	32.32	(N/A)	(N/A)
Basin 3 (OUT)	10 Year	10	1.790	726.0	7.39	991.54	0.743
Basin 3 (IN)	100 Year	100	3.219	714.0	55.42	(N/A)	(N/A)
Basin 3 (OUT)	100 Year	100	3.164	726.0	13.89	991.93	1.281
Basin 2 (IN)	1 Year	1	4.444	729.0	42.67	(N/A)	(N/A)
Basin 2 (OUT)	1 Year	1	0.000	0.0	0.00	972.62	4.439
Basin 2 (IN)	2 Year	2	5.642	729.0	54.05	(N/A)	(N/A)
Basin 2 (OUT)	2 Year	2	0.000	0.0	0.00	973.26	5.635
Basin 2 (IN)	10 Year	10	9.690	729.0	91.64	(N/A)	(N/A)
Basin 2 (OUT)	10 Year	10	1.837	981.0	3.90	974.37	7.932
Basin 2 (IN)	100 Year	100	17.240	729.0	159.92	(N/A)	(N/A)
Basin 2 (OUT)	100 Year	100	9.346	753.0	59.37	974.86	9.024
Basin A (IN)	1 Year	1	2.027	714.0	36.73	(N/A)	(N/A)
Basin A (OUT)	1 Year	1	0.542	924.0	0.93	992.01	1.501
Basin A (IN)	2 Year	2	2.549	714.0	45.93	(N/A)	(N/A)
Basin A (OUT)	2 Year	2	1.062	762.0	3.22	992.06	1.570
Basin A (IN)	10 Year	10	4.300	714.0	75.89	(N/A)	(N/A)

Kensington Farms - Preliminary Analysis

Subsection: Master Network Summary

Pond Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (min)	Peak Flow (ft ³ /s)	Maximum Water Surface Elevation (ft)	Maximum Pond Storage (ac-ft)
Basin A (OUT)	10 Year	10	2.805	726.0	24.50	992.48	2.213
Basin A (IN)	100 Year	100	7.540	714.0	129.24	(N/A)	(N/A)
Basin A (OUT)	100 Year	100	6.031	726.0	43.43	993.35	3.565

Kensington Farms - Preliminary Analysis

Subsection: Outlet Input Data

Label: Basin 1 Outfall

Scenario: 1 Year

Return Event: 1 years

Storm Event: 1 Year

Requested Pond Water Surface Elevations

Minimum (Headwater)	972.00 ft
Increment (Headwater)	0.50 ft
Maximum (Headwater)	986.00 ft

Outlet Connectivity

Structure Type	Outlet ID	Direction	Outfall	E1 (ft)	E2 (ft)
Inlet Box	Riser - 1	Forward	Culvert - 1	978.00	986.00
Orifice-Area	Orifice - 1	Forward	Culvert - 1	972.00	986.00
Culvert-Circular	Culvert - 1	Forward	TW	972.00	986.00
Tailwater Settings	Tailwater			(N/A)	(N/A)

Kensington Farms - Preliminary Analysis

Subsection: Outlet Input Data

Label: Basin 1 Outfall

Scenario: 1 Year

Return Event: 1 years

Storm Event: 1 Year

Structure ID: Riser - 1
Structure Type: Inlet Box

Number of Openings	1
Elevation	978.00 ft
Orifice Area	25.0 ft ²
Orifice Coefficient	0.600
Weir Length	36.00 ft
Weir Coefficient	3.00 (ft ^{0.5})/s
K Reverse	1.000
Manning's n	0.000
Kev, Charged Riser	0.000
Weir Submergence	False
Orifice H to crest	False

Kensington Farms - Preliminary Analysis

Subsection: Outlet Input Data

Label: Basin 1 Outfall

Scenario: 1 Year

Return Event: 1 years

Storm Event: 1 Year

Structure ID: Culvert - 1	
Structure Type: Culvert-Circular	
Number of Barrels	2
Diameter	60.0 in
Length	50.00 ft
Length (Computed Barrel)	50.01 ft
Slope (Computed)	0.020 ft/ft

Outlet Control Data

Manning's n	0.013
Ke	0.200
Kb	0.004
Kr	0.000
Convergence Tolerance	0.00 ft

Inlet Control Data

Equation Form	Form 1
K	0.0045
M	2.0000
C	0.0317
Y	0.6900
T1 ratio (HW/D)	1.085
T2 ratio (HW/D)	1.187
Slope Correction Factor	-0.500

Use unsubmerged inlet control 0 equation below T1 elevation.

Use submerged inlet control 0 equation above T2 elevation

In transition zone between unsubmerged and submerged inlet control, interpolate between flows at T1 & T2...

T1 Elevation	977.43 ft	T1 Flow	153.67 ft ³ /s
T2 Elevation	977.94 ft	T2 Flow	175.62 ft ³ /s

Kensington Farms - Preliminary Analysis

Subsection: Outlet Input Data

Label: Basin 1 Outfall

Scenario: 1 Year

Return Event: 1 years

Storm Event: 1 Year

Structure ID: Orifice - 1	
Structure Type: Orifice-Area	
Number of Openings	1
Elevation	972.00 ft
Orifice Area	9.0 ft ²
Top Elevation	0.00 ft
Datum Elevation	0.00 ft
Orifice Coefficient	0.600
Structure ID: TW	
Structure Type: TW Setup, DS Channel	
Tailwater Type	Free Outfall
Convergence Tolerances	
Maximum Iterations	30
Tailwater Tolerance (Minimum)	0.01 ft
Tailwater Tolerance (Maximum)	0.50 ft
Headwater Tolerance (Minimum)	0.01 ft
Headwater Tolerance (Maximum)	0.50 ft
Flow Tolerance (Minimum)	0.001 ft ³ /s
Flow Tolerance (Maximum)	10.000 ft ³ /s

Kensington Farms - Preliminary Analysis

Subsection: Outlet Input Data

Label: Basin 2 Outfall

Scenario: 1 Year

Return Event: 1 years

Storm Event: 1 Year

Requested Pond Water Surface Elevations

Minimum (Headwater)	967.00 ft
Increment (Headwater)	0.50 ft
Maximum (Headwater)	979.00 ft

Outlet Connectivity

Structure Type	Outlet ID	Direction	Outfall	E1 (ft)	E2 (ft)
Inlet Box	Riser - 1	Forward	Culvert - 1	974.30	979.00
Culvert-Circular	Culvert - 1	Forward	TW	967.00	979.00
Tailwater Settings	Tailwater			(N/A)	(N/A)

Kensington Farms - Preliminary Analysis

Subsection: Outlet Input Data

Label: Basin 2 Outfall

Scenario: 1 Year

Return Event: 1 years

Storm Event: 1 Year

Structure ID: Culvert - 1	
Structure Type: Culvert-Circular	
Number of Barrels	1
Diameter	72.0 in
Length	125.00 ft
Length (Computed Barrel)	125.00 ft
Slope (Computed)	0.008 ft/ft

Outlet Control Data

Manning's n	0.013
Ke	0.200
Kb	0.003
Kr	0.000
Convergence Tolerance	0.00 ft

Inlet Control Data

Equation Form	Form 1
K	0.0045
M	2.0000
C	0.0317
Y	0.6900
T1 ratio (HW/D)	1.091
T2 ratio (HW/D)	1.193
Slope Correction Factor	-0.500

Use unsubmerged inlet control 0 equation below T1 elevation.

Use submerged inlet control 0 equation above T2 elevation

In transition zone between unsubmerged and submerged inlet control, interpolate between flows at T1 & T2...

T1 Elevation	973.55 ft	T1 Flow	242.40 ft ³ /s
T2 Elevation	974.16 ft	T2 Flow	277.03 ft ³ /s

Kensington Farms - Preliminary Analysis

Subsection: Outlet Input Data

Label: Basin 2 Outfall

Scenario: 1 Year

Return Event: 1 years

Storm Event: 1 Year

Structure ID: Riser - 1
Structure Type: Inlet Box

Number of Openings	1
Elevation	974.30 ft
Orifice Area	120.0 ft ²
Orifice Coefficient	0.600
Weir Length	44.00 ft
Weir Coefficient	3.00 (ft ^{0.5})/s
K Reverse	1.000
Manning's n	0.000
Kev, Charged Riser	0.000
Weir Submergence	False
Orifice H to crest	False

Structure ID: TW
Structure Type: TW Setup, DS Channel

Tailwater Type	Free Outfall
----------------	--------------

Convergence Tolerances

Maximum Iterations	30
Tailwater Tolerance (Minimum)	0.01 ft
Tailwater Tolerance (Maximum)	0.50 ft
Headwater Tolerance (Minimum)	0.01 ft
Headwater Tolerance (Maximum)	0.50 ft
Flow Tolerance (Minimum)	0.001 ft ³ /s
Flow Tolerance (Maximum)	10.000 ft ³ /s

Kensington Farms - Preliminary Analysis

Subsection: Outlet Input Data

Label: Basin 3 Outfall

Scenario: 1 Year

Return Event: 1 years

Storm Event: 1 Year

Requested Pond Water Surface Elevations

Minimum (Headwater)	991.00 ft
Increment (Headwater)	0.50 ft
Maximum (Headwater)	996.00 ft

Outlet Connectivity

Structure Type	Outlet ID	Direction	Outfall	E1 (ft)	E2 (ft)
Stand Pipe	Riser - 1	Forward	Culvert - 1	991.00	996.00
Culvert-Circular	Culvert - 1	Forward	TW	0.00	996.00
Rectangular Weir	Weir - 1	Forward	TW	994.00	996.00
Tailwater Settings	Tailwater			(N/A)	(N/A)

Kensington Farms - Preliminary Analysis

Subsection: Outlet Input Data

Label: Basin 3 Outfall

Scenario: 1 Year

Return Event: 1 years

Storm Event: 1 Year

Structure ID: Riser - 1

Structure Type: Stand Pipe

Number of Openings	1
Elevation	991.00 ft
Diameter	24.0 in
Orifice Area	3.1 ft ²
Orifice Coefficient	0.600
Weir Length	6.28 ft
Weir Coefficient	3.00 (ft ^{0.5})/s
K Reverse	1.000
Manning's n	0.000
Kev, Charged Riser	0.000
Weir Submergence	False
Orifice H to crest	False

Kensington Farms - Preliminary Analysis

Subsection: Outlet Input Data

Label: Basin 3 Outfall

Scenario: 1 Year

Return Event: 1 years

Storm Event: 1 Year

Structure ID: Culvert - 1	
Structure Type: Culvert-Circular	
Number of Barrels	1
Diameter	24.0 in
Length	50.00 ft
Length (Computed Barrel)	50.00 ft
Slope (Computed)	0.000 ft/ft

Outlet Control Data

Manning's n	0.013
Ke	0.200
Kb	0.012
Kr	0.000
Convergence Tolerance	0.00 ft

Inlet Control Data

Equation Form	Form 1
K	0.0045
M	2.0000
C	0.0317
Y	0.6900
T1 ratio (HW/D)	1.095
T2 ratio (HW/D)	1.197
Slope Correction Factor	-0.500

Use unsubmerged inlet control 0 equation below T1 elevation.

Use submerged inlet control 0 equation above T2 elevation

In transition zone between unsubmerged and submerged inlet control, interpolate between flows at T1 & T2...

T1 Elevation	2.19 ft	T1 Flow	15.55 ft ³ /s
T2 Elevation	2.39 ft	T2 Flow	17.77 ft ³ /s

Kensington Farms - Preliminary Analysis

Subsection: Outlet Input Data

Label: Basin 3 Outfall

Scenario: 1 Year

Return Event: 1 years

Storm Event: 1 Year

Structure ID: Weir - 1	
Structure Type: Rectangular Weir	
Number of Openings	1
Elevation	994.00 ft
Weir Length	50.00 ft
Weir Coefficient	3.00 (ft ^{0.5})/s
Structure ID: TW	
Structure Type: TW Setup, DS Channel	
Tailwater Type	Free Outfall
Convergence Tolerances	
Maximum Iterations	30
Tailwater Tolerance (Minimum)	0.01 ft
Tailwater Tolerance (Maximum)	0.50 ft
Headwater Tolerance (Minimum)	0.01 ft
Headwater Tolerance (Maximum)	0.50 ft
Flow Tolerance (Minimum)	0.001 ft ³ /s
Flow Tolerance (Maximum)	10.000 ft ³ /s

Kensington Farms - Preliminary Analysis

Subsection: Outlet Input Data

Label: Basin A Outfall

Scenario: 1 Year

Return Event: 1 years

Storm Event: 1 Year

Requested Pond Water Surface Elevations

Minimum (Headwater)	991.00 ft
Increment (Headwater)	0.50 ft
Maximum (Headwater)	994.00 ft

Outlet Connectivity

Structure Type	Outlet ID	Direction	Outfall	E1 (ft)	E2 (ft)
Inlet Box	Riser - 1	Forward	Culvert - 1	992.00	994.00
Orifice-Circular	Orifice - 1	Forward	Culvert - 1	991.00	994.00
Culvert-Circular	Culvert - 1	Forward	TW	990.00	994.00
Tailwater Settings	Tailwater			(N/A)	(N/A)

Kensington Farms - Preliminary Analysis

Subsection: Outlet Input Data

Label: Basin A Outfall

Scenario: 1 Year

Return Event: 1 years

Storm Event: 1 Year

Structure ID: Riser - 1

Structure Type: Inlet Box

Number of Openings	1
Elevation	992.00 ft
Orifice Area	36.0 ft ²
Orifice Coefficient	0.600
Weir Length	24.00 ft
Weir Coefficient	3.00 (ft ^{0.5})/s
K Reverse	1.000
Manning's n	0.000
Kev, Charged Riser	0.000
Weir Submergence	False
Orifice H to crest	False

Kensington Farms - Preliminary Analysis

Subsection: Outlet Input Data

Label: Basin A Outfall

Scenario: 1 Year

Return Event: 1 years

Storm Event: 1 Year

Structure ID: Culvert - 1	
Structure Type: Culvert-Circular	
Number of Barrels	1
Diameter	36.0 in
Length	221.00 ft
Length (Computed Barrel)	221.01 ft
Slope (Computed)	0.011 ft/ft

Outlet Control Data

Manning's n	0.013
Ke	0.200
Kb	0.007
Kr	0.000
Convergence Tolerance	0.00 ft

Inlet Control Data

Equation Form	Form 1
K	0.0045
M	2.0000
C	0.0317
Y	0.6900
T1 ratio (HW/D)	1.090
T2 ratio (HW/D)	1.192
Slope Correction Factor	-0.500

Use unsubmerged inlet control 0 equation below T1 elevation.

Use submerged inlet control 0 equation above T2 elevation

In transition zone between unsubmerged and submerged inlet control, interpolate between flows at T1 & T2...

T1 Elevation	993.27 ft	T1 Flow	42.85 ft ³ /s
T2 Elevation	993.57 ft	T2 Flow	48.97 ft ³ /s

Kensington Farms - Preliminary Analysis

Subsection: Outlet Input Data

Label: Basin A Outfall

Scenario: 1 Year

Return Event: 1 years

Storm Event: 1 Year

Structure ID: Orifice - 1	
Structure Type: Orifice-Circular	
Number of Openings	1
Elevation	991.00 ft
Orifice Diameter	4.0 in
Orifice Coefficient	0.600
Structure ID: TW	
Structure Type: TW Setup, DS Channel	
Tailwater Type	Free Outfall
Convergence Tolerances	
Maximum Iterations	30
Tailwater Tolerance (Minimum)	0.01 ft
Tailwater Tolerance (Maximum)	0.50 ft
Headwater Tolerance (Minimum)	0.01 ft
Headwater Tolerance (Maximum)	0.50 ft
Flow Tolerance (Minimum)	0.001 ft ³ /s
Flow Tolerance (Maximum)	10.000 ft ³ /s

Kensington Farms - Preliminary Analysis

Index

B

Basin 1 Outfall (Outlet Input Data, 1 years (1 Year))...5, 6, 7, 8

Basin 2 Outfall (Outlet Input Data, 1 years (1 Year))...9, 10, 11

Basin 3 Outfall (Outlet Input Data, 1 years (1 Year))...12, 13, 14, 15

Basin A Outfall (Outlet Input Data, 1 years (1 Year))...16, 17, 18, 19

M

Master Network Summary...2, 3, 4

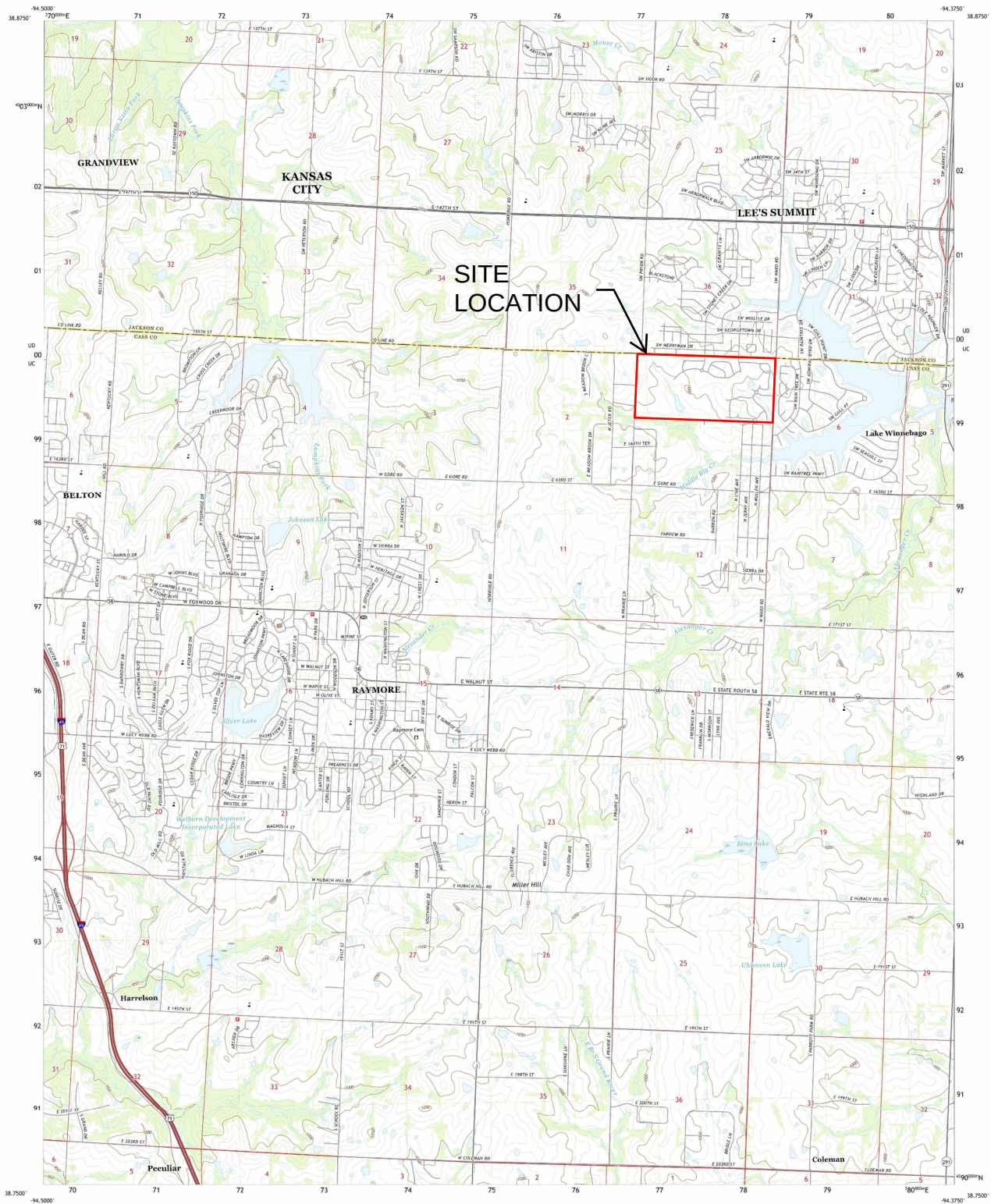
APPENDIX A-4 DRAINAGE MAPS



U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

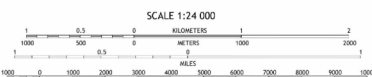
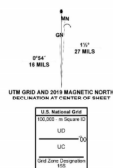


RAYMORE QUADRANGLE
MISSOURI
7.5-MINUTE SERIES



Produced by the United States Geological Survey
North American Datum of 1983 (NAD83)
World Geodetic System of 1984 (WGS84). Projection and
1 800-meter grid/Universal Transverse Mercator, Zone 19S
This map is not a legal document. Boundaries may be
generalized for this map scale. Private lands within government
jurisdiction may not be shown. Obtain permission before
entering private lands.

Image	Source	Year
Roads	U.S. Census Bureau	2010
Boundaries	U.S. Census Bureau	2010
Hydrography	National Hydrography Dataset	2010
Contours	National Elevation Dataset	2010
Boundaries	Multiple sources; see metadata file	2010
Public Land Survey System	BLM	2010
Wetlands	NWS National Wetlands Inventory	Not Available



1	2	3
4	5	6
7	8	9

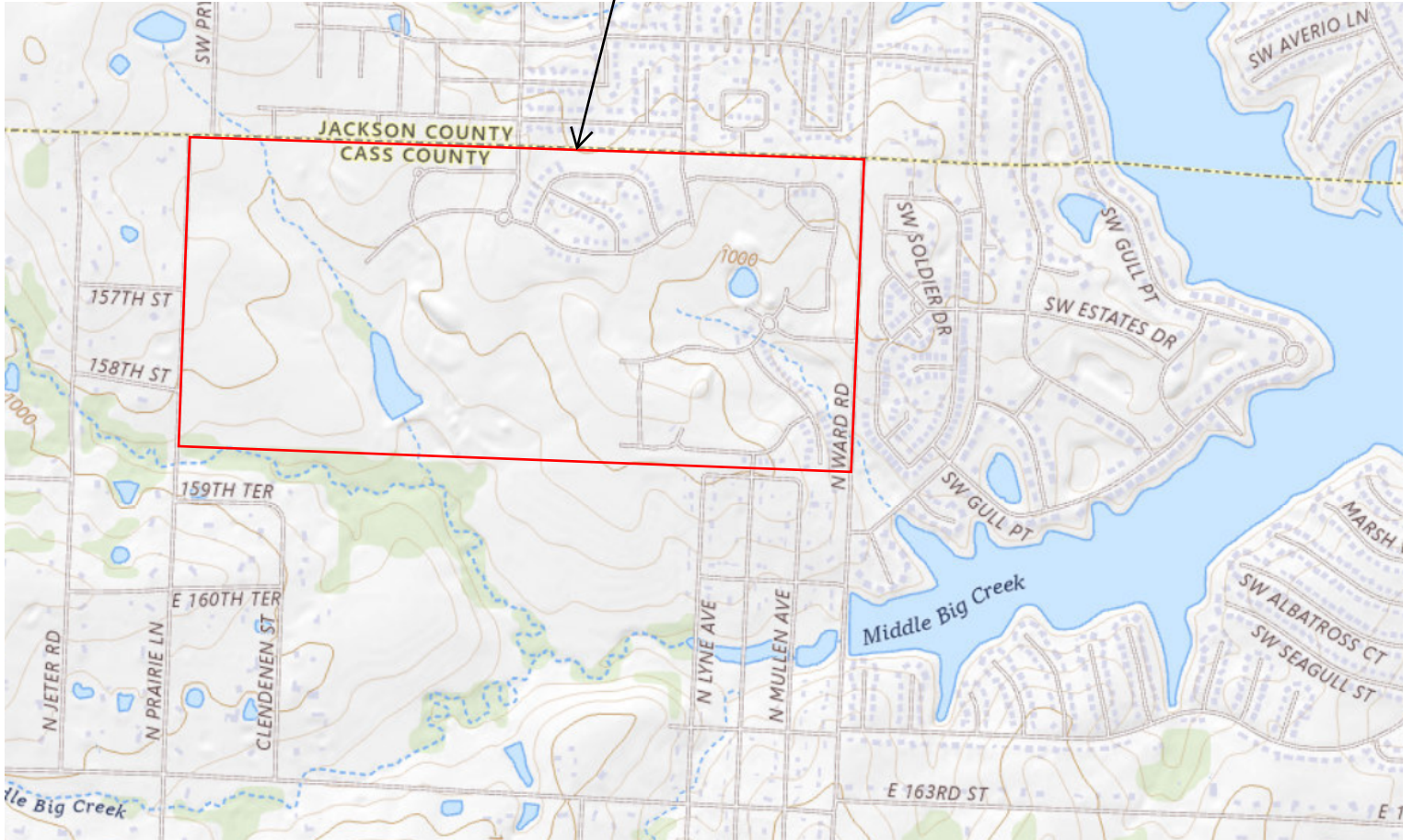
ADJACENT QUADRANGLES



RAYMORE, MO
2021



SITE LOCATION



NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The community map repository should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations (BFEs)** and/or **Floodway** data have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) Report that accompanies the FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS Report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study Report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study Report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Missouri State Plane West Zone (FIPS zone 2403). The **horizontal datum** was NAD 83, GRS 1980 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at <http://www.ngs.noaa.gov> or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, NIMS12
National Geodetic Survey
SIOC-3 #0203
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at (301) 713-3242, or visit its website at <http://www.ngs.noaa.gov>.

Base map information shown on this FIRM was derived from the U.S.D.A. Farm Service National Agriculture Imagery Program (NAIP) dated 2014. Produced at scale of 1:24,000.

The **profile baselines** depicted on this map represent the hydraulic modeling baselines that match the flood profiles in the FIS report. As a result of improved topographic data, the **profile baselines** in some cases may deviate significantly from the channel centerline or appear outside the SFHA.

Based on updated topographic information, this map reflects more detailed and up-to-date stream channel configurations and floodplain delineations than those shown on the previous FIRM for this jurisdiction. As a result, the Flood Profiles and Floodway Data tables for multiple streams in the Flood Insurance Study Report (which contain authoritative hydraulic data) may reflect stream channel changes that differ from what is shown on the map. Also, the road to floodplain relationships for unreviewed streams may differ from what is shown on previous maps.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

For information on available products associated with this FIRM visit the **Map Service Center (MSC)** website at <http://nfm.fema.gov>. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the MSC website.

2810000 FT

JOINS PANEL 0418

2815000 FT

2820000 FT

JOINS PANEL 0419

94° 22' 30"

THIS AREA SHOWN AT A
SCALE OF 1" = 500'
ON MAP NUMBER
29095C0531

THIS AREA SHOWN AT A
SCALE OF 1" = 500'
ON MAP NUMBER
29095C0532

JOINS PANEL 0530

975000 FT

970000 FT

965000 FT

36° 46' 45"

94° 22' 15"

12° 00' 00" E

12° 00' 00" E

12° 00' 00" E

12° 00' 00" E

12° 00' 00" E

94° 22' 30"

LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD.
The 1% annual chance flood (100-year flood), also known as the **base flood**, is the flood that has a 1% chance of being equaled or exceeded in any given year. Areas of Special Flood Hazard include Zone A, AE, AH, AO, AR, V, and VE. The **Base Flood Elevation** is the water-surface elevation of the 1% annual chance flood.

- ZONE A** No Base Flood Elevations determined.
- ZONE AE** Base Flood Elevations determined.
- ZONE AH** Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
- ZONE AO** Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined; for areas of sheet flow flooding, velocities also determined.
- ZONE AR** Special Flood Hazard Areas formerly protected from the 1% annual chance flood by a flood control system that was subsequently derelict. Zone AR indicates that the former flood control system is being retained to provide protection from the 1% annual chance or greater flood.
- ZONE ARS** Area to be protected from the 1% annual chance flood by a federal flood protection system under construction; no Base Flood Elevations determined.
- ZONE V** Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
- ZONE VE** Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE
The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas subject to flooding from the 1% annual chance flood.

OTHER AREAS

ZONE D Areas determined to be outside the 0.2% annual chance floodplain.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

1% Annual Chance Floodplain Boundary

0.2% Annual Chance Floodplain Boundary

Floodway boundary

Zone D boundary

CBRS and OPA boundary

Boundary defining Special Flood Hazard Area zones and boundary

including Special Flood Hazard Areas of different Base Flood Elevations, flood depths, or flood velocities

Base Flood Elevation line and value; inundation in feet*

Base Flood Elevation value where uniform within zone; elevation in feet*

*Referenced to the North American Vertical Datum of 1988

Cross section line

Traverse line

Curved

Bridge

45° 12' 00" 92° 02' 12"

3100000 FT

5000-foot scale Missouri State Plane West Zone

(FIPS Zone 4803). Transverse Mercator projection

Bench mark (see explanation in Notes to Users section of this FISRN panel)

0.15

River Mile

MAP REPOSITORIES

Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP

September 29, 2004

EFFECTIVE DATES OF REVISIONS TO THIS PANEL

January 20, 2017 - No change Special Flood Hazard Areas.

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-438-6620.

MAP SCALE 1" = 1000'

600 0 1000 2000 FEET

300 0 300 600 METERS

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0535G

FIRM

FLOOD INSURANCE RATE MAP

JACKSON COUNTY, MISSOURI, AND INCORPORATED AREAS

PANEL 535 OF 625
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
JACKSON CITY	29073	0508	0
CITY OF LEBAN	29074	0508	0

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
29095C0535G
MAP REVISED
JANUARY 20, 2017
Federal Emergency Management Agency

APPENDIX A-5 CALCULATIONS

DA-1A	SF	AC	CN
TOTAL AREA:	536708	12.32	89.7
WATER TOWER PAD	51304	1.18	98
POND			98
STREET:	80892	1.86	98
DUPLEX:	404512	9.29	87

DA-1A	SF	AC	CN
TOTAL AREA:	3733612.8	85.71	88.6
STREET:	537320	12.34	98
DUPLEX / MULTI-FAMILY:	3196089.5	73.37	87

DA-2A	SF	AC	CN
TOTAL AREA:	327722	7.52	87.8
STREET:	24884	0.57	98
1/4 AC RESIDENTIAL:	302838	6.95	87

DA-2B	SF	AC	CN
TOTAL AREA:	529213	12.15	88.0
STREET:	46710	1.07	98
1/4 AC RESIDENTIAL:	482503	11.08	87

DA-2C	SF	AC	CN
TOTAL AREA:	177668.98	4.08	87.0
1/4 AC RESID.	177669	4.08	87

DA-3A	SF	AC	CN
TOTAL AREA:	231787	5.32	88.6
STREET:	32694	0.75	98
1/4 AC RESIDENTIAL:	199093	4.57	87

APPENDIX A-6
FINAL KENSINGTON FARMS STORM WATER
REPORT BY ARCHER ENGINEERS
(DATED NOVEMBER 18, 2005)

Archer

Total Project Management

FINAL KENSINGTON FARMS STORM WATER REPORT

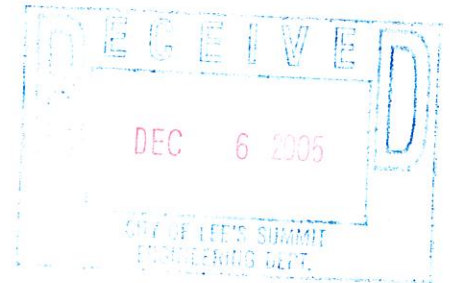
DEVELOPER:
PULTE HOMES

Lee's Summit, Missouri

EN-2005-065⁴⁷

NOVEMBER 18, 2005

ETA PROJECT NO. 24130803



**FINAL KENSINGTON FARMS
STORM WATER REPORT**

**DEVELOPER:
PULTE HOMES**

Lee's Summit, Missouri

NOVEMBER 18, 2005

ETA PROJECT NO. 24130803

TITLE PAGE

**STORM WATER
REPORT**

KENSINGTON FARMS

CONSULTANT:

ARCHER ENGINEERS

3741 NE TROON

LEE'S SUMMIT, MO 64064

816-554-3019 FAX: 816-554-3061

CONTACT: Ray Smalling

rsmalling@archerengineers.com

DEVELOPER:

PULTE HOMES

15700 COLLEGE BLVD SUITE 201

LENEXA, KS 66219

913-307-4515

913-307-4598

NOVENBER 18, 2005

ETA PROJECT NO. 24130803

KENSINGTON FARMS
CASS COUNTY, MISSOURI

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II.	WATERSHED DESCRIPTION.....	2
III.	PRE-DEVELOPMENT	2
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V.	DETENTION BASINS.....	4
VI.	FLOODPLAIN INTRODUCTION.....	6
VII.	FLOODPLAIN ANALYSIS.....	6
VIII.	SUMMARY	8

Figure 1, Existing Site Map

Figure 2, Plat Map

Figure 3, Pre-Development Drainage Map

Figure 4, Soil Map

Figure 5, Post-Development Drainage Map

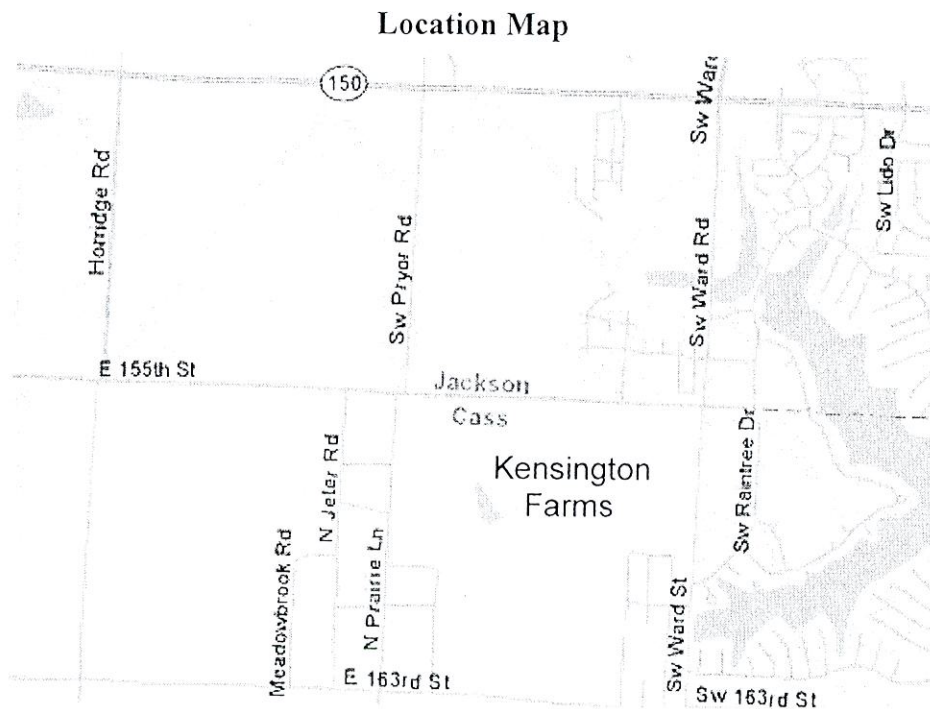
Figure 6, Middle Big Creek Plan View of Cross Sections

APPENDIX A	PRE-DEVELOPMENT TR-55 & HEC-HMS DATA
APPENDIX B	POST-DEVELOPMENT TR-55 & HEC-HMS DATA
APPENDIX C.	DETENTION BASIN DATA STAGE-STORAGE TABLES OUTLET RATING TABLES OUTLET STRUCTURE SKETCHES
APPENDIX D	FLOODPLAIN DATA FEMA FLOODPLAIN MAP HEC-RAS RESULTS HEC-1 RESULTS HY8 RESULTS

**KENSINGTON FARMS
PROJECT NO. 24130803**

INTRODUCTION

Pulte Homes employed the services of Archer Engineers to evaluate and recommend a storm water management plan for the project site called Kensington Farms in Lee's Summit, Missouri. Kensington Farms is located south of 155th Street-County Line Road and between Ward and Prairie Lane Roads. The development is approximately 320 acres and is in the north half of Section 1, Township 46, Range 32 of Cass County. See the attached Figure 1.



The proposed development is comprised of 735 single-family residential units, an elementary school site, emergency service site, water tower, sanitary excess flow holding basin site, green space, and public park. See attached Figure 2.

Pre-development and post-development runoff, including detention analysis, was analyzed using US Army Corps of Engineers Hydrologic Modeling System (HEC-HMS). Soil Conservation Service (SCS) Urban Hydrology for Small Watersheds, Technical Release 55 (TR-55) was used to derive the curve number and time of concentration. The post-development hydrographs for the 2-year, 10-year, and 100-year, 24-hour storm were routed through the proposed detention basins to ensure there was adequate detention in the sub-basins.

WATERSHED DESCRIPTION

The Kensington Farms development is divided into 4 major drainage areas – the southwestern (A-1A), western (A-3A), eastern (A-6) and northeastern regions (A-5). The drainage areas were based on USGS topography and are outlined in Figure 3. Drainage area A-1A contains approximately 22 acres, drainage area A-3A contains approximately 199 acres that drains south, and drainage area A-6 consists of approximately 103 acres that drains southeast. Each of these drainage areas is a tributary to Middle Big Creek and the south leg of Raintree Lake. Drainage area A-5 comprises approximately 20 acres, which drains north into the northern branch of Raintree Lake.

Land use and soil type, which were used to determine the SCS curve number, were obtained from the aerial photographs, field inspection and SCS "Soil Survey of Cass County, Missouri." From this, it was determined that the area consisted of gently rolling, agricultural land composed of poorly drained soil ranging from silt loam on the ridges to silty clay loam along the drainage ways. Permeability and surface runoff for such soils range from moderate permeability moderately slow surface runoff along the ridgelines to slow permeability, medium runoff along the drainage ways. See Figure 4 for a detailed drawing of the hydrologic soil groups in the watershed.

There is a 100-year floodplain within drainage area A-3A designated Zone "A"; however, the Federal Emergency Management Agency (FEMA) has not performed a study to determine the 100-year floodplain elevation within the boundary of the development. The storm water summary will address the floodplain elevation in this report. See Appendix D for a copy of the FEMA Map.

PRE-DEVELOPMENT

Pre-development analysis includes 4 on-site watersheds and 6 off-site watersheds, as shown on Figure 3. The pre-development discharge for the 2-year, 10-year and 100-year, 24-hour storms for the development can be found in Table A.

Table A: Pre-Development Runoff

Watershed	Area (acre)	SCS Curve Number	Time of Concentration (min)	Peak Runoff (cfs)			Volume of Runoff (ac-ft)		
				2-Year	10-Year	100-Year	2-Year	10-Year	100-Year
A-1	476.5	68	55.2	240.7	604.3	1171.6	38.1	86.1	161.5
A-1A	22.1	76	20.4	35.5	71.9	124.3	2.7	5.3	9.2
A-2	623.5	71	73.8	314.2	727.1	1352.7	58.6	125.9	228.9
A-3	89.3	65	45.6	64.0	147.4	273.5	8.4	18.0	32.8
A-3A	168.6	79	48.6	180.9	353.4	596.2	23.1	44.2	74.8
A-3B	134.5	77	25.8	198.7	397.8	681.9	16.9	33.2	57.1
A-4	149.3	75	31.8	174.1	364.4	639.6	17.1	34.6	60.5
A-5	20.7	77	20.4	34.9	69.5	118.7	2.6	5.1	6.5
A-6	103.6	78	21.6	177.6	348.8	589.4	13.6	26.4	44.9
A-6A	465.5	77	27.0	668.5	1342.0	2299.3	58.4	114.9	197.5

POST-DEVELOPMENT

For the post-development condition, detention was added to A-3A, A-6 and A-5 to reduce discharge to the allowable release rates as per American Public Works Association (APWA) Standards Section 5600. For the post-development HEC-HMS model all off-site areas were kept in pre-development conditions. All time of concentrations for on-site areas were set to 15 minutes except area A-5B, which is 10 minutes. A post-development drainage area map is provided as Figure 5. In Appendix B TR-55 and HEC-HMS data can be found.

To analyze watershed A-3A in post-developed conditions the watershed was broken down into 3 separate watersheds (A-3A1, A-3A2, and A-3A3). Watershed A-3A1 is approximately 112 acres. Watershed A-3A2 is approximately 15 acres. Watershed A-3A3 is approximately 41 acres. More detailed information on the watersheds can be found in Appendix B. For modeling purposes watersheds A-3A1 and A-3A3 were combined into one watershed, flowing into the proposed detention basin. To control the peak runoffs in watershed A-3A there is an existing basin, Basin #1, that will be modified to provide the required detention. Since, watershed A-3A2 will be free releasing off-site, the proposed detention basin will be oversized to provide more detention. Over-detaining watersheds A-3A1 and A-3A3 will allow the free release of watershed A-3A2 to peak before the detention basin peaks netting a peak off-site flow below or equal to the allowable release rates. Table D compares peak off-site flows for pre-developed and post-developed conditions.

The A-6 watershed was broken down into 2 watersheds for post-development analysis (A-6B and A-6C). Watershed A-6B is approximately 85 acres. Watershed A-6C is approximately 18 acres. In the A-6B watershed, near the mid-point of the property along Ward Rd., Basin #2 will be constructed with the volume required to attenuate post-development flow to pre-development levels. In the A-6C watershed the existing pond, Basin #3, will be modified for detention use. As in watershed A-3A, over-detaining will be used in watershed A-6C. By over-detaining at the modified pond the release rates will be limited to allow the detention basin downstream to release at or equal to allowable release rates. Table D compares peak off-site flows for pre-developed and post-developed conditions.

For post-development analysis watershed A-5 was broken down into 2 watersheds (A-5A and A-5B). Watershed A-5A is 14.2 acres and A-5B is 6.5 acres. In watershed A-5 Basin #4 will be constructed south of County Line Road located approximately 200 ft south of County Line Road. This detention basin will over-detain the A-5A watershed to allow the A-5B watershed to peak before the detention basin peaks. With A-5B peaking before the detention basin the net peak off-site flow will be below or equal to the allowable release rates.

The post-development discharge and volume of runoff for the 2-year, 10-year and 100-year, 24-hour storms for the development can be found in Table B. Also included in

Table B is the watershed area, curve number, and time of concentration. The HEC-HMS model output for these storms is located in Appendix B.

Table B: Post-Development Runoff

Watershed	Area (acre)	SCS Curve Number	Time of Concentration (min)	Peak Runoff (cfs)			Volume of Runoff (ac-ft)		
				2-Year	10-Year	100-Year	2-Year	10-Year	100-Year
A-1	476.5	68	55.2	240.7	604.3	1171.6	38.1	86.1	161.5
A-1A	22.1	80	15.0	49.3	92.9	153.3	3.2	6.0	10.0
A-2	623.5	71	73.8	314.2	727.1	1352.7	58.6	125.9	228.9
A-3	89.3	65	45.6	64.0	147.4	273.5	8.4	18.0	32.8
A-3A1	112.3	85	15.0	417.6	731.0	1151.3	26.8	47.6	76.7
A-3A2	15.3	88	15.0	46.3	77.7	119.3	3.0	5.1	8.1
*A-3A3	41.0	85	15.0	-	-	-	-	-	-
A-3B	134.5	77	25.8	198.7	397.8	681.9	16.9	33.2	57.1
A-4	149.3	75	31.8	174.1	364.4	639.6	17.1	34.6	60.5
A-5A	14.2	85	15.0	38.7	67.7	106.6	2.5	4.4	7.1
A-5B	6.5	88	10.0	22.2	37.3	57.1	1.3	2.2	3.5
A-6A	465.5	77	27.0	668.5	1342.0	2299.3	58.4	114.9	197.5
A-6B	85.5	87	15.0	250.3	426.0	659.5	16.2	28.1	44.6
A-6C	18.2	85	15.0	47.7	84.7	134.6	3.1	5.5	9.0

* For modeling purposes A-3A3 was combined with A-3A1.

DETENTION BASINS

The development will include the use of 4 detention basins. The 4 basins will be used to keep off-site flows at or below pre-developed flows for the 2-year, 10-year, and 100-year storm events.

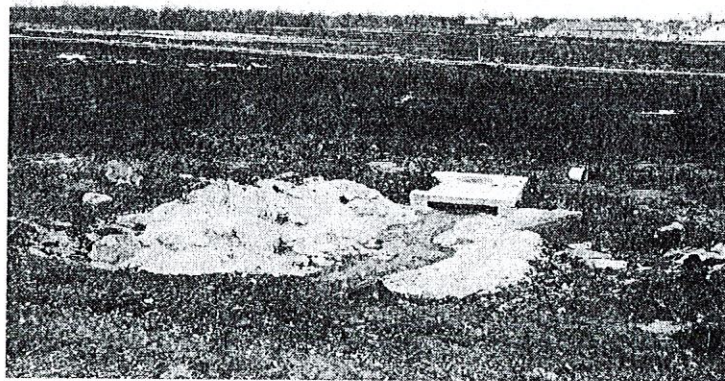
Basin #1 is located in the western portion of the development. The basin will collect runoff from A-3A1 and A-3A3 watersheds. In combination with this basin, watershed A-3A2 will free release and the detention basin must be oversized to meet pre-development flows. The detention basin will have an outflow elevation at 972.00 and a top of dam elevation 987.00. The emergency spillway is located at elevation 984.20 and has a length of 170 ft. The outlet structure to control the 2-year flows will consist of a 3'x3' orifice. For the 10-year flow a combination of the 3'x3' orifice and 30 ft long weir will be used to control the release rate. The 100-year flow will be controlled with two 60" Ultra-Flo pipes. See Appendix C for a sketch of the described outlet structure. Table C gives a summary of results for Basin #1.

Basin #2 and #3 are located in the eastern portion of the development. Basin #2 collects runoff from watersheds A-6B and A-6C. In watershed A-6C is Basin #3, which will work in combination with Basin #2. Basin #3 will be a wet basin, with a constant water surface elevation at 991.00. The basin will have a top of dam elevation of 996.00. The emergency spillway is located at elevation 994.00, with a length of 50 ft. All storm event flows will be controlled with a 24" stand pipe at elevation 991.00. Basin #2 is a

dry detention basin with an outflow at elevation 967.00 and a top of dam elevation at 979.00. The emergency spillway is located at elevation 976.65, with a length of 150 ft. The 2-year flow will be controlled by a 5'x4' orifice. For the 10-year flow a combination of the 5'x4' orifice and a 44 ft long weir will be used to control the release rate. The 100-year flow will be controlled by a 72" Ultra-Flo pipe. See Appendix C for a sketch of the described outlet structure. Table C gives a summary of results for Basin #2 and #3.

Basin #4 is located in the northern portion of the development. The basin will be releasing to the 6th plat of Stoney Creek where a field inlet (See Figure A) will be used to collect the enclosed pipe flow from Kensington Farms and pipe it downstream. The field inlet was designed to capture a maximum flow of 70 cfs. However, calculations showed that the 100-year pre-development flow was greater than 70 cfs used to design the field inlet. Due to these results basin #4 was oversized to reduce the 100-year release rate to 70 cfs. The outflow elevation of the basin will be 998.00 and top of dam elevation will be 1006.50. All release rates will be controlled with an 18" orifice. The emergency spillway will be controlled with a 6'x6' field inlet with 4 sides open and 1 ft windows. See Appendix C for a sketch of the described outlet structure. Table C gives a summary of results for Basin #4.

Figure A: Stoney Creek 6th Plat - Field Inlet



Located north of County Line Road

Table C lists the inflow, outflow, elevation, and volume of each detention basin.

Table C: Detention Basin Summary

		Basin #1	Basin #2	Basin #3	Basin #4
Inflow (cfs)	2-year	426.87	259.92	47.70	38.67
	10-year	770.11	439.87	84.73	67.69
	100-year	1245.30	677.86	134.64	106.60
Outflow (cfs)	2-year	100.70	157.44	13.03	12.67
	10-year	421.58	208.37	18.40	16.21
	100-year	594.06	357.08	24.14	19.63
Elevation	2-year	978.43	971.50	991.70	1000.80
	10-year	980.52	973.39	992.39	1002.10
	100-year	983.75	975.34	993.39	1003.70
Volume (ac-ft)	2-year	10.42	2.76	0.96	0.77
	10-year	15.85	6.08	1.96	1.52
	100-year	25.16	10.30	3.45	2.65

Table D below lists the pre-development, allowable release rates, and post-development flows at points of location where runoff leaves the site.

Table D: Off-site Discharge

Watershed	Pre-Development Runoff (cfs)			Post-Development (cfs)			Location
	2-Year	10-Year	100-Year	2-Year	10-Year	100-Year	
A-3 & A-3A	211.1	456.7	813.44	127.1	458.3	662.9	At Southern Property Line
A-5	34.9	69.5	118.7	32.6	49.5	71.8	At County Line Road
A-6	177.6	348.8	589.4	157.4	208.4	357.1	At Ward Road

FLOODPLAIN INTRODUCTION

Middle Big Creek flows generally southeast, then east to drain into Raintree Lake after crossing under Mullen Road and Ward Road. FEMA has designated this portion of the creek as Zone "A" floodplain. Although Zone "A" denotes a 100-year floodplain, no base flood elevations are determined by FEMA for the creek. Consequently, a water surface profile for that part of Middle Big Creek impacting the proposed Kensington Farms development was estimated using a HEC-RAS analysis for the 100-year event. This analysis extended from Raintree Lake in the east to the proposed west detention basin in Kensington Farm (see Figure 6).

FLOODPLAIN ANALYSIS

In order to establish a 100-year starting water surface elevation downstream in Raintree Lake, the MDNR Dam and Safety Program was contacted (573-368-2175) and the HEC-1 model (stage-storage-discharge, tributary area, etc) obtained for this lake. With the HEC-1 model, a 100-year event water surface elevation was calculated and found to be 963.35. This HEC-1 model is included in Appendix D.

Once the water surface elevation was established for Raintree Lake, a HY-8 analysis was conducted for the culvert under Ward Road (See Figure B), using the 963.35 as a

tailwater elevation. This analysis in turn yielded a headwater surface elevation of 963.96. Proceeding just upstream to the bridge under Mullen Road (See Figure C), another HY-8 analysis was conducted. This analysis for the bridge under Mullen Road used the 963.96 as a tailwater elevation, and this analysis in turn yielded a headwater surface elevation of 964.00 west of Mullen Road. The water surface profile west of Mullen Road to Section 1, see Figure 6, was assumed to be level for the 100-year event as this is indicated by the topographic survey data. The HY-8 model results for the Ward Road and Mullen Road culverts are included in Appendix D.

Figure B: Culvert Under Ward Road

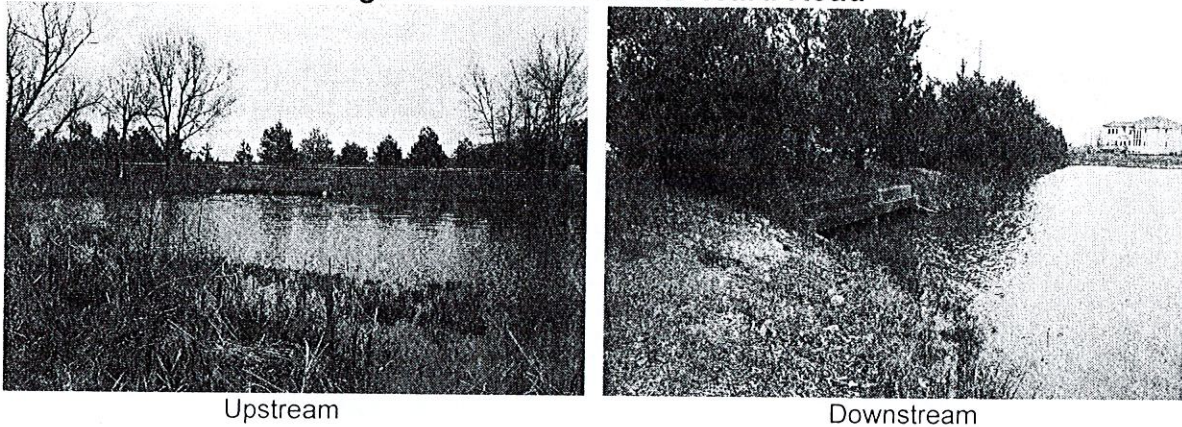
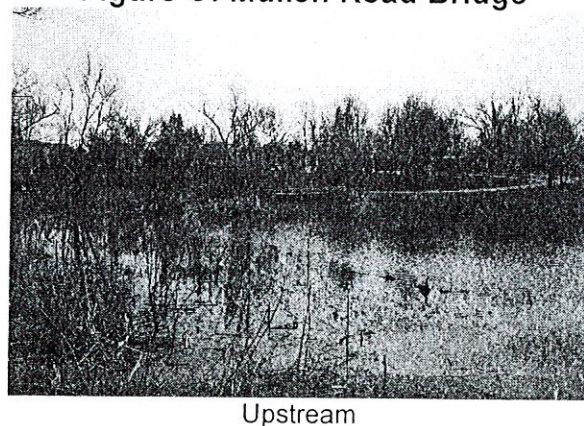


Figure C: Mullen Road Bridge



Note: Water level is at the bottom of Bridge Girders

This water surface elevation of 964.00 was used as the downstream boundary condition at Section 1 for establishing the upstream water surface profile of Middle Big Creek. This water surface profile was calculated upstream onto the proposed Kensington Farm development site to establish the 100-year flood plain elevation. At Section 9 this proposed 100-year base flood elevation is 976.46 and at Section 8 is 976.29. Flows used for this profile were established using a HEC-HMS model of the Middle Big Creek watershed, assuming full development of the Kensington Farm site (including detention basins). Appendix D contains the HEC-RAS water surface profile results for Middle Big Creek.

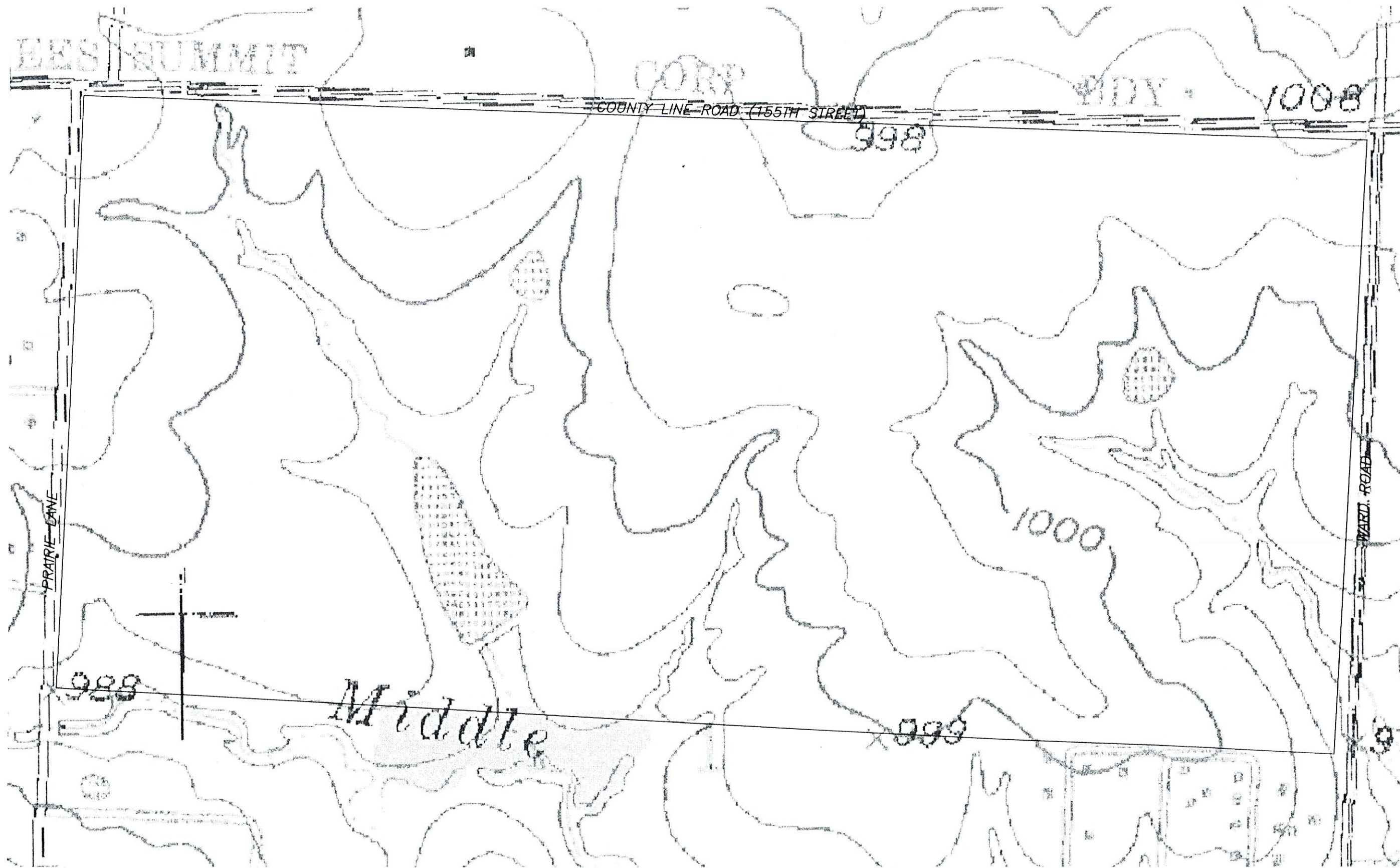
As can be seen in Figure 6, the floodplain water surface profile terminates at the north end just downstream of the proposed west detention basin dam (at Section 9 in Figure 6). This west detention basin is in the same location as an existing farm pond, and will employ the same dam structure with modifications. As noted earlier, the 100-year flood plain elevation at the toe of this dam (at Section 9) is 976.46, while the top of the dam is at elevation 987.00. This elevation difference of 10.5-ft at the existing dam causes an abrupt vertical break or interruption in the flowline of Middle Big Creek. Downstream of this dam, open channel flow occurs. Upstream of this dam (especially when modified), ponding and detention of the flow occurs. Consequently, this existing dam is considered to be the northern limit of Middle Big Creek's FEMA Zone "A" floodplain for post-developed conditions.

SUMMARY

Kensington Farms is located west of Raintree Lake, south of County Line Road and between Ward and Prairie Lane Roads. The development is approximately 320 acres and is in the north half of Section 1, Township 46, Range 32 of Cass County. The development was divided into 4 major drainage areas for pre-development runoff calculations. These 4 drainage areas were then sub-divided to determine post-development runoffs and size detention basins.

The project will include the use of 4 detention basins to control runoff to meet off-site release rates set forth by Section 5600 of APWA as adopted by the City of Lee's Summit. The use of multi-staged outlet structures will be used to meet release rates, as well as, one-stage outlet structures. Basin #1 was oversized to allow 40 acres (A-3A2) of free release to peak before Basin #1 peaks, netting a peak off-site flow less than or equal to allowable release rates. Basin #4 was oversized to meet downstream constraints in the 6th plat of Stoney Creek.

Also, from FEMA floodplain maps (See Appendix D) it showed Zone "A" encroaching onto the development. HEC-RAS was used to analyze Middle Big Creek to find 100-year base flood elevation. At Section 9 this base flood elevation is 976.46 and at Section 8 is 976.29. With these results, lots abutting Middle Big Creek can have minimum basement opening elevations (MBOE) set above the calculated 100-year base flood elevation.

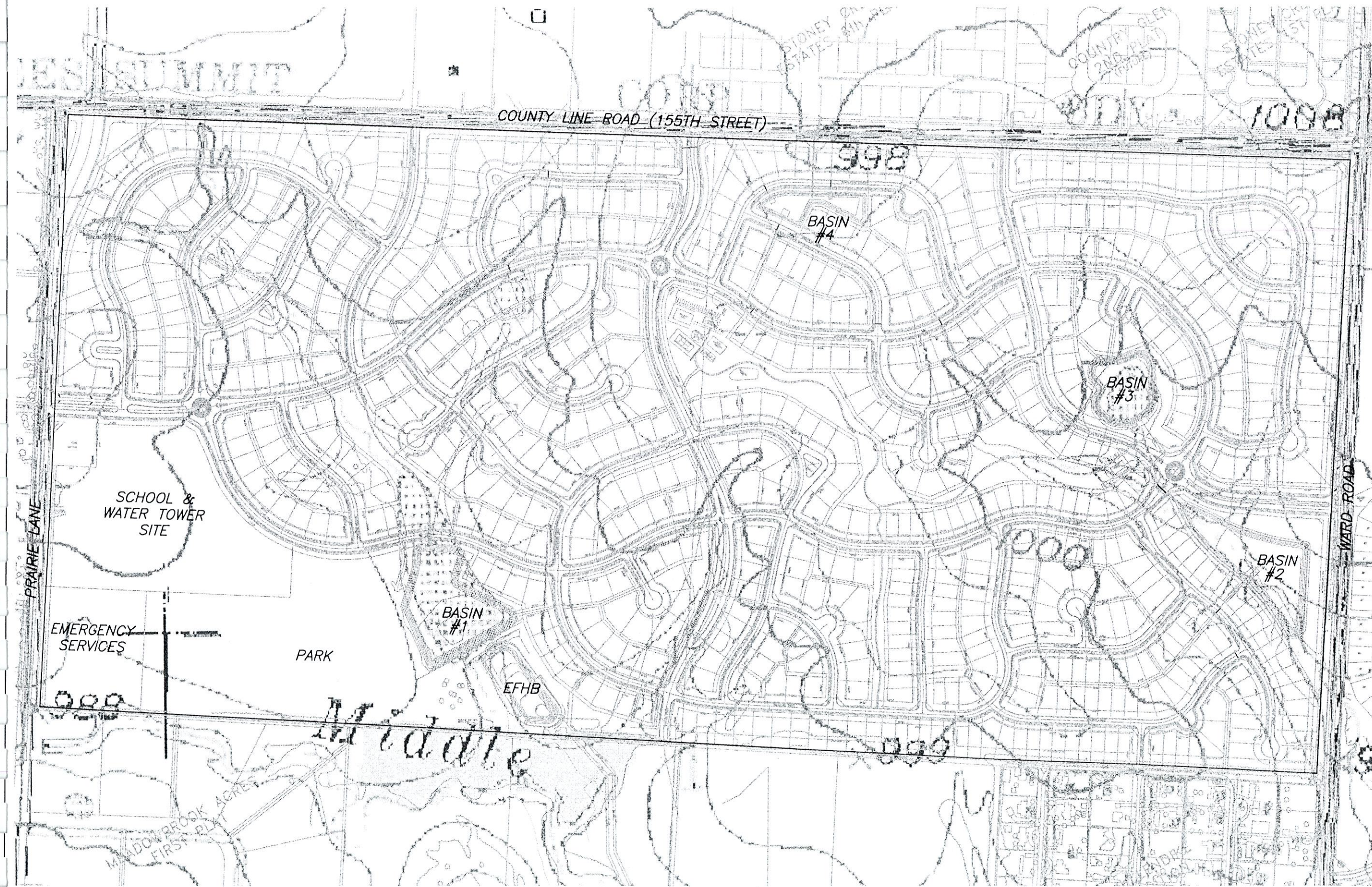


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PULTE HOMES KENSINGTON FARMS LEE'S SUMMIT, MISSOURI		PROJECT NO. 24130803
EXISTING SITE MAP		DRAWING NO. FIG. 1



- LEGEND**
- BASIN #1 - PROPOSED DETENTION BASIN
- EFHB - EXCESS FLOW HOLDING BASIN

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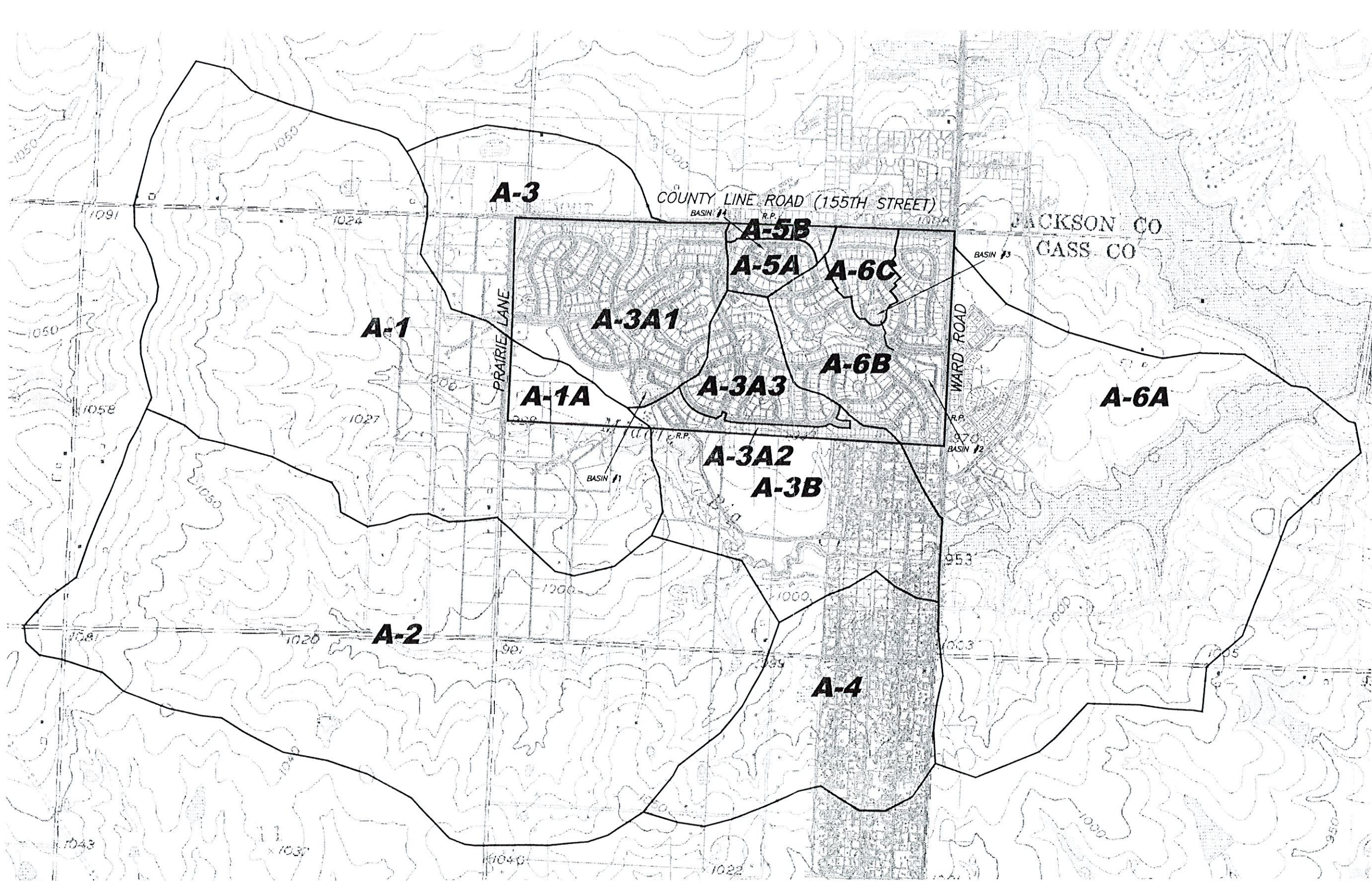
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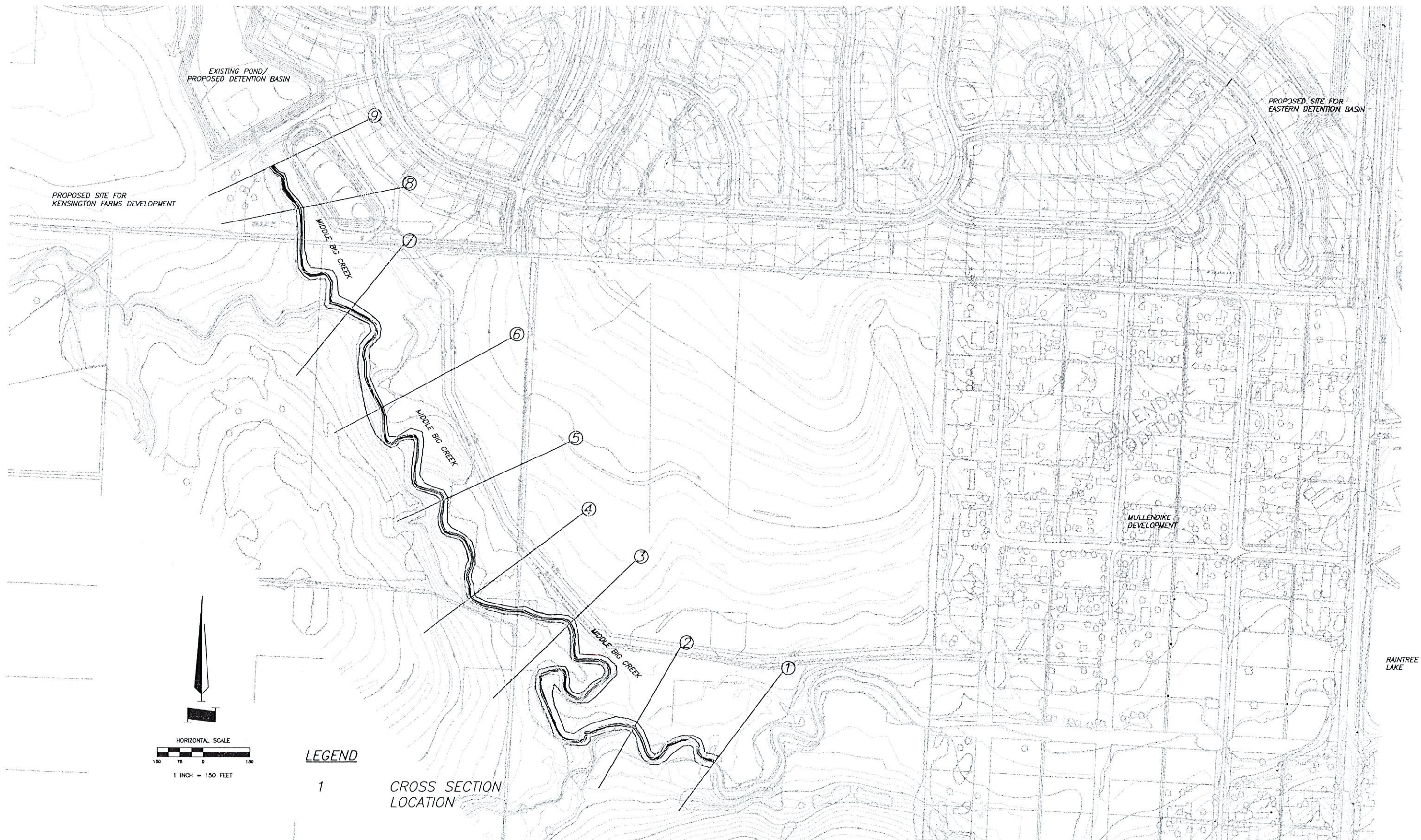
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- DRAINAGE DIVIDE
 - A-1 DRAINAGE AREA
 - R.P. RELEASE POINT

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PULTE HOMES KENSINGTON FARMS LEE'S SUMMIT, MISSOURI		PROJECT NO. 24130803
POST-DEVELOPMENT DRAINAGE MAP		DRAWING NO. FIG. 5

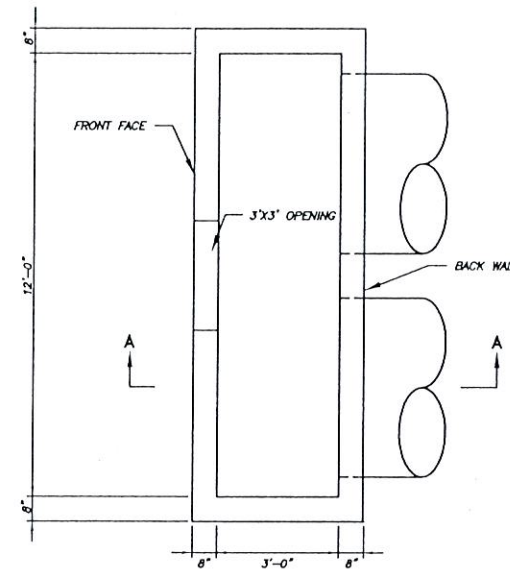
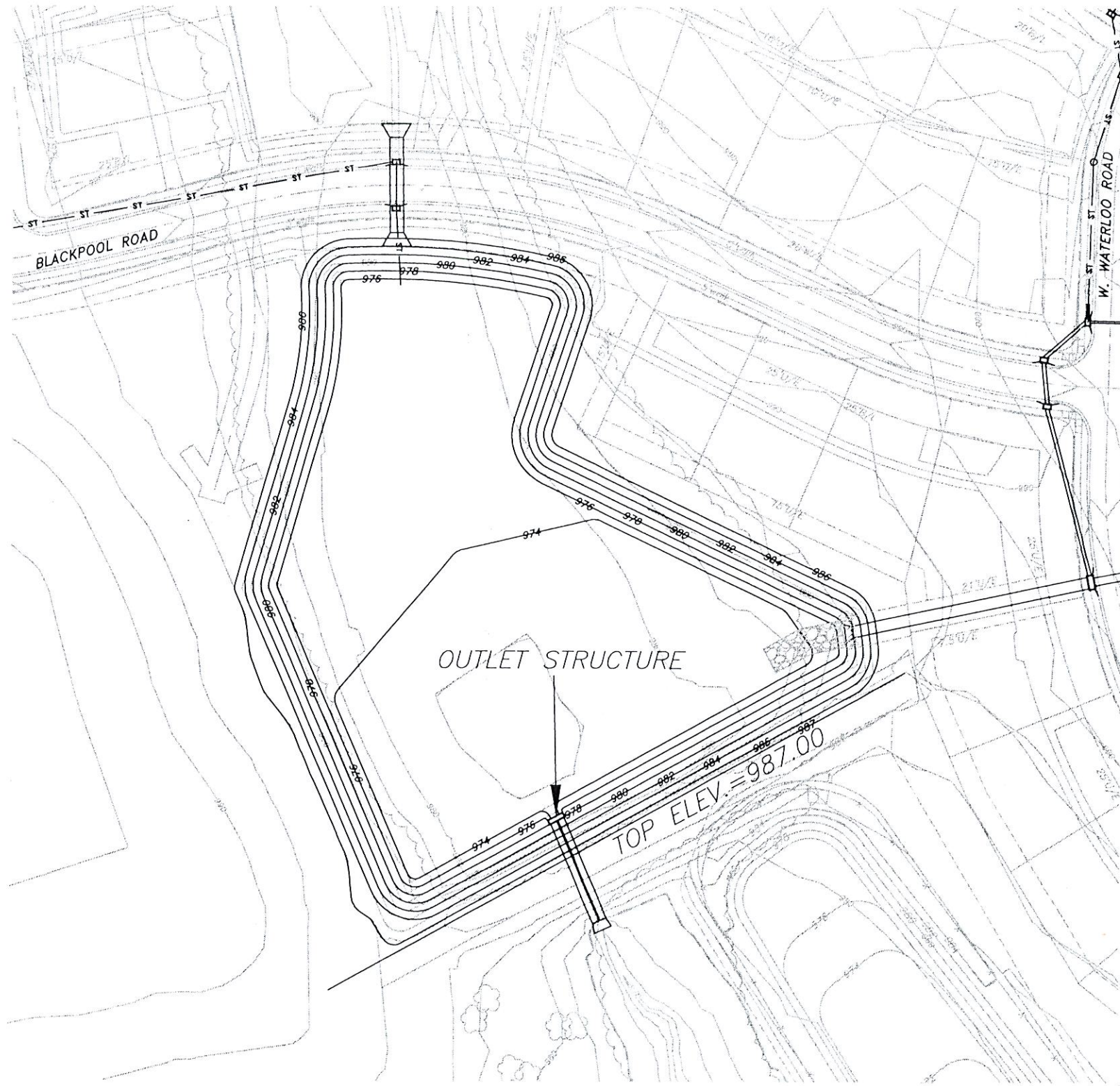


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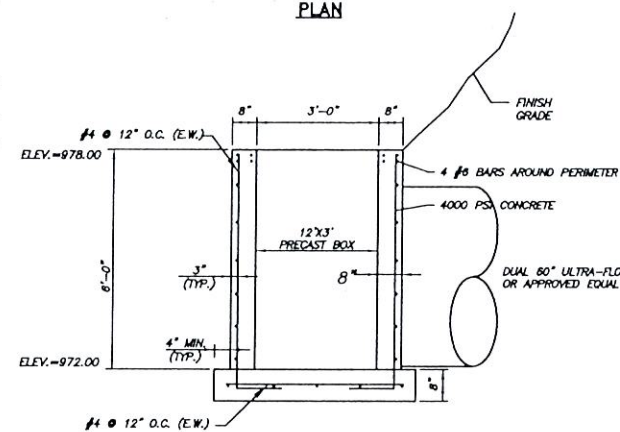
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MIDDLE BIG CREEK PLAN VIEW OF CROSS SECTIONS		DRAWING NO. FIG. 6

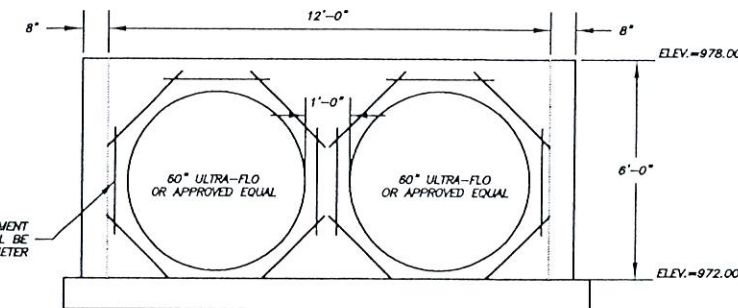


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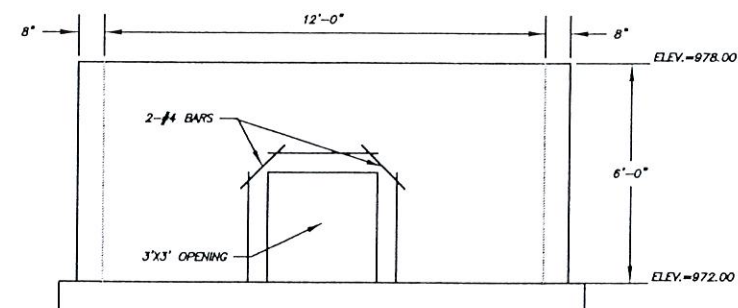


SECTION A-A
(TYPICAL REINFORCEMENT SHOWN)

OMITTED TYPICAL REINFORCEMENT
IN OPENINGS SHALL BE
INSTALLED AROUND PERIMETER



BACK WALL
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FRONT FACE
(TYPICAL REINFORCEMENT NOT SHOWN)

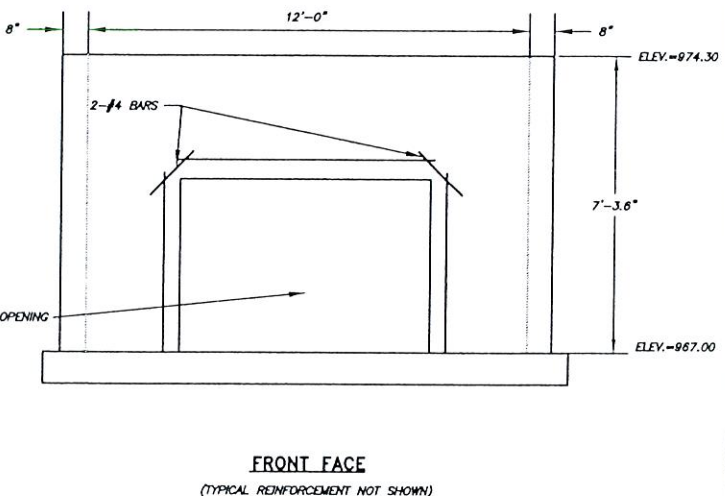
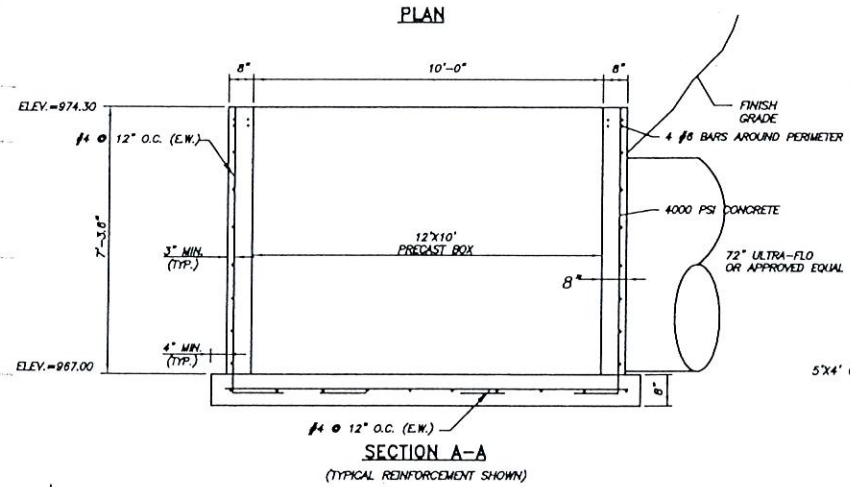
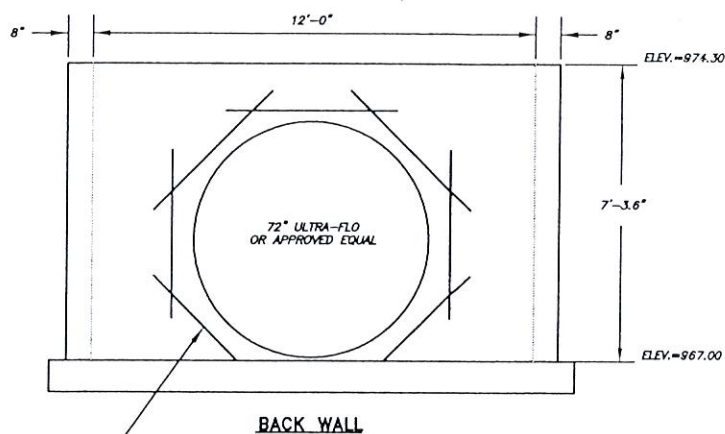
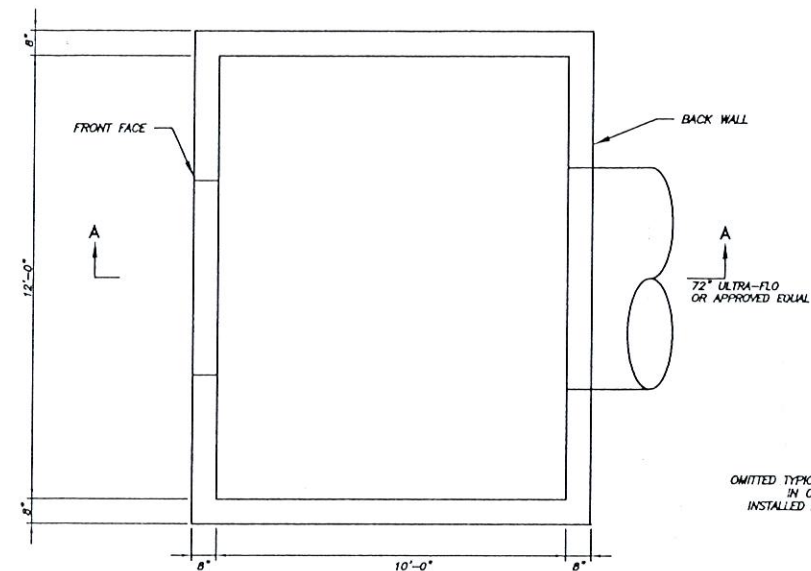
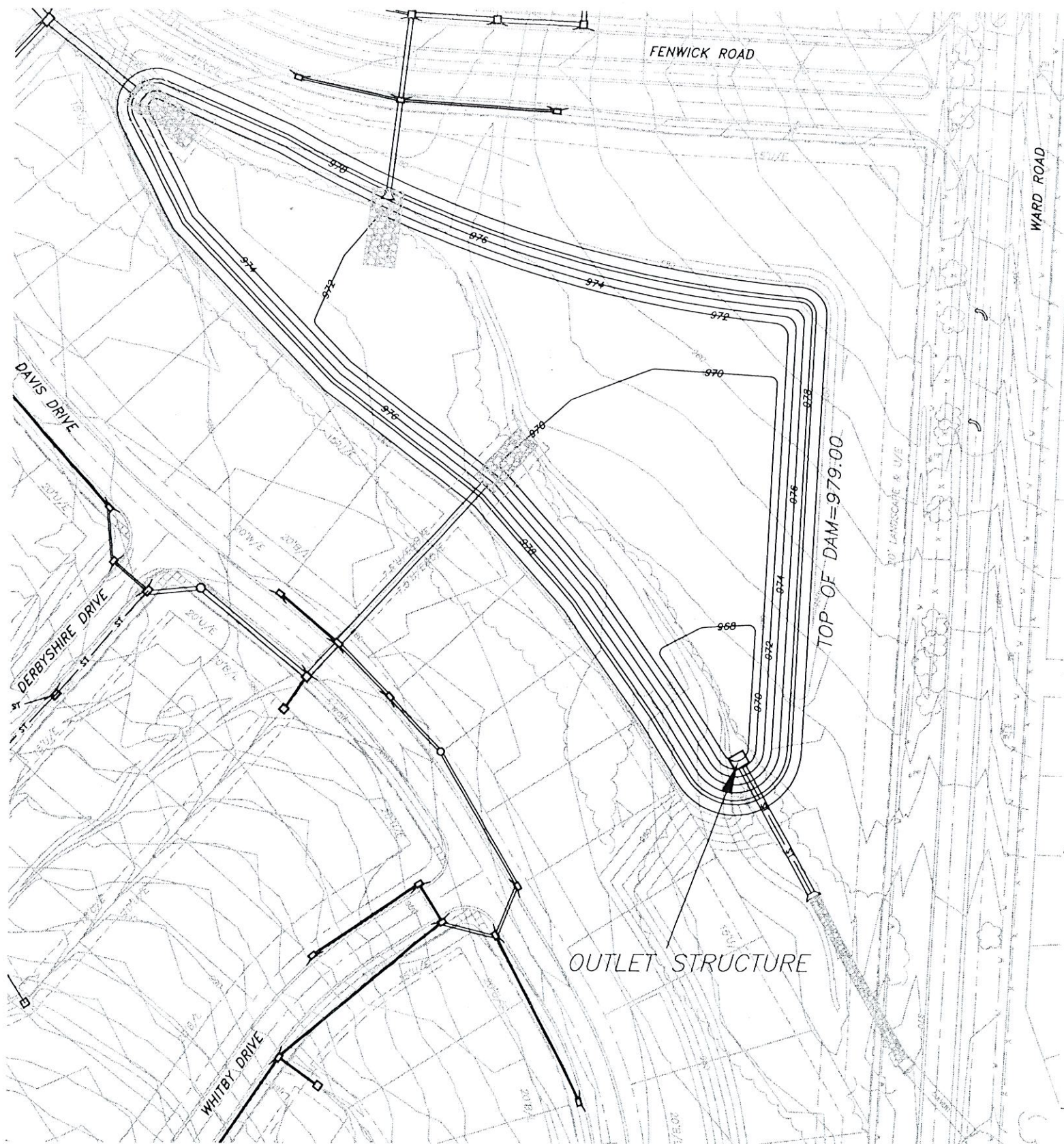
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 • 187 E. DAVIS, P.O. BOX 908, FORSYTH, MO 65653 • 417-548-3218 • FAX 417-548-5324
 • 800 STARKS BUILDING, LOUISVILLE, KY 40202 • 502-581-9484 • FAX 502-581-6486
 • 1000 CITY PARKWAY, OSAGE BEACH, MO 65065 • 573-348-3222 • FAX 573-348-3499
 • 1081 KINGS HIGHWAY, SUITE 7, P.O. BOX 537, ROLLA, MO 65402 • 573-384-3420 • FAX 573-384-4170
 • 308 CARPENTER DRIVE, HOLLISTER, MO 65472 • 417-334-7817 • FAX 417-334-8812
 • 258 SO. UNION, SPRINGFIELD, MO 65802 • 417-865-4083 • FAX 417-865-4085
 • 2480 EXECUTIVE DRIVE, SUITE 118, ST. CHARLES, MO 63303 • 636-477-8308 • FAX 636-477-7508

PULTE HOMES KENSINGTON FARMS LEE'S SUMMIT, MISSOURI		PROJECT NO. 24130803
BASIN #1 OUTLET STRUCTURE		DRAWING NO. BASIN #1



BASIN #2 OUTLET STRUCTURE
N.T.S.

DRAWING FILE NAME: DETENTION-OUTLETS2.DWG	DOCUMENT NO.:	USER I.D.:			
DATE LAST SAVED: 11/18/05	PLOT SCALE: 1:2	DATE/TIME PLOTTED:			
FILES ATTACHED: 4	DESIGNED BY: RBH/BKI	DRAWN BY: RBH	CHECKED BY: RLS		
ATTACHED FILE NAMES: XRF30803CT, XRF30803RD, XRF30803ST, & XRF30803SV					
No.	DATE	BY	REVISION		

E. T. ARCHER CORPORATION D.B.A.

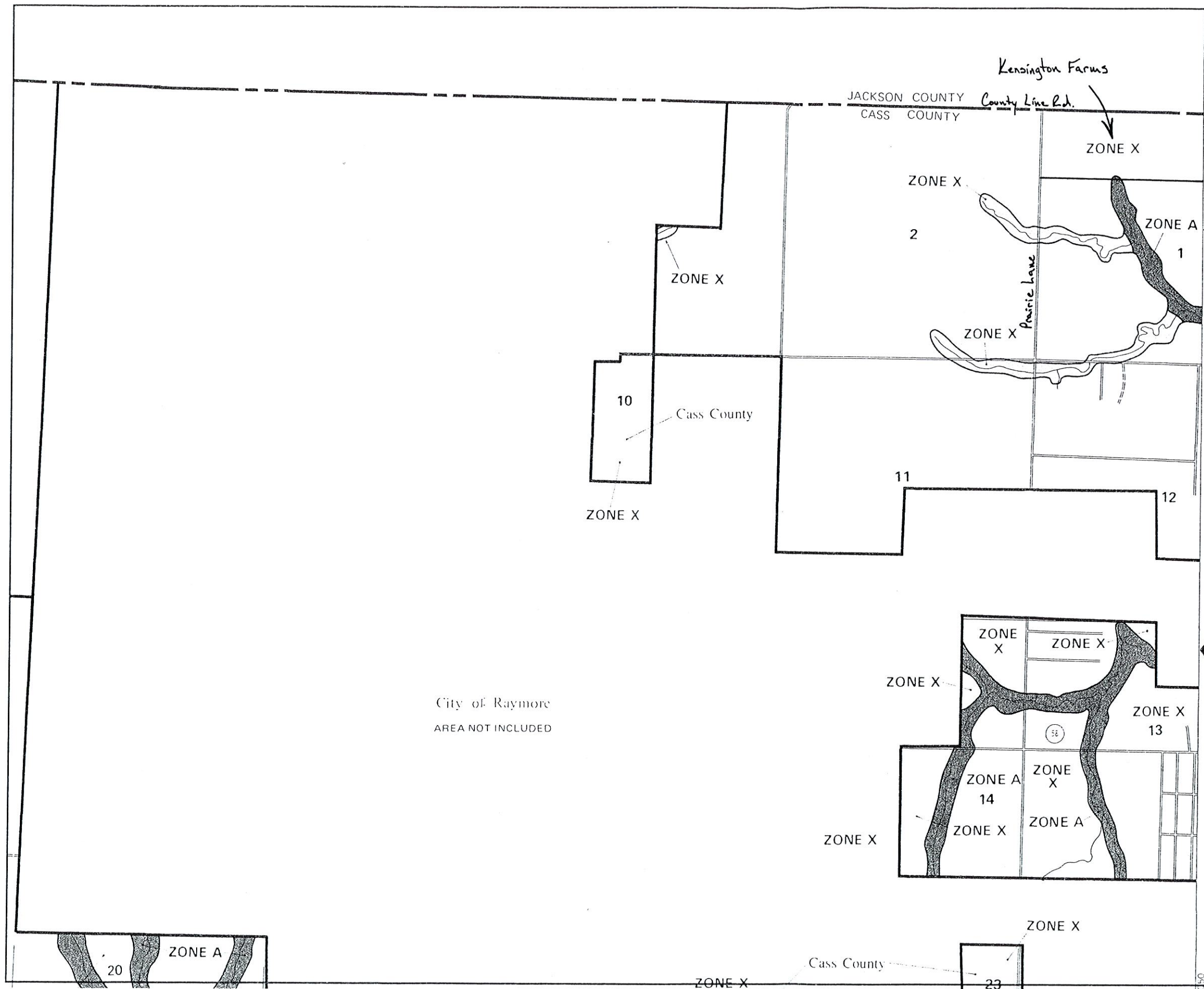
Archer

TOTAL PROJECT MANAGEMENT

CORPORATE OFFICE: 3741 NE TROON DRIVE
LEE'S SUMMIT, MO 64064
816-554-3019 • Fax 816-554-3061

- OTHER OFFICE LOCATIONS
- 8340 MISSION ROAD, SUITE 240, PRINCE VILLAGE, KS 66206 • 813-652-8787 • FAX 816-347-1309
 - 187 E. DAVID, P.O. BOX 906, FORSYTH, MO 65053 • 417-548-3218 • FAX 417-548-5324
 - 800 STARKS BUILDING, LOUISVILLE, KY 40202 • 502-581-9484 • FAX 502-581-6485
 - 1000 CITY PARKWAY, OSAGE BEACH, MO 65065 • 573-348-3222 • FAX 573-348-3499
 - 1061 KINGS HIGHWAY, SUITE 7, P.O. BOX 637, ROLLA, MO 65402 • 673-364-3420 • FAX 673-364-4170
 - 368 CARPENTER DRIVE, HOLLISTER, MO 65042 • 417-334-7817 • FAX 417-334-8912
 - 250 SO. UNION, SPRINGFIELD, MO 65802 • 417-865-4083 • FAX 417-865-4085
 - 2480 EXECUTIVE DRIVE, SUITE 118, ST. CHARLES, MO 63303 • 636-477-8309 • FAX 636-477-7509

PULTE HOMES KENSINGTON FARMS LEE'S SUMMIT, MISSOURI	PROJECT NO. 24130803
BASIN #2 OUTLET STRUCTURE	DRAWING NO. BASIN #2



APPROXIMATE SCALE IN FEET

2000 0 2000

NATIONAL FLOOD INSURANCE PROGRAM

FIRM FLOOD INSURANCE RATE MAP

CASS COUNTY,
MISSOURI
(UNINCORPORATED AREAS)

PANEL 25 OF 225

COMMUNITY—PANEL NUMBER:

290783 0025 C

MAP REVISED:

MAY 4, 1992



Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov

APPENDIX A
PRE-DEVELOPMENT
TR-55 & HEC-HMS DATA

RUNOFF CURVE NUMBER COMPUTATION
 Project : KENSINGTON FARMS
 County : CASS State: MO
 Subtitle: PRE-DEVELOPED CONDITIONS
 Subarea : A1

Version 2.10
 Date: 11-15-2004
 User: BKI
 Checked: _____ Date: _____

COVER DESCRIPTION	Hydrologic Soil Group			
	A	B	C	D
	Acres (CN)			
FULLY DEVELOPED URBAN AREAS (Veg Estab.)				
Residential districts Avg % imperv				
(by average lot size)				
2 acre 12	-	45(65)	43.1(77)	59.5(82)
CULTIVATED AGRICULTURAL LANDS				
Row crops C + Crop residue good	-	4.8(74)	-	-
OTHER AGRICULTURAL LANDS				
Meadow -cont. grass (non grazed) ----	-	176(58)	86.9(71)	61.1(78)
Total Area (by Hydrologic Soil Group)	225.	130	120.	
	=====	=====	=====	
SUBAREA: A1	TOTAL DRAINAGE AREA: 476.4 Acres		WEIGHTED CURVE NUMBER: 68	

RUNOFF CURVE NUMBER COMPUTATION
 Project : KENSINGTON FARMS
 County : CASS State: MO
 Subtitle: PRE-DEVELOPED CONDITIONS
 Subarea : A1A

Version 2.10
 Date: 11-15-2004
 User: BKI
 Checked: _____ Date: _____

COVER DESCRIPTION	Hydrologic Soil Group			
	A	B	C	D
	Acres (CN)			
CULTIVATED AGRICULTURAL LANDS				
Row crops C + Crop residue good	-	14.7(74)	-	5.44(85)
OTHER AGRICULTURAL LANDS				
Meadow -cont. grass (non grazed) ----	-	1(58)	-	1(78)
Total Area (by Hydrologic Soil Group)	15.7		6.44	
	=====		=====	
SUBAREA: A1A	TOTAL DRAINAGE AREA: 22.14 Acres		WEIGHTED CURVE NUMBER: 76	

RUNOFF CURVE NUMBER COMPUTATION

Version 2.10

Project : KENSINGTON FARMS

User: BKI

Date: 11-15-2004

County : CASS

State: MO

Checked: _____

Date: _____

Subtitle: PRE-DEVELOPED CONDITIONS

Subarea : A2

COVER DESCRIPTION	Hydrologic Soil Group			
	A	B	C	D
	Acres (CN)			
FULLY DEVELOPED URBAN AREAS (Veg Estab.)				
Residential districts Avg % imperv				
(by average lot size)				
2 acre 12	-	61.4(65)	14.8(77)	19.1(82)
CULTIVATED AGRICULTURAL LANDS				
Row crops C + Crop residue good	-	24.6(74)	21.7(81)	38.9(85)
OTHER AGRICULTURAL LANDS				
Meadow -cont. grass (non grazed) ----	-	159(58)	140(71)	144(78)
Total Area (by Hydrologic Soil Group)	245	176.	202	
	====	====	====	
SUBAREA: A2 TOTAL DRAINAGE AREA: 623.5 Acres	WEIGHTED CURVE NUMBER: 71			

RUNOFF CURVE NUMBER COMPUTATION

Version 2.10

Project : KENSINGTON FARMS

User: BKI

Date: 11-15-2004

County : CASS

State: MO

Checked: _____

Date: _____

Subtitle: PRE-DEVELOPED CONDITIONS

Subarea : A3

COVER DESCRIPTION	Hydrologic Soil Group			
	A	B	C	D
	Acres (CN)			
FULLY DEVELOPED URBAN AREAS (Veg Estab.)				
Residential districts Avg % imperv				
(by average lot size)				
2 acre 12	-	19.7(65)	9.2(77)	-
OTHER AGRICULTURAL LANDS				
Meadow -cont. grass (non grazed) ----	-	36.2(58)	19.3(71)	4.9(78)
Total Area (by Hydrologic Soil Group)	55.9	28.5	4.9	
	====	====	====	
SUBAREA: A3 TOTAL DRAINAGE AREA: 89.3 Acres	WEIGHTED CURVE NUMBER: 65			

RUNOFF CURVE NUMBER COMPUTATION

Version 2.10

Project : KENSINGTON FARMS

User: BKI

Date: 11-15-2004

County : CASS

State: MO

Checked: _____

Date: _____

Subtitle: PRE-DEVELOPED CONDITIONS

Subarea : A3A

COVER DESCRIPTION	Hydrologic Soil Group			
	A	B	C	D
	Acres (CN)			
CULTIVATED AGRICULTURAL LANDS				
Row crops C + Crop residue good	-	70.5(74)	48.4(81)	49.8(85)
Total Area (by Hydrologic Soil Group)	70.5	48.4	49.8	
	=====	=====	=====	
SUBAREA: A3A	TOTAL DRAINAGE AREA: 168.6 Acres			WEIGHTED CURVE NUMBER: 79

RUNOFF CURVE NUMBER COMPUTATION

Version 2.10

Project : KENSINGTON FARMS

User: BKI

Date: 11-15-2004

County : CASS

State: MO

Checked: _____

Date: _____

Subtitle: PRE-DEVELOPED CONDITIONS

Subarea : A3B

COVER DESCRIPTION	Hydrologic Soil Group			
	A	B	C	D
	Acres (CN)			
FULLY DEVELOPED URBAN AREAS (Veg Estab.)				
Residential districts Avg % imperv				
(by average lot size)				
1 acre 20	-	21.4(68)	2.7(79)	29.7(84)
CULTIVATED AGRICULTURAL LANDS				
Row crops C + Crop residue good	-	25.1(74)	0.9(81)	17.3(85)
OTHER AGRICULTURAL LANDS				
Meadow -cont. grass (non grazed) ----	-	5.50(58)	1.4(71)	30.5(78)
Total Area (by Hydrologic Soil Group)	52	5	77.5	
	=====	=====	=====	
SUBAREA: A3B	TOTAL DRAINAGE AREA: 134.5 Acres			WEIGHTED CURVE NUMBER: 77

RUNOFF CURVE NUMBER COMPUTATION
 Project : KENSINGTON FARMS
 County : CASS State: MO
 Subtitle: PRE-DEVELOPED CONDITIONS
 Subarea : A4

Version 2.10
 Date: 11-15-2004
 Date:

COVER DESCRIPTION	Hydrologic Soil Group			
	A	B	C	D
	Acres (CN)			

FULLY DEVELOPED URBAN AREAS (Veg Estab.)				
Residential districts Avg % imperv				
(by average lot size)				
1 acre				

RUNOFF CURVE NUMBER COMPUTATION
 Project : KENSINGTON FARMS
 County : CASS State: MO
 Subtitle: PRE-DEVELOPED CONDITIONS
 Subarea : A5

Version 2.10
 Date: 11-15-2004
 Date:

COVER DESCRIPTION	Hydrologic Soil Group			
	A	B	C	D
	Acres (CN)			

CULTIVATED AGRICULTURAL LANDS				
Row crops C + Crop residue good	-	12.3(74)	8.4(81)	-
Total Area (by Hydrologic Soil Group)	12.3	8.4		
	====	====		

SUBAREA: A5	TOTAL DRAINAGE AREA: 20.7 Acres		WEIGHTED CURVE NUMBER: 77	

Project : KENSINGTON FARMS
 County : CASS
 Subtitle: PRE-DEVELOPED CONDITIONS
 Subarea : A6

RUNOFF CURVE NUMBER COMPUTATION

User: BKI
 State: MO
 Checked: _____

Version 2.10
 Date: 11-15-2004
 Date: _____

COVER DESCRIPTION	Hydrologic Soil Group			
	A	B	C	D
	Acres (CN)			
CULTIVATED AGRICULTURAL LANDS				
Row crops C + Crop residue good	-	46(74)	57.6(81)	-
Total Area (by Hydrologic Soil Group)	46	57.6		
	====	====		
SUBAREA: A6	TOTAL DRAINAGE AREA: 103.6 Acres		WEIGHTED CURVE NUMBER: 78	

Project : KENSINGTON FARMS
 County : CASS
 Subtitle: PRE-DEVELOPED CONDITIONS
 Subarea : A6A

RUNOFF CURVE NUMBER COMPUTATION

User: BKI
 State: MO
 Checked: _____

Version 2.10
 Date: 11-15-2004
 Date: _____

COVER DESCRIPTION	Hydrologic Soil Group			
	A	B	C	D
	Acres (CN)			
FULLY DEVELOPED URBAN AREAS (Veg Estab.)				
Residential districts Avg % imperv				
(by average lot size)				
1/3 acre 30	-	132(72)	166(81)	94(86)
OTHER AGRICULTURAL LANDS				
Meadow -cont. grass (non grazed) ----	-	29.8(58)	31.8(71)	11.9(78)
Total Area (by Hydrologic Soil Group)	161.	197.	105.	
	====	====	====	
SUBAREA: A6A	TOTAL DRAINAGE AREA: 465.5 Acres		WEIGHTED CURVE NUMBER: 77	

TIME OF CONCENTRATION AND TRAVEL TIME
 Project : KENSINGTON FARMS
 County : CASS State: MO
 Subtitle: PRE-DEVELOPED CONDITIONS

Version 2.10
 User: BKI
 Checked: _____
 Date: 11-15-2004
 Date: _____

----- Subarea #1 - A1 -----

Flow Type	2 year rain	Length (ft)	Slope (ft/ft)	Surface code	n	Area (sq/ft)	Wp (ft)	Velocity (ft/sec)	Time (hr)
Sheet	3.5	300	.0133	J					0.395
Open Channel		1469	.041		.04	50	200		0.136
Open Channel		7051	.008		.035	135	90		0.393
Time of Concentration = 0.92*									
=====									

Open Channel		2225	.008		.035	135	90		0.124
									Travel Time = 0.12*
									=====

----- Subarea #2 - A1A -----

Flow Type	2 year rain	Length (ft)	Slope (ft/ft)	Surface code	n	Area (sq/ft)	Wp (ft)	Velocity (ft/sec)	Time (hr)
Sheet	3.5	300	.026	J					0.302
Shallow Concent'd		360	.04	u					0.031
Open Channel		459	.025		.040	123	40.4		0.010
Time of Concentration = 0.34*									
=====									

----- Subarea #3 - A2 -----

Flow Type	2 year rain	Length (ft)	Slope (ft/ft)	Surface code	n	Area (sq/ft)	Wp (ft)	Velocity (ft/sec)	Time (hr)
Sheet	3.5	300	.0333	J					0.273
Open Channel		3786	.022		.04	30	120		0.480
Open Channel		6801	.005		.035	90	60		0.479
Time of Concentration = 1.23*									
=====									

----- Subarea #4 - A3 -----

Flow Type	2 year rain	Length (ft)	Slope (ft/ft)	Surface code	n	Area (sq/ft)	Wp (ft)	Velocity (ft/sec)	Time (hr)
Sheet	3.5	300	.0067	J					0.519
Shallow Concent'd		300	.01	P					0.041
Open Channel		1532	.020		.04	62.5	250		0.204
Time of Concentration = 0.76*									
=====									

TIME OF CONCENTRATION AND TRAVEL TIME
 Project : KENSINGTON FARMS
 County : CASS State: MO
 Subtitle: PRE-DEVELOPED CONDITIONS

Version 2.10
 User: BKI
 Date: 11-15-2004
 Checked: _____
 Date: _____

----- Subarea #5 - A3A -----

Flow Type	2 year rain	Length (ft)	Slope (ft/ft)	Surface code	n	Area (sq/ft)	Wp (ft)	Velocity (ft/sec)	Time (hr)
Sheet	3.5	300	.0135	J					0.392
Shallow Concent'd		329	.0216	U					0.039
Open Channel		1366	.013		.04020.0	32			0.122
Open Channel		1150	.007		.04 62.5	250			0.258

Time of Concentration = 0.81*

=====

Open Channel		2969	.007		.04 62.5	250			0.667
--------------	--	------	------	--	----------	-----	--	--	-------

Travel Time = 0.67*

=====

----- Subarea #6 - A3B -----

Flow Type	2 year rain	Length (ft)	Slope (ft/ft)	Surface code	n	Area (sq/ft)	Wp (ft)	Velocity (ft/sec)	Time (hr)
Sheet	3.5	300	.0167	J					0.360
Shallow Concent'd		694	.0317	U					0.067

Time of Concentration = 0.43*

=====

----- Subarea #7 - A4 -----

Flow Type	2 year rain	Length (ft)	Slope (ft/ft)	Surface code	n	Area (sq/ft)	Wp (ft)	Velocity (ft/sec)	Time (hr)
Sheet	3.5	300	.0267	J					0.299
Open Channel		955	.047		.04 25	100			0.083
Open Channel		3433	.014		.035135	90			0.144

Time of Concentration = 0.53*

=====

----- Subarea #8 - A5 -----

Flow Type	2 year rain	Length (ft)	Slope (ft/ft)	Surface code	n	Area (sq/ft)	Wp (ft)	Velocity (ft/sec)	Time (hr)
Sheet	3.5	300	.039	D					0.318
Open Channel		590	.017		.04 750	300			0.018

Time of Concentration = 0.34*

=====

----- Subarea #9 - A6 -----

Flow Type	2 year rain	Length (ft)	Slope (ft/ft)	Surface code	n	Area (sq/ft)	Wp (ft)	Velocity (ft/sec)	Time (hr)
Sheet	3.5	300	.023	J					0.317
Open Channel		1160	.013		.04 1430	286			0.026
Open Channel		1333	.015		.035613	88			0.019

Time of Concentration = 0.36*

=====

TIME OF CONCENTRATION AND TRAVEL TIME

Version 2.10

Project : KENSINGTON FARMS

User: BKI

Date: 11-15-2004

County : CASS

State: MO

Checked: _____

Date: _____

Subtitle: PRE-DEVELOPED CONDITIONS

----- Subarea #10 - A6A -----

Flow Type	2 year rain	Length (ft)	Slope (ft/ft)	Surface code	n	Area (sq/ft)	Wp (ft)	Velocity (ft/sec)	Time (hr)
Sheet	3.5	300	.0167	J					0.360
Shallow Concent'd		660	.031	U					0.065
Open Channel		724	.041			.04 225	225		0.027
									Time of Concentration = 0.45*
									=====
Open Channel		790	.015			.035613	88		0.012
									Travel Time = 0.01*
									=====

--- Sheet Flow Surface Codes ---

A Smooth Surface

F Grass, Dense

--- Shallow Concentrated ---

B Fallow (No Res.)

G Grass, Bermuda

--- Surface Codes ---

C Cultivated < 20 % Res.

H Woods, Light

P Paved

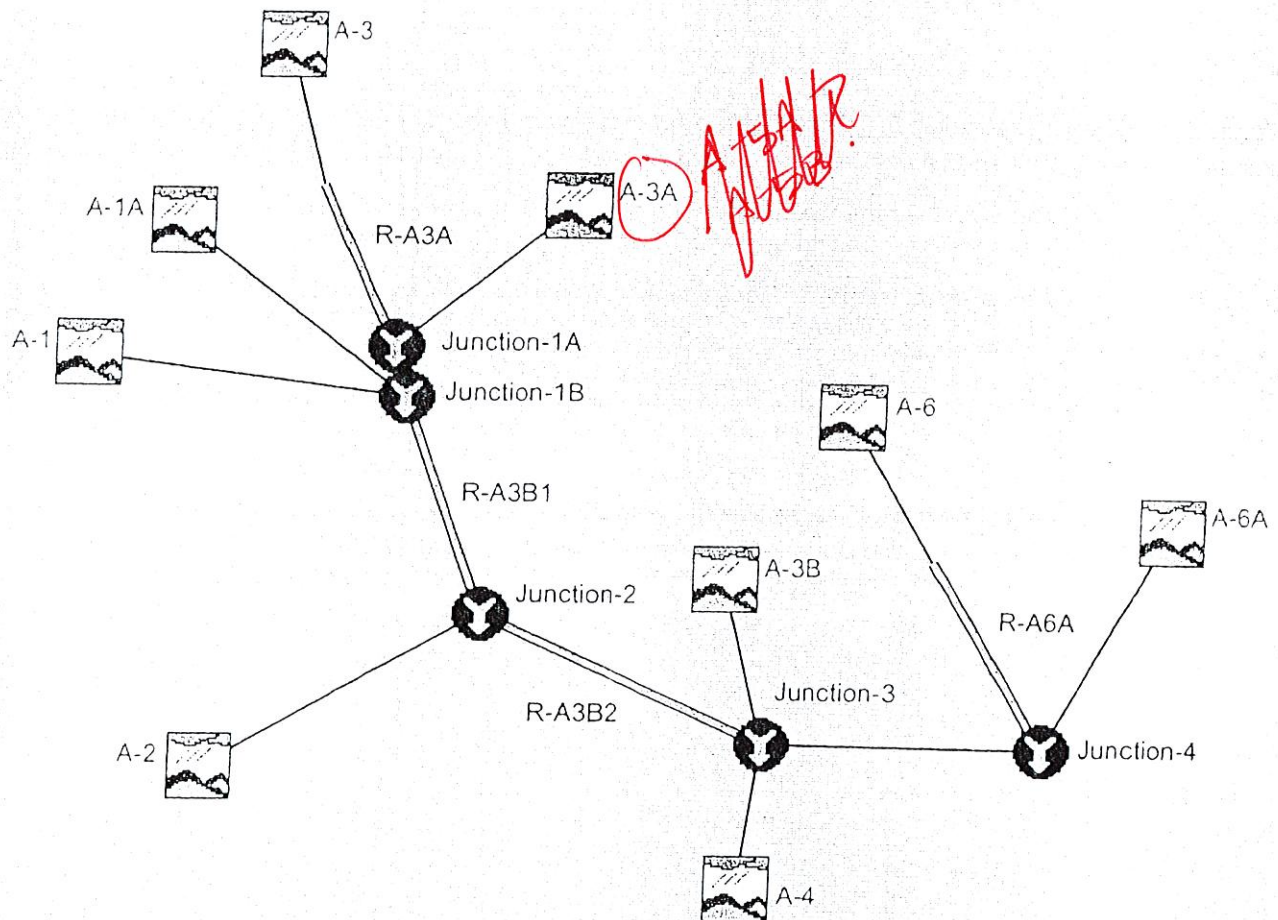
D Cultivated > 20 % Res.

I Woods, Dense

U Unpaved

E Grass-Range, Short

J Range, Natural



HMS * Summary of Results

Project : Pulte

Run Name : Run 1

Start of Run : 23Nov04 0000 Basin Model : Pre-development

End of Run : 24Nov04 2400 Met. Model : 2-yr

Execution Time : 01Apr05 1323 Control Specs : 11-23-04

Hydrologic Element	Discharge Peak (cfs)	Time of Peak	Volume (ac ft)	Drainage Area (sq mi)
A-3	63.953	23 Nov 04 1222	8.3931	0.140
R-A3A	63.245	23 Nov 04 1241	8.3949	0.140
A-3A	180.88	23 Nov 04 1222	23.099	0.263
Junction-1A	211.14	23 Nov 04 1232	31.494	0.403
A-1	240.67	23 Nov 04 1229	38.108	0.744
A-1A	35.477	23 Nov 04 1206	2.6537	0.035
Junction-1B	459.59	23 Nov 04 1231	72.255	1.182
R-A3B1	448.43	23 Nov 04 1240	72.173	1.182
A-2	314.22	23 Nov 04 1241	58.601	0.974
Junction-2	762.31	23 Nov 04 1240	130.77	2.156
R-A3B2	708.87	23 Nov 04 1240	124.99	2.156
A-3B	198.66	23 Nov 04 1209	16.871	0.210
A-4	174.09	23 Nov 04 1213	17.083	0.233
Junction-3	825.05	23 Nov 04 1237	158.95	2.600
A-6	177.58	23 Nov 04 1206	13.587	0.162
R-A6A	175.76	23 Nov 04 1210	13.579	0.162
A-6A	668.45	23 Nov 04 1210	58.389	0.727
Junction-4	1433.0	23 Nov 04 1212	230.92	3.489

HMS * Summary of Results

Project : Pulte

Run Name : Run 2

Start of Run : 23Nov04 0000 Basin Model : Pre-development

End of Run : 24Nov04 2400 Met. Model : 10-yr

Execution Time : 01Apr05 1323 Control Specs : 11-23-04

Hydrologic Element	Discharge Peak (cfs)	Time of Peak	Volume (ac ft)	Drainage Area (sq mi)
A-3	147.39	23 Nov 04 1221	18.034	0.140
R-A3A	145.70	23 Nov 04 1237	18.019	0.140
A-3A	353.36	23 Nov 04 1222	44.243	0.263
Junction-1A	456.69	23 Nov 04 1229	62.262	0.403
A-1	604.28	23 Nov 04 1227	86.122	0.744
A-1A	71.932	23 Nov 04 1205	5.2927	0.035
Junction-1B	1079.5	23 Nov 04 1228	153.68	1.182
R-A3B1	1059.1	23 Nov 04 1234	153.51	1.182
A-2	727.10	23 Nov 04 1239	125.91	0.974
Junction-2	1778.4	23 Nov 04 1236	279.42	2.156
R-A3B2	1688.0	23 Nov 04 1236	270.12	2.156
A-3B	397.81	23 Nov 04 1208	33.188	0.210
A-4	364.35	23 Nov 04 1212	34.556	0.233
Junction-3	1956.9	23 Nov 04 1232	337.86	2.600
A-6	348.77	23 Nov 04 1206	26.370	0.162
R-A6A	344.22	23 Nov 04 1209	26.355	0.162
A-6A	1342.0	23 Nov 04 1209	114.86	0.727
Junction-4	3125.0	23 Nov 04 1212	479.08	3.489

HMS * Summary of Results

Project : Pulte

Run Name : Run 3

Start of Run : 23Nov04 0000 Basin Model : Pre-development

End of Run : 24Nov04 2400 Met. Model : 25-yr

Execution Time : 01Apr05 1323 Control Specs : 11-23-04

Hydrologic Element	Discharge Peak (cfs)	Time of Peak	Volume (ac ft)	Drainage Area (sq mi)
A-3	193.37	23 Nov 04 1220	23.384	0.140
R-A3A	191.12	23 Nov 04 1235	23.364	0.140
A-3A	443.43	23 Nov 04 1221	55.479	0.263
Junction-1A	588.03	23 Nov 04 1228	78.843	0.403
A-1	809.53	23 Nov 04 1227	113.27	0.744
A-1A	91.320	23 Nov 04 1205	6.7165	0.035
Junction-1B	1421.9	23 Nov 04 1227	198.83	1.182
R-A3B1	1397.5	23 Nov 04 1233	198.64	1.182
A-2	955.00	23 Nov 04 1239	163.27	0.974
Junction-2	2337.4	23 Nov 04 1235	361.91	2.156
R-A3B2	2230.9	23 Nov 04 1235	350.91	2.156
A-3B	503.07	23 Nov 04 1208	41.946	0.210
A-4	465.90	23 Nov 04 1212	44.033	0.233
Junction-3	2586.6	23 Nov 04 1231	436.89	2.600
A-6	438.18	23 Nov 04 1206	33.196	0.162
R-A6A	432.64	23 Nov 04 1209	33.178	0.162
A-6A	1696.7	23 Nov 04 1209	145.17	0.727
Junction-4	4057.0	23 Nov 04 1212	615.24	3.489

HMS * Summary of Results

Project : Pulte

Run Name : Run 4

Start of Run : 23Nov04 0000 Basin Model : Pre-development

End of Run : 24Nov04 2400 Met. Model : 100-yr

Execution Time : 01Apr05 1323 Control Specs : 11-23-04

Hydrologic Element	Discharge Peak (cfs)	Time of Peak	Volume (ac ft)	Drainage Area (sq mi)
A-3	273.45	23 Nov 04 1220	32.788	0.140
R-A3A	270.24	23 Nov 04 1234	32.759	0.140
A-3A	596.24	23 Nov 04 1221	74.774	0.263
Junction-1A	813.44	23 Nov 04 1227	107.53	0.403
A-1	1171.6	23 Nov 04 1226	161.49	0.744
A-1A	124.32	23 Nov 04 1205	9.1812	0.035
Junction-1B	2018.8	23 Nov 04 1226	278.21	1.182
R-A3B1	1986.0	23 Nov 04 1231	277.98	1.182
A-2	1352.7	23 Nov 04 1238	228.93	0.974
Junction-2	3310.1	23 Nov 04 1233	506.91	2.156
R-A3B2	3178.1	23 Nov 04 1233	493.28	2.156
A-3B	681.86	23 Nov 04 1208	57.064	0.210
A-4	639.61	23 Nov 04 1212	60.486	0.233
Junction-3	3685.9	23 Nov 04 1229	610.83	2.600
A-6	589.42	23 Nov 04 1206	44.949	0.162
R-A6A	583.07	23 Nov 04 1209	44.940	0.162
A-6A	2299.3	23 Nov 04 1209	197.50	0.727
Junction-4	5699.1	23 Nov 04 1212	853.27	3.489

HMS * Basin Model * Routing Reach [Help] [Icons]

Reach Name :

Description : ...

Routing Method : ▼

Reach Length (ft)

Energy Slope (ft/ft)

Manning's N Values

Left Overbank	Channel	Right Overbank
0.1	0.045	0.1

Cross Section Coordinates

	Station (ft)	Elevation (ft)
1	0	990
2	19	988
3	39	986
4	53	985.5
5	91	986
6	163	988
7	267	990
8	319	992

OK Apply Cancel

HMS * Basin Model * Routing Reach

Help

Reach Name : R-A3B1

Description : X-Section @ Midpoint of Channel Reach

Routing Method : Muskingum Cunge 8 Point

Reach Length (ft)
2473

Energy Slope (ft/ft)
0.004

Manning's N Values

Left Overbank	Channel	Right Overbank
0.1	0.045	0.1

Cross Section Coordinates

	Station (ft)	Elevation (ft)
1	0	968
2	10	966
3	20	964
4	29	962
5	33	961
6	36	962
7	44	964
8	52	966

OK Apply Cancel

HMS * Basin Model * Routing Reach

Help

Reach Name : R-A3B2

Description : X-Section @ Midpoint of Channel Reach

Routing Method : Muskingum Cunge 8 Point

Reach Length (ft)
2432

Energy Slope (ft/ft)
0.001

Manning's N Values

Left Overbank	Channel	Right Overbank
0.1	0.045	0.1

Cross Section Coordinates

	Station (ft)	Elevation (ft)
1	0	962
2	20	960
3	37	958
4	45	45
5	53	956
6	63	956
7	66	958
8	77	960

OK Apply Cancel

HMS * Basin Model * Routing Reach

Help

Reach Name : R-A6A

Description : X-Section @ 3/4th the way Upstream of Channel R...

Routing Method : Muskingum Cunge 8 Point

Reach Length (ft)
790

Energy Slope (ft/ft)
0.011

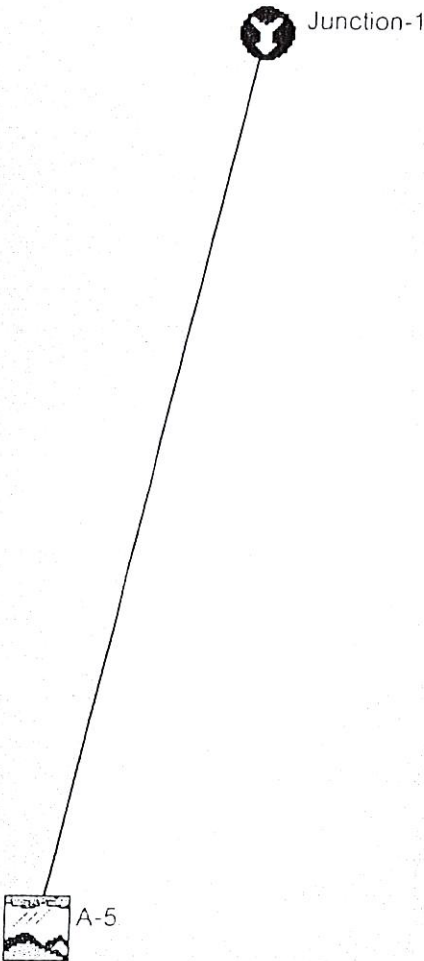
Manning's N Values

Left Overbank	Channel	Right Overbank
0.1	0.045	0.1

Cross Section Coordinates

	Station (ft)	Elevation (ft)
1	0	970
2	50	968
3	65	966
4	71	964
5	77	962
6	85	962
7	89	964
8	230	970

OK Apply Cancel



HMS * Summary of Results

Project : Pulte

Run Name : Run 17

Start of Run : 23Nov04 0000 Basin Model : Pre-A5

End of Run : 24Nov04 2400 Met. Model : 2-yr

Execution Time : 02Dec04 0935 Control Specs : 11-23-04

Hydrologic Element	Discharge Peak (cfs)	Time of Peak	Volume (ac ft)	Drainage Area (sq mi)
A-5	34.872	23 Nov 04 1206	2.5965	0.032
Junction-1	34.872	23 Nov 04 1206	2.5965	0.032

HMS * Summary of Results

Project : Pulte

Run Name : Run 18

Start of Run : 23Nov04 0000 Basin Model : Pre-A5

End of Run : 24Nov04 2400 Met. Model : 10-yr

Execution Time : 02Dec04 0935 Control Specs : 11-23-04

Hydrologic Element	Discharge Peak (cfs)	Time of Peak	Volume (ac ft)	Drainage Area (sq mi)
A-5	69.455	23 Nov 04 1205	5.1077	0.032
Junction-1	69.455	23 Nov 04 1205	5.1077	0.032

HMS * Summary of Results

Project : Pulte

Run Name : Run 19

Start of Run : 23Nov04 0000 Basin Model : Pre-A5

End of Run : 24Nov04 2400 Met. Model : 25-yr

Execution Time : 02Dec04 0935 Control Specs : 11-23-04

Hydrologic Element	Discharge Peak (cfs)	Time of Peak	Volume (ac ft)	Drainage Area (sq mi)
A-5	87.720	23 Nov 04 1205	6.4556	0.032
Junction-1	87.720	23 Nov 04 1205	6.4556	0.032

HMS * Summary of Results

Project : Pulte

Run Name : Run 20

Start of Run : 23Nov04 0000 Basin Model : Pre-A5

End of Run : 24Nov04 2400 Met. Model : 100-yr

Execution Time : 02Dec04 0935 Control Specs : 11-23-04

Hydrologic Element	Discharge Peak (cfs)	Time of Peak	Volume (ac ft)	Drainage Area (sq mi)
A-5	118.71	23 Nov 04 1205	8.7823	0.032
Junction-1	118.71	23 Nov 04 1205	8.7823	0.032

APPENDIX B
POST-DEVELOPMENT
TR-55 & HEC-HMS DATA

RUNOFF CURVE NUMBER COMPUTATION

Project : KENSINGTON FARMS User: RBH Version 2.10
 County : CASS State: MO Date: 11-23-2004
 Subtitle: POST-DEVELOPMENT Checked: _____ Date: _____
 Subarea : A1A

COVER DESCRIPTION	Hydrologic Soil Group			
	A	B	C	D
	Acres (CN)			
FULLY DEVELOPED URBAN AREAS (Veg Estab.)				
Open space (Lawns,parks etc.)				
Good condition; grass cover > 75%	-	8.8(61)	-	2.4(80)
Urban Districts Avg % imperv				
Commercial & business 85	-	-	5.9(94)	5.3(95)
Total Area (by Hydrologic Soil Group)	8.8	5.9	7.7	
	=====	=====	=====	
SUBAREA: A1A TOTAL DRAINAGE AREA: 22.4 Acres	WEIGHTED CURVE NUMBER: 80			

RUNOFF CURVE NUMBER COMPUTATION

Project : KENSINGTON FARMS User: RBH Version 2.10
 County : CASS State: MO Date: 11-23-2004
 Subtitle: POST-DEVELOPMENT Checked: _____ Date: _____
 Subarea : A3A1 + A3A3

COVER DESCRIPTION	Hydrologic Soil Group			
	A	B	C	D
	Acres (CN)			
FULLY DEVELOPED URBAN AREAS (Veg Estab.)				
Open space (Lawns,parks etc.)				
Good condition; grass cover > 75%	-	6.7(61)	-	9.8(80)
Streets and roads				
Paved; curbs and storm sewers	-	-	3.2(98)	-
Urban Districts Avg % imperv				
Commercial & business 85	-	-	9.1(94)	-
Residential districts Avg % imperv				
(by average lot size)				
1/8 acre (town houses) 65	-	-	5.1(90)	3.5(92)
1/4 acre 38	-	-	38.9(83)	77.0(87)
Total Area (by Hydrologic Soil Group)	6.7	56.3	90.3	
	=====	=====	=====	
SUBAREA: A3A1 TOTAL DRAINAGE AREA: 153.4 Acres	WEIGHTED CURVE NUMBER: 85			

+ A3A3

RUNOFF CURVE NUMBER COMPUTATION		Version 2.10
Project : KENSINGTON FARMS	User: RBH	Date: 11-23-2004
County : CASS	State: MO	Checked: _____
Subtitle: POST-DEVELOPMENT		Date: _____
Subarea : A3A2		

COVER DESCRIPTION	A	Hydrologic Soil Group		D
		B	C	
		Acres (CN)		

FULLY DEVELOPED URBAN AREAS (Veg Estab.)				
Open space (Lawns, parks etc.)				
Good condition; grass cover > 75%	-	0.5(61)	-	1.7(80)
Residential districts				
(by average lot size)				
1/8 acre (town houses) 65	-	-	6.3(90)	3.3(92)
1/4 acre 38	-	-		3.4(87)
Total Area (by Hydrologic Soil Group)		0.5	6.3	8.4
		=====	=====	=====

SUBAREA: A3A2	TOTAL DRAINAGE AREA: 15.3 Acres		WEIGHTED CURVE NUMBER: 88	

RUNOFF CURVE NUMBER COMPUTATION		Version 2.10
Project : KENSINGTON FARMS	User: RBH	Date: 11-23-2004
County : CASS	State: MO	Checked: _____
Subtitle: POST-DEVELOPMENT		Date: _____
Subarea : A5A		

COVER DESCRIPTION	A	Hydrologic Soil Group		D
		B	C	
		Acres (CN)		

FULLY DEVELOPED URBAN AREAS (Veg Estab.)				
Residential districts				
(by average lot size)				
1/4 acre 38	-	-	8.4(83)	5.8(87)
Total Area (by Hydrologic Soil Group)			8.4	5.8
			=====	=====

SUBAREA: A5A	TOTAL DRAINAGE AREA: 14.2 Acres		WEIGHTED CURVE NUMBER: 85	

RUNOFF CURVE NUMBER COMPUTATION

Version 2.10

Project : KENSINGTON FARMS
County : CASS
Subtitle: POST-DEVELOPMENT
Subarea : A5B

State: MO

User: RBH
Checked: _____

Date: 11-23-2004
Date: _____

COVER DESCRIPTION	A	Hydrologic Soil Group		D
		B	C	
		Acres (CN)		
FULLY DEVELOPED URBAN AREAS (Veg Estab.)				
Streets and roads				
Paved; curbs and storm sewers	-	-	1.7(98)	-
Residential districts				
(by average lot size)				
1/4 acre	38	-	3.1(83)	1.7(87)
Total Area (by Hydrologic Soil Group)			4.8	1.7
			====	====

SUBAREA: A5B TOTAL DRAINAGE AREA: 6.5 Acres WEIGHTED CURVE NUMBER: 88

RUNOFF CURVE NUMBER COMPUTATION

Version 2.10

Project : KENSINGTON FARMS
County : CASS
Subtitle: POST-DEVELOPMENT
Subarea : A6C

State: MO

User: RBH
Checked: _____

Date: 11-23-2004
Date: _____

COVER DESCRIPTION	A	Hydrologic Soil Group		D
		B	C	
		Acres (CN)		
FULLY DEVELOPED URBAN AREAS (Veg Estab.)				
Residential districts				
(by average lot size)				
1/4 acre	38	-	11.6(83)	6.6(87)
Total Area (by Hydrologic Soil Group)			11.6	6.6
			====	====

SUBAREA: A6C TOTAL DRAINAGE AREA: 18.2 Acres WEIGHTED CURVE NUMBER: 84

RUNOFF CURVE NUMBER COMPUTATION

Version 2.10

Project : KENSINGTON FARMS

User: RBH

Date: 11-23-2004

County : CASS

State: MO

Checked: _____

Date: _____

Subtitle: POST-DEVELOPMENT

Subarea : A6B

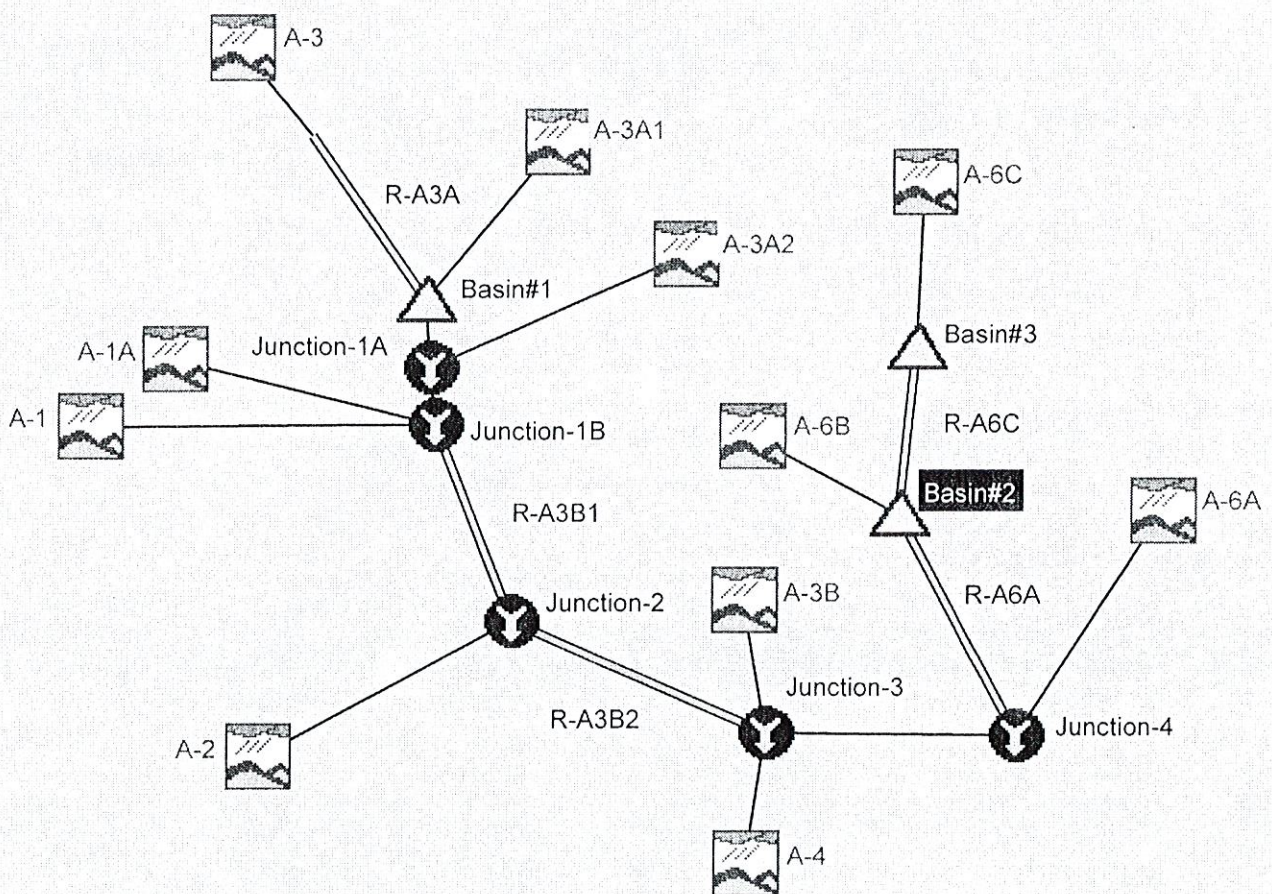
COVER DESCRIPTION	A	Hydrologic Soil Group		D	
		B	C		
		Acres (CN)			

FULLY DEVELOPED URBAN AREAS (Veg Estab.)					
Open space (Lawns,parks etc.)					
Good condition; grass cover > 75%	-	-	2.7(74)	11.5(80)	
Streets and roads					
Paved; curbs and storm sewers	-	-	3.5(98)	-	
Residential districts					
Avg % imperv					
(by average lot size)					
1/8 acre (town houses)	65	-	-	10.6(90)	21.2(92)
1/4 acre	38	-	-	18.5(83)	17.5(87)
Total Area (by Hydrologic Soil Group)			35.3	50.2	
			=====	=====	

SUBAREA: A6B

TOTAL DRAINAGE AREA: 85.5 Acres

WEIGHTED CURVE NUMBER: 87



HMS * Summary of Results

Project : Kensington

Run Name : Run 33

Start of Run : 21Oct05 0000 Basin Model : Final Post
 End of Run : 21Oct05 2400 Met. Model : 2-yr
 Execution Time : 19Oct05 1602 Control Specs : 10-21-05

Hydrologic Element	Discharge Peak (cfs)	Stage Peak (ft)	Time of Peak	e (ac ft)	Drainage Area (sq mi)
A-3	40.601		21 Oct 05 1224	5.8960	0.140
R-A3A	40.582		21 Oct 05 1225	5.8921	0.140
A-3A1	417.58		21 Oct 05 1202	26.799	0.240
Basin#1	100.70	978.43	21 Oct 05 1231	32.463	0.379
A-3A2	46.291		21 Oct 05 1202	2.9960	0.024
Junction-1A	127.10		21 Oct 05 1205	35.459	0.403
A-1	240.67		21 Oct 05 1229	37.430	0.744
A-1A	49.257		21 Oct 05 1203	3.1547	0.035
Junction-1B	356.71		21 Oct 05 1229	76.044	1.182
R-A3B1	351.59		21 Oct 05 1238	75.449	1.182
A-2	314.22		21 Oct 05 1241	57.299	0.974
Junction-2	664.67		21 Oct 05 1240	132.75	2.156
R-A3B2	566.21		21 Oct 05 1256	129.22	2.156
A-3B	198.66		21 Oct 05 1209	16.758	0.210
A-4	174.09		21 Oct 05 1213	16.936	0.233
Junction-3	636.40		21 Oct 05 1252	162.92	2.600
A-6C	47.696		21 Oct 05 1202	3.0571	0.028
Basin#3	13.034		21 Oct 05 1219	3.0552	0.028
R-A6C	13.033		21 Oct 05 1219	3.0545	0.028
A-6B	250.31		21 Oct 05 1202	16.142	0.134
Basin#2	157.44	971.50	21 Oct 05 1211	19.188	0.162
R-A6A	157.08		21 Oct 05 1214	19.168	0.162
A-6A	668.45		21 Oct 05 1210	57.981	0.727
Junction-4	1269.6		21 Oct 05 1211	240.07	3.489

HMS * Summary of Results for Basin#1

Project : Kensington

Run Name : Run 33

Start of Run : 21Oct05 0000 Basin Model : Final Post

End of Run : 21Oct05 2400 Met. Model : 2-yr

Execution Time : 19Oct05 1602 Control Specs : 10-21-05

Computed Results

Peak Inflow : 426.87 (cfs) Date/Time of Peak Inflow : 21 Oct 05 1203

Peak Outflow : 100.70 (cfs) Date/Time of Peak Outflow : 21 Oct 05 1231

Total Inflow : 1.62 (in) ^{32.49} Peak Storage : 10.420(ac-ft)

Total Outflow : 1.61 (in) Peak Elevation : 978.43(ft)

HMS * Summary of Results for Basin#2

Project : Kensington

Run Name : Run 33

Start of Run : 21Oct05 0000 Basin Model : Final Post

End of Run : 21Oct05 2400 Met. Model : 2-yr

Execution Time : 19Oct05 1602 Control Specs : 10-21-05

Computed Results

Peak Inflow : 259.92 (cfs) Date/Time of Peak Inflow : 21 Oct 05 1202

Peak Outflow : 157.44 (cfs) Date/Time of Peak Outflow : 21 Oct 05 1211

Total Inflow : 2.22 (in) ^{19.20} Peak Storage : 2.7597(ac-ft)

Total Outflow : 2.22 (in) Peak Elevation : 971.50(ft)

HMS * Summary of Results for Basin#3

Project : Kensington

Run Name : Run 33

Start of Run : 21Oct05 0000 Basin Model : Final Post

End of Run : 21Oct05 2400 Met. Model : 2-yr

Execution Time : 19Oct05 1602 Control Specs : 10-21-05

Computed Results

Peak Inflow : 47.696 (cfs) Date/Time of Peak Inflow : 21 Oct 05 1202

Peak Outflow : 13.034 (cfs) Date/Time of Peak Outflow : 21 Oct 05 1219

Total Inflow : 2.02 (in) ^{2.06} Peak Storage : 0.96462(ac-ft)

Total Outflow : 2.01 (in) Peak Elevation : 991.70(ft)

HMS * Summary of Results

Project : Kensington

Run Name : Run 34

Start of Run : 21Oct05 0000 Basin Model : Final Post

End of Run : 21Oct05 2400 Met. Model : 10-yr

Execution Time : 19Oct05 1602 Control Specs : 10-21-05

Hydrologic Element	Discharge Peak (cfs)	Stage Peak (ft)	Time of Peak	e (ac ft)	Drainage Area (sq mi)
A-3	112.59		21 Oct 05 1221	14.143	0.140
R-A3A	112.57		21 Oct 05 1222	14.136	0.140
A-3A1	731.03		21 Oct 05 1202	47.652	0.240
Basin#1	421.58	980.52	21 Oct 05 1213	61.166	0.379
A-3A2	77.715		21 Oct 05 1202	5.1429	0.024
Junction-1A	458.29		21 Oct 05 1212	66.309	0.403
A-1	604.28		21 Oct 05 1227	84.855	0.744
A-1A	92.856		21 Oct 05 1202	5.9672	0.035
Junction-1B	972.84		21 Oct 05 1220	157.13	1.182
R-A3B1	959.78		21 Oct 05 1228	156.09	1.182
A-2	727.10		21 Oct 05 1239	123.56	0.974
Junction-2	1647.2		21 Oct 05 1233	279.65	2.156
R-A3B2	1426.9		21 Oct 05 1245	275.19	2.156
A-3B	397.81		21 Oct 05 1208	32.996	0.210
A-4	364.35		21 Oct 05 1212	34.300	0.233
Junction-3	1617.3		21 Oct 05 1240	342.49	2.600
A-6C	84.728		21 Oct 05 1202	5.5017	0.028
Basin#3	18.399		21 Oct 05 1222	5.4960	0.028
R-A6C	18.398		21 Oct 05 1222	5.4950	0.028
A-6B	426.00		21 Oct 05 1202	28.032	0.134
Basin#2	208.37	973.39	21 Oct 05 1213	33.512	0.162
R-A6A	208.07		21 Oct 05 1216	33.481	0.162
A-6A	1342.0		21 Oct 05 1209	114.17	0.727
Junction-4	2654.0		21 Oct 05 1212	490.14	3.489

HMS * Summary of Results for Basin#1

Project : Kensington

Run Name : Run 34

Start of Run : 21Oct05 0000 Basin Model : Final Post

End of Run : 21Oct05 2400 Met. Model : 10-yr

Execution Time : 19Oct05 1602 Control Specs : 10-21-05

Computed Results

Peak Inflow : 770.11 (cfs) Date/Time of Peak Inflow : 21 Oct 05 1202

Peak Outflow : 421.58 (cfs) Date/Time of Peak Outflow : 21 Oct 05 1213

Total Inflow : 3.06 (in) (1.7⁹) Peak Storage : 15.854 (ac-ft)

Total Outflow : 3.02 (in) Peak Elevation : 980.52 (ft)

HMS * Summary of Results for Basin#2

Project : Kensington

Run Name : Run 34

Start of Run : 21Oct05 0000 Basin Model : Final Post

End of Run : 21Oct05 2400 Met. Model : 10-yr

Execution Time : 19Oct05 1602 Control Specs : 10-21-05

Computed Results

Peak Inflow : 439.87 (cfs) Date/Time of Peak Inflow : 21 Oct 05 1202

Peak Outflow : 208.37 (cfs) Date/Time of Peak Outflow : 21 Oct 05 1213

Total Inflow : 3.88 (in) ^{33.53} Peak Storage : 6.0810(ac-ft)

Total Outflow : 3.88 (in) Peak Elevation : 973.39(ft)

HMS * Summary of Results for Basin#3

Project : Kensington

Run Name : Run 34

Start of Run : 21Oct05 0000 Basin Model : Final Post

End of Run : 21Oct05 2400 Met. Model : 10-yr

Execution Time : 19Oct05 1602 Control Specs : 10-21-05

Computed Results

Peak Inflow : 84.728 (cfs) Date/Time of Peak Inflow : 21 Oct 05 1202

Peak Outflow : 18.399 (cfs) Date/Time of Peak Outflow : 21 Oct 05 1222

Total Inflow : 3.63 (in) ^{5.50} Peak Storage : 1.9610(ac-ft)

Total Outflow : 3.62 (in) Peak Elevation : 992.39(ft)

HMS * Summary of Results for Basin#1

Project : Kensington

Run Name : Run 35

Start of Run : 21Oct05 0000 Basin Model : Final Post

End of Run : 21Oct05 2400 Met. Model : 25-yr

Execution Time : 19Oct05 1603 Control Specs : 10-21-05

Computed Results

Peak Inflow : 947.23 (cfs) Date/Time of Peak Inflow : 21 Oct 05 1202

Peak Outflow : 517.11 (cfs) Date/Time of Peak Outflow : 21 Oct 05 1213

Total Inflow : 3.82 (in) ^{77.35} Peak Storage : 18.584(ac-ft)

Total Outflow : 3.79 (in) Peak Elevation : 981.51(ft)

HMS * Summary of Results for Basin#2

Project : Kensington

Run Name : Run 35

Start of Run : 21Oct05 0000 Basin Model : Final Post

End of Run : 21Oct05 2400 Met. Model : 25-yr

Execution Time : 19Oct05 1603 Control Specs : 10-21-05

Computed Results

Peak Inflow : 529.54 (cfs) Date/Time of Peak Inflow : 21 Oct 05 1202

Peak Outflow : 230.63 (cfs) Date/Time of Peak Outflow : 21 Oct 05 1213

Total Inflow : 4.73 (in) ^{4.73} Peak Storage : 7.9648(ac-ft)

Total Outflow : 4.73 (in) Peak Elevation : 974.29(ft)

HMS * Summary of Results for Basin#3

Project : Kensington

Run Name : Run 35

Start of Run : 21Oct05 0000 Basin Model : Final Post

End of Run : 21Oct05 2400 Met. Model : 25-yr

Execution Time : 19Oct05 1603 Control Specs : 10-21-05

Computed Results

Peak Inflow : 103.45 (cfs) Date/Time of Peak Inflow : 21 Oct 05 1202

Peak Outflow : 20.681 (cfs) Date/Time of Peak Outflow : 21 Oct 05 1223

Total Inflow : 4.47 (in) ^{6.77} Peak Storage : 2.5038(ac-ft)

Total Outflow : 4.46 (in) Peak Elevation : 992.75(ft)

HMS * Summary of Results

Project : Kensington

Run Name : Run 36

Start of Run : 21Oct05 0000 Basin Model : Final Post
 End of Run : 21Oct05 2400 Met. Model : 100-yr
 Execution Time : 19Oct05 1603 Control Specs : 10-21-05

Hydrologic Element	Discharge Peak (cfs)	Stage Peak (ft)	Time of Peak	e (ac ft)	Drainage Area (sq mi)
A-3	228.76		21 Oct 05 1220	27.473	0.140
R-A3A	228.68		21 Oct 05 1221	27.463	0.140
A-3A1	1151.3		21 Oct 05 1202	76.733	0.240
Basin#1	594.06	983.75	21 Oct 05 1215	103.30	0.379
A-3A2	119.33		21 Oct 05 1202	8.0937	0.024
Junction-1A	662.92		21 Oct 05 1207	111.39	0.403
A-1	1171.6		21 Oct 05 1226	159.42	0.744
A-1A	153.31		21 Oct 05 1202	10.004	0.035
Junction-1B	1799.3		21 Oct 05 1225	280.82	1.182
R-A3B1	1781.0		21 Oct 05 1230	279.40	1.182
A-2	1352.7		21 Oct 05 1238	225.15	0.974
Junction-2	3099.0		21 Oct 05 1233	504.55	2.156
R-A3B2	2779.1		21 Oct 05 1241	498.07	2.156
A-3B	681.86		21 Oct 05 1208	56.767	0.210
A-4	639.61		21 Oct 05 1212	60.086	0.233
Junction-3	3138.4		21 Oct 05 1237	614.93	2.600
A-6C	134.64		21 Oct 05 1202	8.9290	0.028
Basin#3	24.143		21 Oct 05 1225	8.9157	0.028
R-A6C	24.142		21 Oct 05 1225	8.9142	0.028
A-6B	659.50		21 Oct 05 1202	44.451	0.134
Basin#2	357.08	975.34	21 Oct 05 1211	53.339	0.162
R-A6A	356.14		21 Oct 05 1215	53.283	0.162
A-6A	2299.3		21 Oct 05 1209	196.42	0.727
Junction-4	5019.3		21 Oct 05 1212	864.63	3.489

HMS * Summary of Results for Basin#1

Project : Kensington

Run Name : Run 36

Start of Run : 21Oct05 0000 Basin Model : Final Post

End of Run : 21Oct05 2400 Met. Model : 100-yr

Execution Time : 19Oct05 1603 Control Specs : 10-21-05

Computed Results

Peak Inflow : 1245.3 (cfs) Date/Time of Peak Inflow : 21 Oct 05 1202

Peak Outflow : 594.06 (cfs) Date/Time of Peak Outflow : 21 Oct 05 1215

Total Inflow : 5.15 (in) Peak Storage : 25.163(ac-ft)

Total Outflow : 5.11 (in) Peak Elevation : 983.75(ft)

HMS * Summary of Results for Basin#2

Project : Kensington

Run Name : Run 36

Start of Run : 21Oct05 0000 Basin Model : Final Post

End of Run : 21Oct05 2400 Met. Model : 100-yr

Execution Time : 19Oct05 1603 Control Specs : 10-21-05

Computed Results

Peak Inflow : 677.86 (cfs) Date/Time of Peak Inflow : 21 Oct 05 1202

Peak Outflow : 357.08 (cfs) Date/Time of Peak Outflow : 21 Oct 05 1211

Total Inflow : 6.18 (in) ^{63.37} Peak Storage : 10.304(ac-ft)

Total Outflow : 6.17 (in) Peak Elevation : 975.34(ft)

HMS * Summary of Results for Basin#3

Project : Kensington

Run Name : Run 36

Start of Run : 21Oct05 0000 Basin Model : Final Post

End of Run : 21Oct05 2400 Met. Model : 100-yr

Execution Time : 19Oct05 1603 Control Specs : 10-21-05

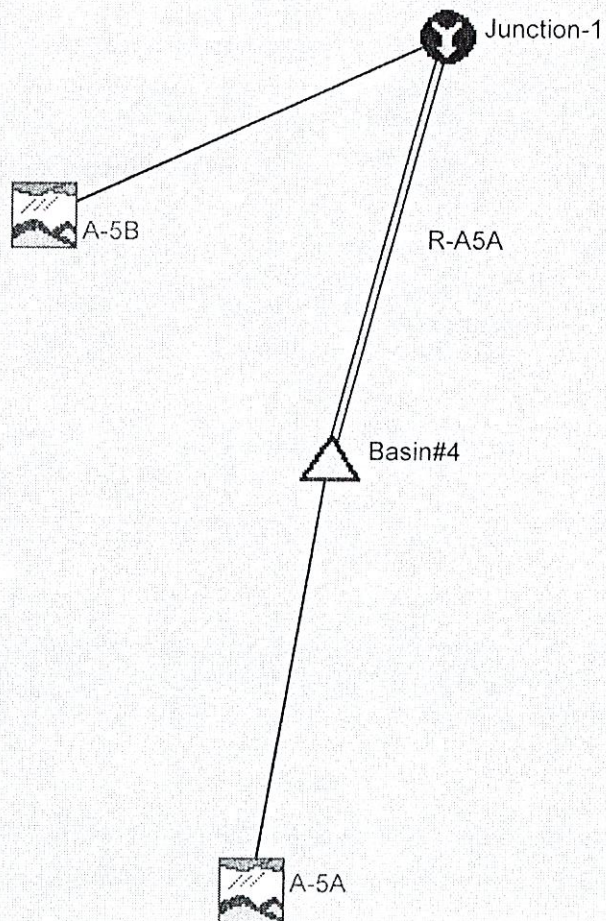
Computed Results

Peak Inflow : 134.64 (cfs) Date/Time of Peak Inflow : 21 Oct 05 1202

Peak Outflow : 24.143 (cfs) Date/Time of Peak Outflow : 21 Oct 05 1225

Total Inflow : 5.89 (in) ^{8.93} Peak Storage : 3.4485(ac-ft)

Total Outflow : 5.88 (in) Peak Elevation : 993.39(ft)



HMS * Summary of Results

Project : Kensington

Run Name : Run 37

Start of Run : 21Oct05 0000 Basin Model : Final Post-A5

End of Run : 21Oct05 2400 Met. Model : 2-yr

Execution Time : 19Oct05 1606 Control Specs : 10-21-05

Hydrologic Element	Discharge Peak (cfs)	Time of Peak	Volume (ac ft)	Drainage Area (sq mi)
A-5A	38.665	21 Oct 05 1202	2.4813	0.022
Basin#4	12.653	21 Oct 05 1216	2.3633	0.022
R-A5A	12.651	21 Oct 05 1216	2.3631	0.022
A-5B	22.239	21 Oct 05 1159	1.2758	0.010
Junction-1	32.601	21 Oct 05 1200	3.6389	0.032

HMS * Summary of Results for Basin#4

Project : Kensington

Run Name : Run 37

Start of Run : 21Oct05 0000 Basin Model : Final Post-A5

End of Run : 21Oct05 2400 Met. Model : 2-yr

Execution Time : 19Oct05 1606 Control Specs : 10-21-05

Computed Results

Peak Inflow : 38.665 (cfs) Date/Time of Peak Inflow : 21 Oct 05 1202

Peak Outflow : 12.653 (cfs) Date/Time of Peak Outflow : 21 Oct 05 1216

Total Inflow : 2.10 (in) ^{2.4B} Peak Storage : 0.76806(ac-ft)

Total Outflow : 2.00 (in) Peak Elevation : 1000.8(ft)

HMS * Summary of Results

Project : Kensington

Run Name : Run 38

Start of Run : 21Oct05 0000 Basin Model : Final Post-A5

End of Run : 21Oct05 2400 Met. Model : 10-yr

Execution Time : 19Oct05 1606 Control Specs : 10-21-05

Hydrologic Element	Discharge Peak (cfs)	Time of Peak	Volume (ac ft)	Drainage Area (sq mi)
A-5A	67.688	21 Oct 05 1202	4.4122	0.022
Basin#4	16.180	21 Oct 05 1220	4.2934	0.022
R-A5A	16.180	21 Oct 05 1220	4.2931	0.022
A-5B	37.252	21 Oct 05 1159	2.1898	0.010
Junction-1	49.490	21 Oct 05 1200	6.4829	0.032

HMS * Summary of Results for Basin#4

Project : Kensington

Run Name : Run 38

Start of Run : 21Oct05 0000 Basin Model : Final Post-A5

End of Run : 21Oct05 2400 Met. Model : 10-yr

Execution Time : 19Oct05 1606 Control Specs : 10-21-05

Computed Results

Peak Inflow : 67.688 (cfs) Date/Time of Peak Inflow : 21 Oct 05 1202

Peak Outflow : 16.180 (cfs) Date/Time of Peak Outflow : 21 Oct 05 1220

Total Inflow : 3.73 (in)^{4.41} Peak Storage : 1.5184(ac-ft)

Total Outflow : 3.63 (in) Peak Elevation : 1002.1(ft)

HMS * Summary of Results

Project : Kensington

Run Name : Run 39

Start of Run : 21Oct05 0000 Basin Model : Final Post-A5

End of Run : 21Oct05 2400 Met. Model : 25-yr

Execution Time : 19Oct05 1606 Control Specs : 10-21-05

Hydrologic Element	Discharge Peak (cfs)	Time of Peak	Volume (ac ft)	Drainage Area (sq mi)
A-5A	82.301	21 Oct 05 1202	5.4117	0.022
Basin#4	17.505	21 Oct 05 1222	5.2924	0.022
R-A5A	17.505	21 Oct 05 1222	5.2920	0.022
A-5B	44.731	21 Oct 05 1159	2.6577	0.010
Junction-1	57.885	21 Oct 05 1200	7.9496	0.032

HMS * Summary of Results for Basin#4

Project : Kensington

Run Name : Run 39

Start of Run : 21Oct05 0000 Basin Model : Final Post-A5

End of Run : 21Oct05 2400 Met. Model : 25-yr

Execution Time : 19Oct05 1606 Control Specs : 10-21-05

Computed Results

Peak Inflow : 82.301 (cfs) Date/Time of Peak Inflow : 21 Oct 05 1202

Peak Outflow : 17.505 (cfs) Date/Time of Peak Outflow : 21 Oct 05 1222

Total Inflow : 4.57 (in) 6.24 Peak Storage : 1.9307(ac-ft)

Total Outflow : 4.47 (in) Peak Elevation : 1002.7(ft)

HMS * Summary of Results

Project : Kensington

Run Name : Run 40

Start of Run : 21Oct05 0000 Basin Model : Final Post-A5

End of Run : 21Oct05 2400 Met. Model : 100-yr

Execution Time : 19Oct05 1606 Control Specs : 10-21-05

Hydrologic Element	Discharge Peak (cfs)	Time of Peak		Volume (ac ft)	Drainage Area (sq mi)
A-5A	106.60	21 Oct 05	1202	7.1049	0.022
Basin#4	19.600	21 Oct 05	1224	6.9846	0.022
R-A5A	19.600	21 Oct 05	1225	6.9840	0.022
A-5B	57.119	21 Oct 05	1159	3.4460	0.010
Junction-1	71.807	21 Oct 05	1159	10.430	0.032

HMS * Summary of Results for Basin#4

Project : Kensington

Run Name : Run 40

Start of Run : 21Oct05 0000 Basin Model : Final Post-A5

End of Run : 21Oct05 2400 Met. Model : 100-yr

Execution Time : 19Oct05 1606 Control Specs : 10-21-05

Computed Results

Peak Inflow : 106.60 (cfs) Date/Time of Peak Inflow : 21 Oct 05 1202

Peak Outflow : 19.600 (cfs) Date/Time of Peak Outflow : 21 Oct 05 1224

Total Inflow : 6.00 (in) ^{7.10} Peak Storage : 2.6490(ac-ft)

Total Outflow : 5.90 (in) Peak Elevation : 1003.7(ft)

HMS * Basin Model * Routing Reach [Help] [] [X]

Reach Name : R-A3A

Description : [] []

Routing Method : Muskingum Cunge Std. [v]

Cross Section Shape: CIRCLE [v]

Reach Length (ft) 1000

Energy Slope (ft/ft) 0.01

Bottom Width
or Diameter (ft) 6

Side Slope (xH:1V) :

Manning's n : 0.012

[OK] [Apply] [Cancel]

[]

HMS * Basin Model * Routing Reach

Help

Reach Name : R-A3B1

Description : X-Section @ Midpoint of Channel Reach

Routing Method : Muskingum Cunge 8 Point

Reach Length (ft)
2473

Energy Slope (ft/ft)
0.004

Manning's N Values

Left Overbank	Channel	Right Overbank
0.1	0.045	0.1

Cross Section Coordinates

	Station (ft)	Elevation (ft)
1	0	968
2	10	966
3	20	964
4	29	962
5	33	961
6	36	962
7	44	964
8	52	966

OK Apply Cancel

HMS * Basin Model * Routing Reach _ | □ | X

Help

Reach Name :

Description : ...

Routing Method : ▼

Reach Length (ft)

Energy Slope (ft/ft)

Manning's N Values

Left Overbank	Channel	Right Overbank
0.1	0.045	0.1

Cross Section Coordinates

	Station (ft)	Elevation (ft)
1	0	962
2	20	960
3	37	958
4	45	956
5	53	955.5
6	63	956
7	66	958
8	77	960

HMS * Basin Model * Routing Reach [min] [max] [close]

Help

Reach Name : R-A6C

Description : [] []

Routing Method : Muskingum Cunge Std. [v]

Cross Section Shape: CIRCLE [v]

Reach Length (ft) 425

Energy Slope (ft/ft) 0.01

Bottom Width
or Diameter (ft) 4

Side Slope (xH:1V) :

Manning's n : 0.012

[OK] [Apply] [Cancel]

[]

HMS * Basin Model * Routing Reach

Help

Reach Name : R-A6A

Description : X-Section @ 3/4th the way Upstream of Channel R...

Routing Method : Muskingum Cunge 8 Point

Reach Length (ft)
790

Energy Slope (ft/ft)
0.011

Manning's N Values

Left Overbank	Channel	Right Overbank
0.1	0.045	0.1

Cross Section Coordinates

	Station (ft)	Elevation (ft)
1	0	970
2	50	968
3	65	966
4	71	964
5	77	962
6	85	962
7	89	964
8	230	970

OK Apply Cancel

HMS * Basin Model * Routing Reach

Help

Reach Name : R-A5A

Description :

Routing Method : Muskingum Cunge Std.

Cross Section Shape: CIRCLE

Reach Length (ft) 250

Energy Slope (ft/ft) 0.083

Bottom Width or Diameter (ft) 3

Side Slope (xH:1V) :

Manning's n : 0.024

OK Apply Cancel

APPENDIX C
STAGE-STORAGE TABLES
OUTLET RATING TABLES
OUTLET STRUCTURE SKETCHES

Project
No.: 24130803

Kensington Farms
Detention Basin
Summary Table

Date: 11/18/05
Initials: RBH

		Basin #1	Basin #2	Basin #3	Basin #4
Pre-Development: Flows (cfs)	2-year	211.14	177.58		34.87
	10-year	456.69	348.77		69.46
	25-year	588.03	438.18		87.72
	100-year	813.44	589.42		118.71
Pre-Development: Volume (ac-ft)	2-year	31.49	13.59		2.60
	10-year	62.26	26.37		5.11
	25-year	78.84	33.20		6.46
	100-year	107.53	44.95		8.78
Post-Development: Flows (cfs)	2-year	426.87	259.92	47.70	38.67
	10-year	770.11	439.87	84.73	67.69
	25-year	947.23	529.54	103.45	82.30
	100-year	1245.30	677.86	134.64	106.60
Post-Development: Volume (ac-ft)	2-year	32.69	19.20	3.06	2.48
	10-year	61.79	33.53	5.50	4.41
	25-year	77.35	40.90	6.77	5.41
	100-year	104.20	53.37	8.93	7.10
Detention Outflow: (cfs)	2-year	100.70	157.44	13.03	12.65
	10-year	421.58	208.37	18.40	16.18
	25-year	517.11	230.63	20.68	17.51
	100-year	594.06	357.08	24.14	19.60
Detention Elevation:	2-year	978.43	971.50	991.70	1000.80
	10-year	980.52	973.39	992.39	1002.10
	25-year	981.51	974.29	992.75	1002.70
	100-year	983.75	975.34	993.39	1003.70
Detention Volume: (ac-ft)	2-year	10.42	2.76	0.96	0.77
	10-year	15.85	6.08	1.96	1.52
	25-year	18.58	7.96	2.50	1.93
	100-year	25.16	10.30	3.45	2.65

Project
No.: 24130803

Project
Kensington Farm

Date: 11/18/2005
Calc By: RBH

Basin #1

Elevation	Area (ft ²)	Avg. Area (ft ²)	Depth	Volume (ft ³)	Cumulative Volume (ft ³)	Cumulative Volume (acre-ft)
972.0	0.00			0.00	0.00	0.00
		26,656.2	2			
974.0	53,312.48			53,312.48	53,312.48	1.22
		75,635.6	2			
976.0	97,958.64			151,271.12	204,583.60	4.70
		102,319.2	2			
978.0	106,679.76			204,638.40	409,222.00	9.39
		111,185.2	2			
980.0	115,690.69			222,370.45	631,592.45	14.50
		120,334.2	2			
982.0	124,977.80			240,668.49	872,260.94	20.02
		129,757.4	2			
984.0	134,537.00			259,514.80	1,131,775.74	25.98
		139,975.9	2			
986.0	145,414.77			279,951.77	1,411,727.51	32.41

Top of Dam = 986.0

Storage at 984.0 = 25.98 acre-ft

Outlet: 3'x3' Orifice
30' long weir @ Elev.=978.0
2-60" Outlet Pipes

Emergency Spillway @ 984.20 w/ L=170 ft

Project
No.: 24130803

Project
Kensington Farm

Date: 11/18/2005
Calc By: RBH

Basin #2

Elevation	Area (ft ²)	Avg. Area (ft ²)	Depth	Volume (ft ³)	Cumulative Volume (ft ³)	Cumulative Volume (acre-ft)
967.00	0.00			0.00	0.00	0.00
		2,349.3	1			
968.00	4,698.60			2,349.30	2,349.30	0.00
		20,923.0	2			
970.00	37,147.35			41,845.95	44,195.25	1.01
		55,054.0	2			
972.00	72,960.57			110,107.92	154,303.17	3.54
		82,910.0	2			
974.00	92,859.51			165,820.08	320,123.25	7.35
		97,705.2	2			
976.00	102,550.96			195,410.47	515,533.72	11.84
		107,517.0	2			
978.00	112,483.12			215,034.08	730,567.80	16.77
		115,004.4	1			
979.00	117,525.76			115,004.44	845,572.24	19.41

Top of Dam = 979.0

Storage at 976.0 = 11.84 acre-ft

Outlet: 5'x4' Orifice
44' long weir @ Elev.=974.30
72" Outlet Pipe

Emergency Spillway @ 97665 w/ L=150 ft

BASIN #2
Orifice-Weir Combined Outlet Structure

* Flow for outlet is calculated for both weir and orifice conditions and which is
 ever smaller is the flow used

Number Pipes = 1
 Orifice Span = 5 ft
 Orifice Rise = 4 ft

Orifice Area =	20.00 ft ²	Elevation	Headwater (b)	Orifice Discharge Coefficient	Orifice Flow	Head / Headwater (H/H _w)	Discharge Coefficient	Weir Coefficient	Flow (cfs)	Total Flow (cfs)
Mid. Pipe Elevation =	969.00	967.00	0.0	0.62	unknown	no weir flow	no weir flow	no weir flow	0.00	0.0
Weir Elevation =	974.30	967.20	0.2	0.62	unknown	no weir flow	no weir flow	no weir flow	1.34	1.3
Length of Weir =	44.00 ft	967.40	0.4	0.62	unknown	no weir flow	no weir flow	no weir flow	3.79	3.8
Top of Bank Elevation =	979.00	967.60	0.6	0.62	unknown	no weir flow	no weir flow	no weir flow	6.97	7.0
Datum =	967.00	967.80	0.8	0.62	unknown	no weir flow	no weir flow	no weir flow	10.73	10.7
Head (H _w) =	7.30	968.00	1.0	0.62	unknown	no weir flow	no weir flow	no weir flow	15.00	15.0
Outlet Pipe=	72.00 in	968.20	1.2	0.62	unknown	no weir flow	no weir flow	no weir flow	19.72	19.7
Emergency Spillway Length =	95 ft	968.40	1.4	0.62	unknown	no weir flow	no weir flow	no weir flow	24.85	24.8
		968.60	1.6	0.62	unknown	no weir flow	no weir flow	no weir flow	30.36	30.4
		968.80	1.8	0.62	0.0	no weir flow	no weir flow	no weir flow	36.22	36.2
		969.00	2.0	0.62	0.0	no weir flow	no weir flow	no weir flow	42.43	42.4
		969.20	2.2	0.62	44.5	no weir flow	no weir flow	no weir flow	44.5	44.5
		969.40	2.4	0.62	62.9	no weir flow	no weir flow	no weir flow	0.00	0.0
		969.60	2.6	0.62	77.1	no weir flow	no weir flow	no weir flow	0.00	0.0
		969.80	2.8	0.62	89.0	no weir flow	no weir flow	no weir flow	0.00	0.0
		970.00	3.0	0.62	99.5	no weir flow	no weir flow	no weir flow	0.00	0.0
		970.20	3.2	0.62	109.0	no weir flow	no weir flow	no weir flow	0.00	0.0
		970.40	3.4	0.62	117.7	no weir flow	no weir flow	no weir flow	0.00	0.0
		970.60	3.6	0.62	125.9	no weir flow	no weir flow	no weir flow	0.00	0.0
		970.80	3.8	0.62	133.5	no weir flow	no weir flow	no weir flow	0.00	0.0
		971.00	4.0	0.62	140.7	no weir flow	no weir flow	no weir flow	0.00	0.0
		971.20	4.2	0.62	147.6	no weir flow	no weir flow	no weir flow	0.00	0.0
		971.40	4.4	0.62	154.2	no weir flow	no weir flow	no weir flow	0.00	0.0
		971.60	4.6	0.62	160.5	no weir flow	no weir flow	no weir flow	0.00	0.0
		971.80	4.8	0.62	166.5	no weir flow	no weir flow	no weir flow	0.00	0.0
		972.00	5.0	0.62	172.4	no weir flow	no weir flow	no weir flow	0.00	0.0
		972.20	5.2	0.62	178.0	no weir flow	no weir flow	no weir flow	0.00	0.0
		972.40	5.4	0.62	183.5	no weir flow	no weir flow	no weir flow	0.00	0.0
		972.60	5.6	0.62	188.8	no weir flow	no weir flow	no weir flow	0.00	0.0
		972.80	5.8	0.62	194.0	no weir flow	no weir flow	no weir flow	0.00	0.0
		973.00	6.0	0.62	199.0	no weir flow	no weir flow	no weir flow	0.00	0.0
		973.20	6.2	0.62	203.9	no weir flow	no weir flow	no weir flow	0.00	0.0
		973.40	6.4	0.62	208.7	no weir flow	no weir flow	no weir flow	0.00	0.0
		973.60	6.6	0.62	213.4	no weir flow	no weir flow	no weir flow	0.00	0.0
		973.80	6.8	0.62	218.0	no weir flow	no weir flow	no weir flow	0.00	0.0
		974.00	7.0	0.62	222.5	no weir flow	no weir flow	no weir flow	0.00	0.0
		974.20	7.2	0.62	226.9	no weir flow	no weir flow	no weir flow	0.00	0.0
		974.40	7.4	0.62	231.2	no weir flow	no weir flow	no weir flow	0.00	0.0
		974.60	7.6	0.62	235.5	0.612	0.612	3.000	4.17	235.4
		974.80	7.8	0.62	239.7	0.616	0.616	3.000	21.69	257.2
		975.00	8.0	0.62	243.7	0.618	0.618	3.000	46.67	286.3
		975.20	8.2	1.62	647.4	0.10	0.10	3.000	77.31	321.1
		975.40	8.4	2.62	1063.8	0.12	0.12	3.000	112.70	760.1
		975.60	8.6	3.62	1492.6	0.15	0.15	3.000	152.29	1216.1
		975.80	8.8	4.62	1933.6	0.18	0.18	3.000	195.65	1688.3
		976.00	9.0	5.62	2386.5	0.21	0.21	3.000	242.50	2176.1
		976.20	9.2	6.62	2851.0	0.23	0.23	3.000	292.58	2679.1
		976.40	9.4	7.62	3326.9	0.26	0.26	3.000	345.70	3196.7
		976.60	9.6	8.62	3814.1	0.29	0.29	3.000	401.70	3728.6
		976.80	9.8	9.62	4312.2	0.32	0.32	3.000	460.43	4374.5
		977.00	10.0	10.62	4821.1	0.34	0.34	3.000	521.78	4833.9
		977.20	10.2	11.62	5340.5	0.37	0.37	3.000	585.62	5406.7
		977.40	10.4	12.62	5870.5	0.40	0.40	3.000	651.88	5992.4
		977.60	10.6	13.62	6410.6	0.42	0.42	3.000	720.47	6590.9
		977.80	10.8	14.62	6960.8	0.45	0.45	3.000	791.31	7201.9
		978.00	11.0	15.62	7521.0	0.48	0.48	3.000	864.32	7825.2
		978.20	11.2	16.62	8090.9	0.51	0.51	3.000	939.46	8460.4
		978.40	11.4	17.62	8670.5	0.53	0.53	3.000	1016.65	9107.6
		978.60	11.6	18.62	9259.5	0.56	0.56	3.000	1095.85	9766.3
		978.80	11.8	19.62	9857.9	0.59	0.59	3.000	1177.00	10436.5
		979.00	12.0	20.62	10465.5	0.62	0.62	3.000	1260.06	11118.0
						0.64	0.64	3.000	1345.00	11810.5

Outlet
 Pipe Flow
 #NUM!

Emergency
 Spillway Flow
 Total
 Flow (cfs)

392.5
 398.8
 405.1
 411.2
 417.2
 423.2
 429.1
 435.2
 441.9
 448.6
 455.3
 462.8
 469.9
 477.0
 484.1
 491.2
 498.3
 505.4
 512.5
 519.6
 526.7
 533.8
 540.9
 548.0
 555.1
 562.2
 569.3
 576.4
 583.5
 590.6
 597.7
 604.8
 611.9
 619.0
 626.1
 633.2
 640.3
 647.4
 654.5
 661.6
 668.7
 675.8
 682.9
 690.0
 697.1
 704.2
 711.3
 718.4
 725.5
 732.6
 739.7
 746.8
 753.9
 761.0
 768.1
 775.2
 782.3
 789.4
 796.5
 803.6
 810.7
 817.8
 824.9
 832.0
 839.1
 846.2
 853.3
 860.4
 867.5
 874.6
 881.7
 888.8
 895.9
 903.0
 910.1
 917.2
 924.3
 931.4
 938.5
 945.6
 952.7
 959.8
 966.9
 974.0
 981.1
 988.2
 995.3
 1002.4
 1009.5
 1016.6
 1023.7
 1030.8
 1037.9
 1045.0
 1052.1
 1059.2
 1066.3
 1073.4
 1080.5
 1087.6
 1094.7
 1101.8
 1108.9
 1116.0
 1123.1
 1130.2
 1137.3
 1144.4
 1151.5
 1158.6
 1165.7
 1172.8
 1179.9
 1187.0
 1194.1
 1201.2
 1208.3
 1215.4
 1222.5
 1229.6
 1236.7
 1243.8
 1250.9
 1258.0
 1265.1
 1272.2
 1279.3
 1286.4
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 3934.7
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 3984.4
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 4005.7
 4012.8
 4019.9
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 4048.3
 4055.4
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 4069.6
 4076.7
 4083.8
 4090.9
 4098.0
 4105.1
 4112.2
 4119.3
 4126.4
 4133.5
 4140.6
 4147.7
 4154.8
 4161.9
 4169.0
 4176.1
 4183.2
 4190.3
 419

Project
No.: 24130803

Project
Kensington Farm

Date: 11/18/2005
Calc By: RBH

Basin #3

Elevation	Area (ft ²)	Avg. Area (ft ²)	Depth	Volume (ft ³)	Cumulative Volume (ft ³)	Cumulative Volume (acre-ft)
986.00	45,735.0			0.00	0.00	0.00
		48,301.1	2			
988.00	50,867.2			96,602.24	96,602.24	2.22
		53,546.5	2			
990.00	56,225.7			107,092.92	203,695.16	4.68
		57,621.8	1			
991.00	59,018.0			57,621.84	261,317.00	6.00

Water Surface Elevation=991.00

991.00	59,018.0			0.00	0.00	0.00
		60,414.2	1			
992.00	61,810.3			60,414.15	60,414.15	1.39
		64,715.7	2			
994.00	67,621.1			129,431.45	189,845.60	4.36
		70,639.7	2			
996.00	73,658.2			141,279.30	331,124.90	7.60

Top of Dam = 996.0

Storage at 994.0 = 4.36 acre-ft

Outlet: 24" Stand Pipe at 991.00

Emergency Spillway @ 994.0 w/ L=50 ft

Elevation	Orifice Release	Weir Flow	Total Flow (cfs)		
991.0	0.0	0.0	0.0		
991.2	7.0	1.7	1.7		
991.4	9.9	4.8	4.8		
991.6	12.1	8.8	8.8		
991.8	14.0	13.5	13.5		
992.0	15.6	18.8	15.6		
992.2	17.1	24.8	17.1		
992.4	18.5	31.2	18.5		
992.6	19.8	38.1	19.8		
992.8	21.0	45.5	21.0		
993.0	22.1	53.3	22.1		
993.2	23.2	61.5	23.2		
993.4	24.2	70.1	24.2		
993.6	25.2	79.0	25.2		
993.8	26.2	88.3	26.2	Emergency Spillway Flow	Total Flow (cfs)
994.0	27.1	97.9	27.1	0.0	27.1
994.2	28.0	107.9	28.0	13.4	41.4
994.4	28.8	118.2	28.8	37.9	66.8
994.6	29.7	128.8	29.7	69.7	99.4
994.8	30.5	139.6	30.5	107.3	137.8
995.0	31.3	150.8	31.3	150.0	181.3
995.2	32.0	162.2	32.0	197.2	229.2
995.4	32.8	174.0	32.8	248.5	281.3
995.6	33.5	186.0	33.5	303.6	337.1
995.8	34.2	198.2	34.2	362.2	396.5

Project
No.: 24130803

Project
Kensington Farm

Date: 11/18/2005
Calc By: RBH

Basin #4

Elevation	Area (ft ²)	Avg. Area (ft ²)	Depth	Volume (ft ³)	Cumulative Volume (ft ³)	Cumulative Volume (acre-ft)
998.00	0.00			0.00	0.00	0.00
		10,162.8	2			
1000.00	20,325.62			20,325.62	20,325.62	0.47
		24,030.1	2			
1002.00	27,734.49			48,060.11	68,385.73	1.57
		31,004.3	2			
1004.00	34,274.06			62,008.55	130,394.28	2.99
		37,703.7	2			
1006.00	41,133.28			75,407.34	205,801.62	4.72

Top of Dam = 1006.50

Storage at 1003.2 = 2.99 acre-ft

Outlet: 18" Dia. Orifice

Emergency Spillway Structure @ 1004.2 - 6'x6' Field Inlet w/ 4-1' Windows

BASIN #4

Orifice-Weir Combined Outlet Structure

Number Pipes = 1

Orifice Diameter = 1.5 ft

Pipe Area = 1.77 ft²

Mid. Pipe Elevation = 998.75

Weir Elevation = 1004.20

Length of Weir = 24.00 ft

Top of Bank Elevation = 1006.50

Datum = 998.00

Head (Hw) = 6.20

Outlet Pipe = 42.00 in

Emergency Spillway

Length = 24 ft

*Flow for outlet is calculated for both weir and orifice conditions and which is ever smaller is the flow used.

Elevation	Headwater (h)	Orifice Discharge Coefficient	Orifice Flow	Head / (H/H _w)	Discharge Coefficient	Weir Coefficient	Flow (cfs)	Total Flow (cfs)
998.00	0.0	0.62	unknown	no weir flow	no weir flow	no weir flow	0.00	0.0
998.20	0.2	0.62	unknown	no weir flow	no weir flow	no weir flow	0.00	0.5
998.40	0.4	0.62	unknown	no weir flow	no weir flow	no weir flow	0.00	1.0
998.60	0.6	0.62	unknown	no weir flow	no weir flow	no weir flow	0.00	1.5
998.80	0.8	0.62	2.0	no weir flow	no weir flow	no weir flow	0.00	2.0
999.00	1.0	0.62	4.4	no weir flow	no weir flow	no weir flow	0.00	4.4
999.20	1.2	0.62	5.9	no weir flow	no weir flow	no weir flow	0.00	5.9
999.40	1.4	0.62	7.1	no weir flow	no weir flow	no weir flow	0.00	7.1
999.60	1.6	0.62	8.1	no weir flow	no weir flow	no weir flow	0.00	8.1
999.80	1.8	0.62	9.0	no weir flow	no weir flow	no weir flow	0.00	9.0
1000.00	2.0	0.62	9.8	no weir flow	no weir flow	no weir flow	0.00	9.8
1000.20	2.2	0.62	10.6	no weir flow	no weir flow	no weir flow	0.00	10.6
1000.40	2.4	0.62	11.3	no weir flow	no weir flow	no weir flow	0.00	11.3
1000.60	2.6	0.62	12.0	no weir flow	no weir flow	no weir flow	0.00	12.0
1000.80	2.8	0.62	12.6	no weir flow	no weir flow	no weir flow	0.00	12.6
1001.00	3.0	0.62	13.2	no weir flow	no weir flow	no weir flow	0.00	13.2
1001.20	3.2	0.62	13.8	no weir flow	no weir flow	no weir flow	0.00	13.8
1001.40	3.4	0.62	14.3	no weir flow	no weir flow	no weir flow	0.00	14.3
1001.60	3.6	0.62	14.8	no weir flow	no weir flow	no weir flow	0.00	14.8
1001.80	3.8	0.62	15.4	no weir flow	no weir flow	no weir flow	0.00	15.4
1002.00	4.0	0.62	15.9	no weir flow	no weir flow	no weir flow	0.00	15.9
1002.20	4.2	0.62	16.3	no weir flow	no weir flow	no weir flow	0.00	16.3
1002.40	4.4	0.62	16.8	no weir flow	no weir flow	no weir flow	0.00	16.8
1002.60	4.6	0.62	17.3	no weir flow	no weir flow	no weir flow	0.00	17.3
1002.80	4.8	0.62	17.7	no weir flow	no weir flow	no weir flow	0.00	17.7
1003.00	5.0	0.62	18.1	no weir flow	no weir flow	no weir flow	0.00	18.1
1003.20	5.2	0.62	18.5	no weir flow	no weir flow	no weir flow	0.00	18.5
1003.40	5.4	0.62	19.0	no weir flow	no weir flow	no weir flow	0.00	19.0
1003.60	5.6	0.62	19.4	no weir flow	no weir flow	no weir flow	0.00	19.4
1003.80	5.8	0.62	19.8	no weir flow	no weir flow	no weir flow	0.00	19.8
1004.00	6.0	0.62	20.1	no weir flow	no weir flow	no weir flow	0.00	20.1
1004.20	6.2	1.62	53.6	0.00	0.611	3.000	0.00	20.1
1004.40	6.4	2.62	88.3	0.03	0.613	3.000	6.44	26.6
1004.60	6.6	3.62	124.2	0.06	0.616	3.000	18.21	38.4
1004.80	6.8	4.62	161.2	0.10	0.618	3.000	33.46	53.6
1005.00	7.0	5.62	199.2	0.13	0.621	3.000	51.52	71.7
1005.20	7.2	6.62	238.4	0.16	0.623	3.000	72.00	92.1
1005.40	7.4	7.62	278.7	0.19	0.626	3.000	94.65	114.8
1005.60	7.6	8.62	319.9	0.23	0.628	3.000	119.27	139.4
1005.80	7.8	9.62	362.2	0.26	0.630	3.000	145.72	165.9
1006.00	8.0	10.62	405.5	0.29	0.633	3.000	173.88	194.0

APPENDIX D
FEMA MAP
HEC-1 RESULTS
WARD RD. HY-8 RESULTS
MULLEN RD. HY-8 RESULTS
HEC-RAS RESULTS


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.....
FLOOD HYDROGRAPH PACKAGE (HEC-1)
JUN 1998
VERSION 4.1
RUN DATE 20JUN03 TIME 08:42:44
.....

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.....
U.S. ARMY CORPS OF ENGINEERS
HYDROLOGIC ENGINEERING CENTER
609 SECOND STREET
DAVIS, CALIFORNIA 95616
(916) 756-1104
.....

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X X XXXXXXX XXXX X
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X X X X X X
XXXXXXX XXXX X XXXX X
X X X X X X
X X X X X X
X X XXXXXXX XXXX XXX

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THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1G5, 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

HEC-1 INPUT

PAGE 1

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LINE ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10
1 ID RAINTREEE LAKE DAM (MO20388) CASS CO
2 IT 10 0 0 150
3 IN 36
4 IO 1
  ..... Main
5 KK AREA 1 Runoff
6 KM Basin runoff calculation for ARE
7 BA 7.6000
8 PB 24.75
9 PC 0.000 3.000 6.000 10.000 13.000 16.000 20.000 23.000 27.000 33.000
10 PC 39.000 46.000 56.000 68.000 79.000 85.000 89.000 92.000 95.000 97.000
11 PC 100.00
12 LS 0 60
13 UD 2.85
  .....
14 KK DAM 1 Route
15 RS 1 ELEV 955.0
16 SV 0.0 9.5 224.0 838.0 2255.0 4877.0 9652.0
17 SE 910.0 920.0 930.0 940.0 950.0 960.0 970.0
18 SQ 0.0 468.0 1324.0 2432.0 2744.0 5232.0 6878.0 8667.0 10590 12636
19 SQ 14799 17074.0
20 SE 955.0 956.0 957.0 958.0 959.0 960.0 961.0 962.0 963 964
21 SE 965.0 966.0
22 SS 955.0
23 ST 965.6 1700.0 3.0 1.5
24 ZZ

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.....
FLOOD HYDROGRAPH PACKAGE (HEC-1)
JUN 1998
VERSION 4.1
RUN DATE 20JUN03 TIME 08:42:44
.....

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.....
U.S. ARMY CORPS OF ENGINEERS
HYDROLOGIC ENGINEERING CENTER
609 SECOND STREET
DAVIS, CALIFORNIA 95616
(916) 756-1104
.....

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RAINTREEE LAKE DAM (MO20388) CASS CO

4 10

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OUTPUT CONTROL VARIABLES
IFRNT 1 PRINT CONTROL
IPLOT 0 PLOT CONTROL
QSCAL 0. HYDROGRAPH PLOT SCALE

```

IT

```

HYDROGRAPH TIME DATA
MMIN 10 MINUTES IN COMPUTATION INTERVAL
IDATE 1 0 STARTING DATE
ITIME 0000 STARTING TIME
NQ 150 NUMBER OF HYDROGRAPH ORDINATES
NDDATE 2 0 ENDING DATE
NDTIME 0050 ENDING TIME
ICENT 19 CENTURY MARK

```

COMPUTATION INTERVAL .17 HOURS
TOTAL TIME BASE 24.83 HOURS

ENGLISH UNITS
DRAINAGE AREA SQUARE MILES
PRECIPITATION DEPTH INCHES
LENGTH, ELEVATION FEET
FLOW CUBIC FEET PER SECOND
STORAGE VOLUME ACRE-Feet
SURFACE AREA ACRES
TEMPERATURE DEGREES FAHRENHEIT

5 KK

AREA

1 Runoff

Basin runoff calculation for

ARE

3 IN

TIME DATA FOR INPUT TIME SERIES

JXMIN 36 TIME INTERVAL IN MINUTES
JXDATE 1 0 STARTING DATE
JXTIME 0 STARTING TIME

SUBBASIN RUNOFF DATA

7 BA

SUBBASIN CHARACTERISTICS

TAREA 7.60 SUBBASIN AREA

PRECIPITATION DATA

8 PB

STORM 24.75 BASIN TOTAL PRECIPITATION

9 PI

INCREMENTAL PRECIPITATION PATTERN

.83	.83	.83	.83	.83	.83	.83	.83	1.06	1.11	1.11
1.06	.83	.83	.83	.83	.83	.83	.83	.83	1.11	1.11
1.11	1.00	.83	.83	.83	1.06	1.11	1.11	1.11	1.22	1.67
1.67	1.67	1.67	1.67	1.67	1.67	1.94	1.94	1.94	1.94	2.28
2.78	2.78	2.78	3.22	3.33	3.33	3.28	3.06	3.06	3.06	3.06
2.22	1.67	1.67	1.67	1.11	1.11	1.11	1.00	.83	.83	.83
.83	.83	.83	.83	.78	.56	.56	.56	.56	.72	.83
.83	.83									

12 LS

SCS LOSS RATE

STRTL 1.33 INITIAL ABSTRACTION
CRVNBR 60.00 CURVE NUMBER
RTIMP .00 PERCENT IMPERVIOUS AREA

13 UD

SCS DIMENSIONLESS UNITGRAPH

TLAG 2.85 LAG

...

UNIT HYDROGRAPH
87 END-OF-PERIOD ORDINATES

21.	50.	99.	156.	220.	299.	385.	497.	615.	750.
876.	990.	1080.	1158.	1203.	1240.	1247.	1249.	1242.	1212.
1169.	1120.	1070.	1013.	951.	880.	800.	715.	641.	572.
522.	475.	432.	393.	358.	330.	304.	278.	253.	232.
210.	189.	173.	159.	145.	131.	121.	110.	99.	91.
83.	75.	68.	62.	57.	52.	47.	43.	40.	36.
33.	30.	27.	25.	23.	21.	19.	17.	16.	14.
13.	12.	12.	11.	10.	9.	8.	7.	6.	6.
5.	4.	4.	3.	2.	1.	1.			

HYDROGRAPH AT STATION AREA

DA	MON	HRMN	ORD	RAIN	LOSS	EXCESS	COMP Q	DA	MON	HRMN	ORD	RAIN	LOSS	EXCESS	COMP Q
1		0000	1	.00	.00	.00	0.	1		1230	76	.00	.00	.00	9907.
1		0010	2	.21	.21	.00	0.	1		1240	77	.00	.00	.00	9487.
1		0020	3	.21	.21	.00	0.	1		1250	78	.00	.00	.00	9075.
1		0030	4	.21	.21	.00	0.	1		1300	79	.00	.00	.00	8674.
1		0040	5	.21	.21	.00	0.	1		1310	80	.00	.00	.00	8284.
1		0050	6	.21	.21	.00	0.	1		1320	81	.00	.00	.00	7903.
1		0100	7	.21	.21	.00	0.	1		1330	82	.00	.00	.00	7526.
1		0110	8	.21	.20	.00	0.	1		1340	83	.00	.00	.00	7148.
1		0120	9	.26	.24	.02	0.	1		1350	84	.00	.00	.00	6771.
1		0130	10	.28	.24	.04	2.	1		1400	85	.00	.00	.00	6393.
1		0140	11	.27	.22	.05	5.	1		1410	86	.00	.00	.00	6018.
1		0150	12	.26	.19	.07	11.	1		1420	87	.00	.00	.00	5645.
1		0200	13	.21	.14	.06	20.	1		1430	88	.00	.00	.00	5280.
1		0210	14	.21	.14	.07	34.	1		1440	89	.00	.00	.00	4923.
1		0220	15	.21	.13	.08	52.	1		1450	90	.00	.00	.00	4576.
1		0230	16	.21	.12	.08	77.	1		1500	91	.00	.00	.00	4239.

1	0240	17	.21	.12	.09	109.	*	1	1510	92	.00	.00	.00	3915.
1	0250	18	.21	.11	.09	150.	*	1	1520	93	.00	.00	.00	3607.
1	0300	19	.21	.11	.10	201.	*	1	1530	94	.00	.00	.00	3316.
1	0310	20	.27	.14	.14	262.	*	1	1540	95	.00	.00	.00	3042.
1	0320	21	.27	.13	.15	335.	*	1	1550	96	.00	.00	.00	2783.
1	0330	22	.28	.12	.15	418.	*	1	1600	97	.00	.00	.00	2549.
1	0340	23	.25	.10	.14	513.	*	1	1610	98	.00	.00	.00	2312.
1	0350	24	.21	.08	.12	618.	*	1	1620	99	.00	.00	.00	2100.
1	0400	25	.21	.08	.13	732.	*	1	1630	100	.00	.00	.00	1908.
1	0410	26	.21	.08	.13	854.	*	1	1640	101	.00	.00	.00	1735.
1	0420	27	.26	.09	.17	986.	*	1	1650	102	.00	.00	.00	1580.
1	0430	28	.27	.09	.18	1126.	*	1	1700	103	.00	.00	.00	1440.
1	0440	29	.27	.09	.19	1274.	*	1	1710	104	.00	.00	.00	1313.
1	0450	30	.30	.09	.21	1431.	*	1	1720	105	.00	.00	.00	1197.
1	0500	31	.41	.12	.29	1595.	*	1	1730	106	.00	.00	.00	1092.
1	0510	32	.41	.11	.30	1767.	*	1	1740	107	.00	.00	.00	997.
1	0520	33	.41	.11	.31	1948.	*	1	1750	108	.00	.00	.00	910.
1	0530	34	.41	.10	.31	2137.	*	1	1800	109	.00	.00	.00	830.
1	0540	35	.41	.09	.32	2336.	*	1	1810	110	.00	.00	.00	756.
1	0550	36	.41	.09	.32	2546.	*	1	1820	111	.00	.00	.00	689.
1	0600	37	.41	.08	.33	2767.	*	1	1830	112	.00	.00	.00	627.
1	0610	38	.48	.09	.39	3003.	*	1	1840	113	.00	.00	.00	571.
1	0620	39	.48	.09	.39	3255.	*	1	1850	114	.00	.00	.00	520.
1	0630	40	.48	.08	.40	3524.	*	1	1900	115	.00	.00	.00	474.
1	0640	41	.56	.09	.47	3811.	*	1	1910	116	.00	.00	.00	432.
1	0650	42	.69	.10	.59	4117.	*	1	1920	117	.00	.00	.00	393.
1	0700	43	.69	.09	.59	4444.	*	1	1930	118	.00	.00	.00	358.
1	0710	44	.69	.09	.60	4792.	*	1	1940	119	.00	.00	.00	326.
1	0720	45	.80	.09	.70	5163.	*	1	1950	120	.00	.00	.00	296.
1	0730	46	.82	.09	.74	5559.	*	1	2000	121	.00	.00	.00	269.
1	0740	47	.93	.08	.74	5981.	*	1	2010	122	.00	.00	.00	244.
1	0750	48	.81	.08	.74	6432.	*	1	2020	123	.00	.00	.00	221.
1	0800	49	.76	.07	.69	6914.	*	1	2030	124	.00	.00	.00	200.
1	0810	50	.76	.06	.70	7427.	*	1	2040	125	.00	.00	.00	181.
1	0820	51	.76	.06	.70	7971.	*	1	2050	126	.00	.00	.00	163.
1	0830	52	.55	.04	.51	8538.	*	1	2100	127	.00	.00	.00	147.
1	0840	53	.41	.03	.38	9122.	*	1	2110	128	.00	.00	.00	132.
1	0850	54	.41	.03	.38	9711.	*	1	2120	129	.00	.00	.00	118.
1	0900	55	.41	.03	.39	10297.	*	1	2130	130	.00	.00	.00	105.
1	0910	56	.28	.02	.26	10865.	*	1	2140	131	.00	.00	.00	93.
1	0920	57	.27	.02	.26	11403.	*	1	2150	132	.00	.00	.00	83.
1	0930	58	.28	.02	.26	11897.	*	1	2200	133	.00	.00	.00	73.
1	0940	59	.25	.01	.23	12335.	*	1	2210	134	.00	.00	.00	65.
1	0950	60	.21	.01	.19	12709.	*	1	2220	135	.00	.00	.00	57.
1	1000	61	.21	.01	.19	13007.	*	1	2230	136	.00	.00	.00	50.
1	1010	62	.21	.01	.19	13223.	*	1	2240	137	.00	.00	.00	44.
1	1020	63	.21	.01	.19	13358.	*	1	2250	138	.00	.00	.00	39.
1	1030	64	.21	.01	.19	13413.	*	1	2300	139	.00	.00	.00	34.
1	1040	65	.21	.01	.20	13389.	*	1	2310	140	.00	.00	.00	30.
1	1050	66	.19	.01	.18	13293.	*	1	2320	141	.00	.00	.00	26.
1	1100	67	.14	.01	.13	13128.	*	1	2330	142	.00	.00	.00	23.
1	1110	68	.14	.01	.13	12903.	*	1	2340	143	.00	.00	.00	20.
1	1120	69	.14	.01	.13	12625.	*	1	2350	144	.00	.00	.00	18.
1	1130	70	.18	.01	.17	12301.	*	2	0000	145	.00	.00	.00	16.
1	1140	71	.21	.01	.20	11941.	*	2	0010	146	.00	.00	.00	14.
1	1150	72	.21	.01	.20	11556.	*	2	0020	147	.00	.00	.00	12.
1	1200	73	.21	.01	.20	11159.	*	2	0030	148	.00	.00	.00	10.
1	1210	74	.00	.00	.00	10747.	*	2	0040	149	.00	.00	.00	8.
1	1220	75	.00	.00	.00	10329.	*	2	0050	150	.00	.00	.00	7.

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TOTAL RAINFALL = 24.75, TOTAL LOSS = 6.52, TOTAL EXCESS = 18.23

PEAK FLOW	TIME		6-HR	24-HR	72-HR	24.83-HR
+	(CFS)	(HR)	(CFS)			
+	13413.	10.50	10560.	3725.	3600.	3600.
			(INCHES)	18.227	18.227	18.227
			(AC-FT)	7388.	7388.	7388.

CUMULATIVE AREA = 7.60 SQ MI

14 KK

.....

DAM

.....

1 Route

HYDROGRAPH ROUTING DATA

15 RS

STORAGE ROUTING

NSTPS 1 NUMBER OF SUBREACHES
 ITYP ELEV TYPE OF INITIAL CONDITION
 RSVRIC 955.00 INITIAL CONDITION
 X .00 WORKING R AND D COEFFICIENT

16 SV

STORAGE

.0 9.5 224.0 838.0 2255.0 4877.0 9652.0

17 SE	ELEVATION	910.00	920.00	930.00	940.00	950.00	960.00	970.00			
18 SQ	DISCHARGE	0.	468.	1024.	2432.	2744.	5232.	6878.	8667.	10590.	12636.
		14799.	17074.								
20 SE	ELEVATION	955.00	956.00	957.00	958.00	959.00	960.00	961.00	962.00	963.00	964.00
		965.00	966.00								
22 SS	SPILLWAY										
	CREL	955.00	SPILLWAY CREST ELEVATION								
	SPWID	.00	SPILLWAY WIDTH								
	COOW	.00	WEIR COEFFICIENT								
	EXPW	1.50	EXPONENT OF HEAD								
23 ST	TOP OF DAM										
	TOPEL	965.60	ELEVATION AT TOP OF DAM								
	DAMWID	1700.00	DAM WIDTH								
	COOD	3.00	WEIR COEFFICIENT								
	EXPD	1.50	EXPONENT OF HEAD								

COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

(INCLUDING FLOW OVER DAM)

STORAGE	.00	9.50	224.00	838.00	2255.00	3566.00	3828.20	4090.40	4352.60	4614.80
OUTFLOW	.00	.00	.00	.00	.00	.00	468.00	1324.00	2432.00	2744.00
ELEVATION	910.00	920.00	930.00	940.00	950.00	955.00	956.00	957.00	958.00	959.00
STORAGE	4877.00	5354.50	5832.00	6309.50	6787.00	7264.50	7742.00	8219.50	8697.00	9174.50
OUTFLOW	5232.00	6078.00	6867.00	7656.00	8445.00	9234.00	10023.00	10812.00	11601.00	12390.00
ELEVATION	960.00	961.00	962.00	963.00	964.00	965.00	966.00	967.00	968.00	969.00

HYDROGRAPH AT STATION DAM

DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE
1	0000	1	0.	3566.0	955.0	*	1	0820	51	2619.	4509.4	958.6	*	1	1640	101	5945.	5083.8	960.4	
1	0010	2	0.	3566.0	955.0	*	1	0830	52	2710.	4586.3	958.9	*	1	1650	102	5746.	5026.1	960.3	
1	0020	3	0.	3566.0	955.0	*	1	0840	53	3239.	4667.0	959.2	*	1	1700	103	5549.	4969.1	960.2	
1	0030	4	0.	3566.0	955.0	*	1	0850	54	3997.	4746.9	959.5	*	1	1710	104	5356.	4913.0	960.1	
1	0040	5	0.	3566.0	955.0	*	1	0900	55	4730.	4824.1	959.8	*	1	1720	105	5057.	4858.5	959.9	
1	0050	6	0.	3566.0	955.0	*	1	0910	56	5312.	4900.3	960.0	*	1	1730	106	4577.	4808.0	959.7	
1	0100	7	0.	3566.0	955.0	*	1	0920	57	5582.	4978.6	960.2	*	1	1740	107	4144.	4762.3	959.6	
1	0110	8	0.	3566.0	955.0	*	1	0930	58	5864.	5060.3	960.4	*	1	1750	108	3752.	4721.0	959.4	
1	0120	9	0.	3566.0	955.0	*	1	0940	59	6154.	5144.4	960.6	*	1	1800	109	3398.	4683.8	959.3	
1	0130	10	0.	3566.0	955.0	*	1	0950	60	6449.	5230.0	960.7	*	1	1810	110	3079.	4650.1	959.1	
1	0140	11	0.	3566.1	955.0	*	1	1000	61	6746.	5316.2	960.9	*	1	1820	111	2790.	4619.6	959.0	
1	0150	12	0.	3566.2	955.0	*	1	1010	62	7055.	5401.7	961.1	*	1	1830	112	2715.	4590.8	958.9	
1	0200	13	1.	3566.4	955.0	*	1	1020	63	7369.	5485.4	961.3	*	1	1840	113	2681.	4561.9	958.8	
1	0210	14	1.	3566.7	955.0	*	1	1030	64	7671.	5566.2	961.4	*	1	1850	114	2646.	4532.7	958.7	
1	0220	15	2.	3567.3	955.0	*	1	1040	65	7960.	5643.2	961.6	*	1	1900	115	2611.	4503.3	958.6	
1	0230	16	4.	3568.2	955.0	*	1	1050	66	8230.	5715.4	961.8	*	1	1910	116	2576.	4473.8	958.5	
1	0240	17	6.	3569.4	955.0	*	1	1100	67	8480.	5782.2	961.9	*	1	1920	117	2541.	4444.3	958.3	
1	0250	18	9.	3571.1	955.0	*	1	1110	68	8711.	5843.0	962.0	*	1	1930	118	2506.	4414.7	958.2	
1	0300	19	13.	3573.3	955.0	*	1	1120	69	8930.	5897.3	962.1	*	1	1940	119	2471.	4385.1	958.1	
1	0310	20	18.	3576.3	955.0	*	1	1130	70	9121.	5944.7	962.2	*	1	1950	120	2436.	4355.6	958.0	
1	0320	21	25.	3580.1	955.1	*	1	1140	71	9283.	5984.9	962.3	*	1	2000	121	2323.	4326.7	957.9	
1	0330	22	34.	3584.9	955.1	*	1	1150	72	9416.	6017.9	962.4	*	1	2010	122	2206.	4299.1	957.8	
1	0340	23	44.	3590.8	955.1	*	1	1200	73	9521.	6044.0	962.4	*	1	2020	123	2094.	4272.6	957.7	
1	0350	24	57.	3597.9	955.1	*	1	1210	74	9598.	6063.2	962.5	*	1	2030	124	1988.	4247.4	957.6	
1	0400	25	72.	3606.3	955.2	*	1	1220	75	9649.	6075.8	962.5	*	1	2040	125	1886.	4223.4	957.5	
1	0410	26	89.	3616.1	955.2	*	1	1230	76	9674.	6082.1	962.5	*	1	2050	126	1789.	4200.4	957.4	
1	0420	27	110.	3627.4	955.2	*	1	1240	77	9675.	6082.4	962.5	*	1	2100	127	1697.	4178.6	957.3	
1	0430	28	133.	3640.2	955.3	*	1	1250	78	9654.	6077.1	962.5	*	1	2110	128	1609.	4157.7	957.3	
1	0440	29	158.	3654.8	955.3	*	1	1300	79	9612.	6066.6	962.5	*	1	2120	129	1525.	4137.9	957.2	
1	0450	30	187.	3671.0	955.4	*	1	1310	80	9551.	6051.5	962.5	*	1	2130	130	1445.	4119.0	957.1	
1	0500	31	220.	3689.1	955.5	*	1	1320	81	9472.	6031.9	962.4	*	1	2140	131	1369.	4101.0	957.0	
1	0510	32	255.	3708.9	955.5	*	1	1330	82	9377.	6008.4	962.4	*	1	2150	132	1302.	4083.8	957.0	
1	0520	33	294.	3730.7	955.6	*	1	1340	83	9267.	5981.0	962.3	*	1	2200	133	1249.	4067.3	956.9	
1	0530	34	336.	3754.5	955.7	*	1	1350	84	9143.	5950.1	962.2	*	1	2210	134	1197.	4051.4	956.9	
1	0540	35	382.	3780.2	955.8	*	1	1400	85	9004.	5915.8	962.2	*	1	2220	135	1147.	4036.1	956.8	
1	0550	36	432.	3808.2	955.9	*	1	1410	86	8853.	5878.3	962.1	*	1	2230	136	1099.	4021.4	956.7	
1	0600	37	501.	3838.2	956.0	*	1	1420	87	8690.	5837.8	962.0	*	1	2240	137	1052.	4007.2	956.7	
1	0610	38	606.	3870.3	956.2	*	1	1430	88	8527.	5794.5	961.9	*	1	2250	138	1008.	3993.6	956.6	
1	0620	39	717.	3904.3	956.3	*	1	1440	89	8354.	5748.6	961.8	*	1	2300	139	965.	3980.5	956.6	
1	0630	40	834.	3940.3	956.4	*	1	1450	90	8173.	5700.2	961.7	*	1	2310	140	924.	3967.9	956.5	
1	0640	41	959.	3978.5	956.6	*	1	1500	91	7984.	5649.7	961.6	*	1	2320	141	885.	3955.8	956.5	
1	0650	42	1091.	4019.0	956.7	*	1	1510	92	7788.	5597.3	961.5	*	1	2330	142	847.	3944.3	956.4	
1	0700	43	1231.	4061.8	956.9	*	1	1520	93	7585.	5543.2	961.4	*	1	2340	143	811.	3933.1	956.4	
1	0710	44	1395.	4107.2	957.1	*	1	1530	94	7378.	5487.8	961.3	*	1	2350	144	776.	3922.5	956.4	
1	0720	45	1598.	4155.1	957.2	*	1	1540	95	7166.	5431.5	961.2	*	2	0000	145	742.	3912.3	956.3	
1	0730	46	1810.	4205.5	957.4	*	1	1550	96	6952.	5374.3	961.0	*	2	0010	146	710.	3902.4	956.3	
1	0740	47	2034.	4258.5	957.6	*	1	1600	97	6748.	5316.7	960.9	*	2	0020	147	680.	3893.0	956.2	
1	0750	48	2272.	4314.7	957.9	*	1	1610	98	6548.	5258.7	960.8	*	2	0030	148	650.	3884.0	956.2	
1	0800	49	2458.	4374.4	958.1	*	1	1620	99	6347.	5200.3	960.7	*	2	0040	149	622.	3875.4	956.2	
1	0810	50	2535.	4438.8	958.3	*	1	1630	100	6145.	5142.0	960.6	*	2	0050	150	595.	3867.1	956.1	

PEAK OUTFLOW IS 9675. AT TIME 12.67 HOURS

PEAK FLOW	TIME		6-HR	24-HR	72-HR	24.83-HR
(CFS)	(HR)					
+	9675.	12.67	8601.	3573.	3453.	3453.
		(INCHES)	10.522	17.482	17.482	17.482
		(AC-FT)	4265.	7086.	7086.	7086.

PEAK STORAGE	TIME		6-HR	24-HR	72-HR	24.83-HR
(AC-FT)	(HR)					
+	6082.	12.67	5808.	4580.	4546.	4546.

PEAK STAGE	TIME		6-HR	24-HR	72-HR	24.83-HR
(FEET)	(HR)					
+	962.52	12.67	961.95	958.43	958.32	958.32

CUMULATIVE AREA = 7.60 SQ MI

1

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	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
				6-HOUR	24-HOUR	72-HOUR	
+	HYDROGRAPH AT						
+	AREA	13413.	10.50	10560.	3725.	3600.	7.60
+	ROUTED TO						
+	DAM	9675.	12.67	8601.	3573.	3453.	7.60
+						962.52	12.67

1

SUMMARY OF DAM OVERTOPPING/BREACH ANALYSIS FOR STATION DAM
(PEAKS SHOWN ARE FOR INTERNAL TIME STEP USED DURING BREACH FORMATION)

PLAN 1		INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
	ELEVATION	955.00	955.00	965.60
	STORAGE	3566.	3566.	7551.
	OUTFLOW	0.	0.	16164.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	962.52	.00	6082.	9675.	.00	12.67	.00

*** NORMAL END OF HEC-1 ***

CURRENT DATE: 06-20-2003
CURRENT TIME: 10:51:13

FILE DATE: 06-20-2003
FILE NAME: WARDCULV

FHWA CULVERT ANALYSIS
HY-8, VERSION 6.1

C U L V N O.	SITE DATA			CULVERT SHAPE, MATERIAL, INLET				
	INLET ELEV. (ft)	OUTLET ELEV. (ft)	CULVERT LENGTH (ft)	BARRELS SHAPE MATERIAL	SPAN (ft)	RISE (ft)	MANNING n	INLET TYPE
1	949.05	948.91	108.00	2 RCB	12.00	8.00	.012	CONVENTIONAL
2								
3								
4								
5								
6								

SUMMARY OF CULVERT FLOWS (cfs)

FILE: WARDCULV

DATE: 06-20-2003

ELEV (ft)	TOTAL	1	2	3	4	5	6	ROADWAY	ITR
963.60	2000.0	609.9	0.0	0.0	0.0	0.0	0.0	1409.54	8
963.63	2150.0	651.2	0.0	0.0	0.0	0.0	0.0	1500.81	2
963.67	2300.0	695.3	0.0	0.0	0.0	0.0	0.0	1593.92	2
963.71	2450.0	742.7	0.0	0.0	0.0	0.0	0.0	1704.62	3
963.75	2600.0	780.3	0.0	0.0	0.0	0.0	0.0	1800.72	2
963.80	2750.0	820.3	0.0	0.0	0.0	0.0	0.0	1925.13	3
963.83	2900.0	854.1	0.0	0.0	0.0	0.0	0.0	2023.92	2
963.87	3050.0	894.5	0.0	0.0	0.0	0.0	0.0	2150.76	3
963.91	3200.0	924.6	0.0	0.0	0.0	0.0	0.0	2251.90	2
963.95	3350.0	961.4	0.0	0.0	0.0	0.0	0.0	2383.22	3
963.96	3363.8	964.0	0.0	0.0	0.0	0.0	0.0	2392.63	2
962.43	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	OVERTOPPING

SUMMARY OF ITERATIVE SOLUTION ERRORS

FILE: WARDCULV

DATE: 06-20-2003

HEAD ELEV (ft)	HEAD ERROR (ft)	TOTAL FLOW (cfs)	FLOW ERROR (cfs)	% FLOW ERROR
963.60	0.002	2000.00	-19.42	-0.97
963.63	0.000	2150.00	-2.05	-0.10
963.67	-0.003	2300.00	10.81	0.47
963.71	-0.006	2450.00	2.70	0.11
963.75	-0.005	2600.00	18.96	0.73
963.80	-0.010	2750.00	4.55	0.17
963.83	-0.005	2900.00	21.99	0.76
963.87	-0.009	3050.00	4.78	0.16
963.91	-0.005	3200.00	23.49	0.73
963.95	-0.010	3350.00	5.37	0.16
963.96	1.000	3363.80	7.22	0.21

<1> TOLERANCE (ft) = 0.010

<2> TOLERANCE (%) = 1.000

CURRENT DATE: 06-20-2003
CURRENT TIME: 10:51:13

FILE DATE: 06-20-2003
FILE NAME: WARDCULV

PERFORMANCE CURVE FOR CULVERT 1 - 2(12.00 (ft) BY 8.00 (ft)) RCB

DIS-CHARGE FLOW (cfs)	HEAD-WATER ELEV. (ft)	INLET CONTROL DEPTH (ft)	OUTLET CONTROL DEPTH (ft)	FLOW TYPE <F4>	NORMAL DEPTH (ft)	CRIT. DEPTH (ft)	OUTLET DEPTH (ft)	TW DEPTH (ft)	OUTLET VEL. (fps)	TW VEL. (fps)	
609.88	963.59	4.18	14.54	4-FFt	3.39	2.72	8.00	14.44	3.18	0.00	
651.24	963.62	4.37	14.57	4-FFt	3.55	2.84	8.00	14.44	3.39	0.00	
695.27	963.66	4.57	14.61	4-FFt	3.71	2.97	8.00	14.44	3.62	0.00	
742.68	963.71	4.78	14.66	4-FFt	3.90	3.10	8.00	14.44	3.87	0.00	
780.32	963.74	4.94	14.69	4-FFt	4.04	3.21	8.00	14.44	4.06	0.00	
820.31	963.79	5.11	14.74	4-FFt	4.18	3.32	8.00	14.44	4.27	0.00	
854.09	963.82	5.25	14.77	4-FFt	4.30	3.41	8.00	14.44	4.45	0.00	
894.47	963.87	5.42	14.82	4-FFt	4.45	3.51	8.00	14.44	4.66	0.00	
924.61	963.90	5.54	14.85	4-FFt	4.56	3.59	8.00	14.44	4.82	0.00	
961.41	963.95	5.68	14.90	4-FFt	4.69	3.69	8.00	14.44	5.01	0.00	
963.95	963.95	5.69	14.90	4-FFt	4.70	3.69	8.00	14.44	5.02	0.00	
El. inlet face invert					949.05 ft	El. outlet invert					948.91 ft
El. inlet throat invert					0.00 ft	El. inlet crest					0.00 ft

***** SITE DATA ***** CULVERT INVERT *****
 INLET STATION 108.00 ft
 INLET ELEVATION 949.05 ft
 OUTLET STATION 0.00 ft
 OUTLET ELEVATION 948.91 ft
 NUMBER OF BARRELS 2
 SLOPE (V/H) 0.0013
 CULVERT LENGTH ALONG SLOPE 108.00 ft

***** CULVERT DATA SUMMARY *****
 BARREL SHAPE BOX
 BARREL SPAN 12.00 ft
 BARREL RISE 8.00 ft
 BARREL MATERIAL CONCRETE
 BARREL MANNING'S n 0.012
 INLET TYPE CONVENTIONAL
 INLET EDGE AND WALL SQUARE EDGE (30-75 DEG. FLARE)
 INLET DEPRESSION NONE

CURRENT DATE: 06-20-2003
CURRENT TIME: 10:51:13

FILE DATE: 06-20-2003
FILE NAME: WARDCULV

TAILWATER

CONSTANT WATER SURFACE ELEVATION
963.35

ROADWAY OVERTOPPING DATA

ROADWAY SURFACE
EMBANKMENT TOP WIDTH

PAVED
24.00 ft

***** USER DEFINED ROADWAY PROFILE

CROSS-SECTION COORD. NO.	X ft	Y ft
1	0.00	977.57
2	99.96	971.43
3	199.69	965.67
4	299.96	963.16
5	399.96	962.43
6	499.78	962.69
7	600.02	963.06
8	699.94	962.57
9	800.22	962.44
10	926.58	964.00
11	1028.35	968.00
12	1114.34	972.00
13	1225.44	976.00
14	1325.44	977.20

CURRENT DATE: 06-20-2003
CURRENT TIME: 11:35:14

FILE DATE: 06-20-2003
FILE NAME: MULLBRDG

FWHA CULVERT ANALYSIS
HY-8, VERSION 6.1

C U L V N O.	SITE DATA			CULVERT SHAPE, MATERIAL, INLET				
	INLET ELEV. (ft)	OUTLET ELEV. (ft)	CULVERT LENGTH (ft)	BARRELS SHAPE MATERIAL	SPAN (ft)	RISE (ft)	MANNING n	INLET TYPE
1	949.15	949.12	11.00	1 RCB	19.50	7.00	.030	CONVENTIONAL
2								
3								
4								
5								
6								

SUMMARY OF CULVERT FLOWS (cfs)

FILE: MULLBRDG

DATE: 06-20-2003

ELEV (ft)	TOTAL	1	2	3	4	5	6	ROADWAY	ITR
963.98	2000.0	100.2	0.0	0.0	0.0	0.0	0.0	1899.95	5
963.98	2140.0	105.7	0.0	0.0	0.0	0.0	0.0	2034.72	3
963.99	2280.0	114.7	0.0	0.0	0.0	0.0	0.0	2168.76	3
963.99	2420.0	119.9	0.0	0.0	0.0	0.0	0.0	2301.26	3
963.99	2560.0	125.0	0.0	0.0	0.0	0.0	0.0	2433.80	3
963.99	2700.0	130.1	0.0	0.0	0.0	0.0	0.0	2571.33	3
963.99	2840.0	134.9	0.0	0.0	0.0	0.0	0.0	2703.99	3
963.99	2980.0	139.8	0.0	0.0	0.0	0.0	0.0	2841.62	3
964.00	3120.0	144.3	0.0	0.0	0.0	0.0	0.0	2974.40	3
964.00	3260.0	148.9	0.0	0.0	0.0	0.0	0.0	3112.16	3
964.00	3363.8	152.1	0.0	0.0	0.0	0.0	0.0	3210.50	3
957.51	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	OVERTOPPING

SUMMARY OF ITERATIVE SOLUTION ERRORS

FILE: MULLBRDG

DATE: 06-20-2003

HEAD ELEV (ft)	HEAD ERROR (ft)	TOTAL FLOW (cfs)	FLOW ERROR (cfs)	% FLOW ERROR
963.98	0.000	2000.00	-0.14	-0.01
963.98	0.004	2140.00	-0.41	-0.02
963.99	0.004	2280.00	-3.41	-0.15
963.99	0.004	2420.00	-1.14	-0.05
963.99	0.004	2560.00	1.23	0.05
963.99	0.004	2700.00	-1.42	-0.05
963.99	0.004	2840.00	1.12	0.04
963.99	0.004	2980.00	-1.37	-0.05
964.00	0.004	3120.00	1.29	0.04
964.00	0.004	3260.00	-1.08	-0.03
964.00	0.003	3363.80	1.16	0.03

<1> TOLERANCE (ft) = 0.010

<2> TOLERANCE (%) = 1.000

CURRENT DATE: 06-20-2003
CURRENT TIME: 11:35:14

FILE DATE: 06-20-2003
FILE NAME: MULLBRDG

PERFORMANCE CURVE FOR CULVERT 1 - 1 (19.50 (ft) BY 7.00 (ft)) RCB

DIS-CHARGE FLOW (cfs)	HEAD-WATER ELEV. (ft)	INLET CONTROL DEPTH (ft)	OUTLET CONTROL DEPTH (ft)	FLOW TYPE <F4>	NORMAL DEPTH (ft)	CRIT. DEPTH (ft)	OUTLET DEPTH (ft)	TW DEPTH (ft)	OUTLET VEL. (fps)	TW VEL. (fps)	
100.19	963.97	1.62	14.82	4-FFt	1.59	0.94	7.00	14.84	0.73	0.00	
105.70	963.98	1.68	14.83	4-FFt	1.65	0.97	7.00	14.84	0.77	0.00	
114.65	963.98	1.77	14.83	4-FFt	1.73	1.03	7.00	14.84	0.84	0.00	
119.88	963.98	1.82	14.83	4-FFt	1.78	1.06	7.00	14.84	0.88	0.00	
124.97	963.98	1.87	14.83	4-FFt	1.83	1.09	7.00	14.84	0.92	0.00	
130.09	963.98	1.92	14.83	4-FFt	1.88	1.12	7.00	14.84	0.95	0.00	
134.89	963.98	1.97	14.83	4-FFt	1.93	1.14	7.00	14.84	0.99	0.00	
139.75	963.99	2.01	14.84	4-FFt	1.98	1.17	7.00	14.84	1.02	0.00	
144.31	963.99	2.06	14.84	4-FFt	2.02	1.20	7.00	14.84	1.06	0.00	
148.92	963.99	2.10	14.84	4-FFt	2.07	1.22	7.00	14.84	1.09	0.00	
152.14	963.99	2.13	14.84	4-FFt	2.10	1.24	7.00	14.84	1.11	0.00	
El. inlet face invert					949.15 ft	El. outlet invert					949.12 ft
El. inlet throat invert					0.00 ft	El. inlet crest					0.00 ft

***** SITE DATA ***** CULVERT INVERT *****

INLET STATION	11.00 ft
INLET ELEVATION	949.15 ft
OUTLET STATION	0.00 ft
OUTLET ELEVATION	949.12 ft
NUMBER OF BARRELS	1
SLOPE (V/H)	0.0027
CULVERT LENGTH ALONG SLOPE	11.00 ft

***** CULVERT DATA SUMMARY *****

BARREL SHAPE	BOX
BARREL SPAN	19.50 ft
BARREL RISE	7.00 ft
BARREL MATERIAL	CONCRETE
BARREL MANNING'S n	0.030
INLET TYPE	CONVENTIONAL
INLET EDGE AND WALL	SQUARE EDGE (90-45 DEG.)
INLET DEPRESSION	NONE

CURRENT DATE: 06-20-2003
CURRENT TIME: 11:35:14

FILE DATE: 06-20-2003
FILE NAME: MULLBRDG

TAILWATER

CONSTANT WATER SURFACE ELEVATION
963.96

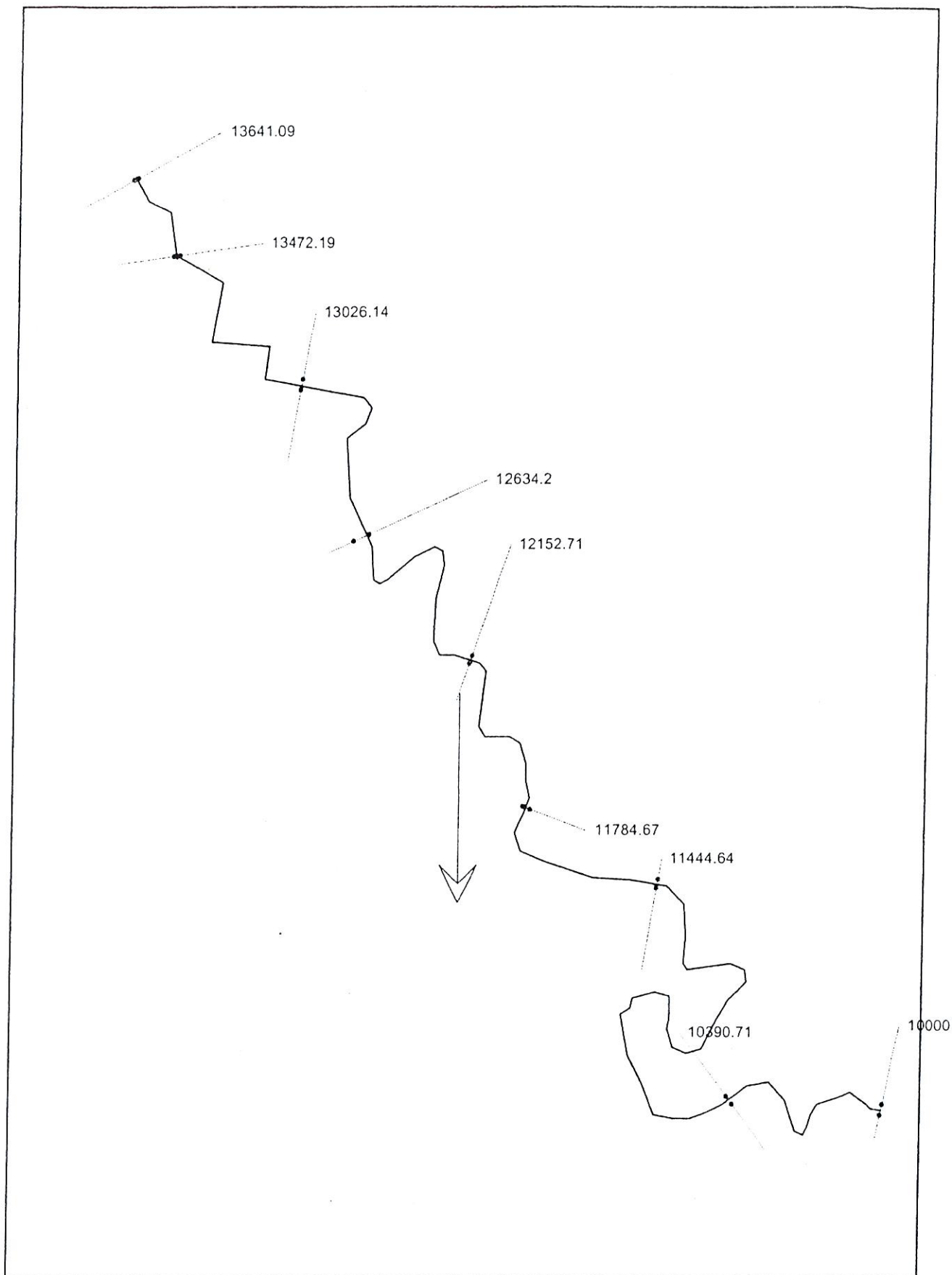
ROADWAY OVERTOPPING DATA

ROADWAY SURFACE
EMBANKMENT TOP WIDTH

GRAVEL
11.00 ft

***** USER DEFINED ROADWAY PROFILE

CROSS-SECTION	X	Y
COORD. NO.	ft	ft
1	0.00	976.98
2	100.00	972.38
3	199.98	964.44
4	299.96	959.21
5	399.93	957.51
6	500.04	957.64
7	600.13	958.56
8	700.34	959.45
9	800.02	961.90
10	885.85	966.00
11	986.24	970.00
12	1085.52	974.00
13	1189.28	978.00



Kensington Farms Plan: Plan 01 12/9/2004
Middle Big Creek 1

Legend	
EG PF 1	
WS PF 1	
Crit PF 1	
Ground	



HEC-RAS Plan: Plan 01 River: Middle Big Creek Reach: 1 Profile: PF 1

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
1	13641.09	PF 1	609.00	970.36	976.46		976.78	0.004458	5.87	223.59	96.38	0.47
1	13472.19	PF 1	609.00	970.10	976.29		976.39	0.001038	3.22	403.86	156.87	0.25
1	13026.14	PF 1	1814.00	968.10	974.50		975.07	0.004782	6.84	523.29	273.59	0.52
1	12634.2	PF 1	1814.00	966.10	973.13		973.41	0.003416	4.99	615.91	220.37	0.43
1	12152.71	PF 1	2075.00	962.10	971.37		971.85	0.003055	6.67	639.39	201.19	0.43
1	11784.67	PF 1	2075.00	960.10	970.46		970.80	0.002511	5.93	799.57	249.81	0.38
1	11444.64	PF 1	2075.00	960.10	970.16		970.26	0.000876	3.68	1332.68	314.27	0.23
1	10390.71	PF 1	3555.00	958.10	966.23		967.42	0.007911	10.39	700.62	233.47	0.70
1	10000	PF 1	3555.00	956.10	964.00	963.38	964.58	0.005918	8.19	1060.79	416.72	0.59

Plan: Plan 01 Middle Big Creek 1 RS: 13641.09 Profile: PF 1

E.G. Elev (ft)	976.78	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.32	Wt. n-Val.	0.100	0.045	0.100
W.S. Elev (ft)	976.46	Reach Len. (ft)	173.43	168.90	166.92
Crit W.S. (ft)		Flow Area (sq ft)	141.96	59.32	22.31
E.G. Slope (ft/ft)	0.004458	Area (sq ft)	141.96	59.32	22.31
Q Total (cfs)	609.00	Flow (cfs)	236.39	348.04	24.57
Top Width (ft)	96.38	Top Width (ft)	65.15	12.32	18.92
Vel Total (ft/s)	2.72	Avg. Vel. (ft/s)	1.67	5.87	1.10
Max Chl Dpth (ft)	6.10	Hydr. Depth (ft)	2.18	4.82	1.18
Conv. Total (cfs)	9121.0	Conv. (cfs)	3540.3	5212.6	368.0
Length Wtd. (ft)	169.96	Wetted Per. (ft)	65.29	13.67	19.06
Min Ch El (ft)	970.36	Shear (lb/sq ft)	0.61	1.21	0.33
Alpha	2.80	Stream Power (lb/ft s)	1.01	7.09	0.36
Frctn Loss (ft)	0.32	Cum Volume (acre-ft)	17.80	17.94	28.61
C & E Loss (ft)	0.07	Cum SA (acres)	8.91	2.88	8.83

Plan: Plan 01 Middle Big Creek 1 RS: 13472.19 Profile: PF 1

E.G. Elev (ft)	976.39	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.11	Wt. n-Val.	0.100	0.045	0.100
W.S. Elev (ft)	976.29	Reach Len. (ft)	412.59	446.05	460.38
Crit W.S. (ft)		Flow Area (sq ft)	139.49	119.47	144.90
E.G. Slope (ft/ft)	0.001038	Area (sq ft)	139.49	119.47	144.90
Q Total (cfs)	609.00	Flow (cfs)	109.37	385.12	114.51
Top Width (ft)	156.87	Top Width (ft)	66.44	22.23	68.20
Vel Total (ft/s)	1.51	Avg. Vel. (ft/s)	0.78	3.22	0.79
Max Chl Dpth (ft)	6.19	Hydr. Depth (ft)	2.10	5.37	2.12
Conv. Total (cfs)	18899.4	Conv. (cfs)	3394.1	11951.6	3553.7
Length Wtd. (ft)	443.00	Wetted Per. (ft)	66.57	22.65	68.34
Min Ch El (ft)	970.10	Shear (lb/sq ft)	0.14	0.34	0.14
Alpha	2.99	Stream Power (lb/ft s)	0.11	1.10	0.11
Frctn Loss (ft)	1.28	Cum Volume (acre-ft)	17.24	17.60	28.29
C & E Loss (ft)	0.05	Cum SA (acres)	8.65	2.82	8.66

Plan: Plan 01 Middle Big Creek 1 RS: 13026.14 Profile: PF 1

E.G. Elev (ft)	975.07	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.57	Wt. n-Val.	0.100	0.045	0.100
W.S. Elev (ft)	974.50	Reach Len. (ft)	394.03	391.94	389.66
Crit W.S. (ft)		Flow Area (sq ft)	206.71	204.83	111.74
E.G. Slope (ft/ft)	0.004782	Area (sq ft)	206.71	204.83	111.74
Q Total (cfs)	1814.00	Flow (cfs)	236.16	1401.43	176.41
Top Width (ft)	273.59	Top Width (ft)	176.29	38.81	58.49
Vel Total (ft/s)	3.47	Avg. Vel. (ft/s)	1.14	6.84	1.58
Max Chl Dpth (ft)	6.40	Hydr. Depth (ft)	1.17	5.28	1.91
Conv. Total (cfs)	26232.0	Conv. (cfs)	3415.1	20265.8	2551.1
Length Wtd. (ft)	392.28	Wetted Per. (ft)	176.32	39.49	58.67
Min Ch El (ft)	968.10	Shear (lb/sq ft)	0.35	1.55	0.57
Alpha	3.04	Stream Power (lb/ft s)	0.40	10.59	0.90
Frctn Loss (ft)	1.57	Cum Volume (acre-ft)	15.60	15.94	26.94
C & E Loss (ft)	0.09	Cum SA (acres)	7.50	2.50	7.99

Plan: Plan 01 Middle Big Creek 1 RS: 12634.2 Profile: PF 1

E.G. Elev (ft)	973.41	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.28	Wt. n-Val.	0.100	0.045	0.100
W.S. Elev (ft)	973.13	Reach Len. (ft)	478.50	481.49	470.93
Crit W.S. (ft)		Flow Area (sq ft)	362.09	252.52	1.31
E.G. Slope (ft/ft)	0.003416	Area (sq ft)	362.09	252.52	1.31
Q Total (cfs)	1814.00	Flow (cfs)	552.37	1261.17	0.46
Top Width (ft)	220.37	Top Width (ft)	155.44	59.90	5.03
Vel Total (ft/s)	2.95	Avg. Vel. (ft/s)	1.53	4.99	0.35
Max Chl Dpth (ft)	7.03	Hydr. Depth (ft)	2.33	4.22	0.26
Conv. Total (cfs)	31038.0	Conv. (cfs)	9451.2	21578.9	7.9
Length Wtd. (ft)	479.80	Wetted Per. (ft)	155.52	60.65	5.05
Min Ch EI (ft)	966.10	Shear (lb/sq ft)	0.50	0.89	0.06
Alpha	2.08	Stream Power (lb/ft s)	0.76	4.43	0.02
Frctn Loss (ft)	1.54	Cum Volume (acre-ft)	13.02	13.88	26.43
C & E Loss (ft)	0.02	Cum SA (acres)	6.00	2.06	7.71

Plan: Plan 01 Middle Big Creek 1 RS: 12152.71 Profile: PF 1

E.G. Elev (ft)	971.85	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.48	Wt. n-Val.	0.100	0.045	0.100
W.S. Elev (ft)	971.37	Reach Len. (ft)	355.18	368.04	368.32
Crit W.S. (ft)		Flow Area (sq ft)	227.02	209.87	202.51
E.G. Slope (ft/ft)	0.003055	Area (sq ft)	227.02	209.87	202.51
Q Total (cfs)	2075.00	Flow (cfs)	293.48	1398.95	382.56
Top Width (ft)	201.19	Top Width (ft)	114.90	28.68	57.62
Vel Total (ft/s)	3.25	Avg. Vel. (ft/s)	1.29	6.67	1.89
Max Chl Dpth (ft)	9.27	Hydr. Depth (ft)	1.98	7.32	3.51
Conv. Total (cfs)	37542.9	Conv. (cfs)	5310.0	25311.2	6921.7
Length Wtd. (ft)	364.51	Wetted Per. (ft)	114.95	30.07	58.04
Min Ch EI (ft)	962.10	Shear (lb/sq ft)	0.38	1.33	0.67
Alpha	2.93	Stream Power (lb/ft s)	0.49	8.87	1.26
Frctn Loss (ft)	1.01	Cum Volume (acre-ft)	9.79	11.32	25.33
C & E Loss (ft)	0.04	Cum SA (acres)	4.51	1.57	7.37

Plan: Plan 01 Middle Big Creek 1 RS: 11784.67 Profile: PF 1

E.G. Elev (ft)	970.80	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.33	Wt. n-Val.	0.100	0.045	0.100
W.S. Elev (ft)	970.46	Reach Len. (ft)	341.45	340.03	336.49
Crit W.S. (ft)		Flow Area (sq ft)	585.58	204.45	9.54
E.G. Slope (ft/ft)	0.002511	Area (sq ft)	585.58	204.45	9.54
Q Total (cfs)	2075.00	Flow (cfs)	855.10	1213.16	6.75
Top Width (ft)	249.81	Top Width (ft)	213.12	26.69	10.00
Vel Total (ft/s)	2.60	Avg. Vel. (ft/s)	1.46	5.93	0.71
Max Chl Dpth (ft)	10.36	Hydr. Depth (ft)	2.75	7.66	0.95
Conv. Total (cfs)	41406.5	Conv. (cfs)	17063.5	24208.4	134.6
Length Wtd. (ft)	339.33	Wetted Per. (ft)	213.23	30.11	10.30
Min Ch EI (ft)	960.10	Shear (lb/sq ft)	0.43	1.06	0.15
Alpha	3.19	Stream Power (lb/ft s)	0.63	6.32	0.10
Frctn Loss (ft)	0.47	Cum Volume (acre-ft)	6.47	9.57	24.43
C & E Loss (ft)	0.07	Cum SA (acres)	3.18	1.34	7.08

Plan: Plan 01 Middle Big Creek 1 RS: 11444.64 Profile: PF 1

E.G. Elev (ft)	970.26	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.10	Wt. n-Val.	0.100	0.045	0.100
W.S. Elev (ft)	970.16	Reach Len. (ft)	937.39	1053.93	1047.53
Crit W.S. (ft)		Flow Area (sq ft)	37.94	238.71	1056.03
E.G. Slope (ft/ft)	0.000876	Area (sq ft)	37.94	238.71	1056.03
Q Total (cfs)	2075.00	Flow (cfs)	25.36	879.38	1170.27
Top Width (ft)	314.27	Top Width (ft)	19.88	30.59	263.80
Vel Total (ft/s)	1.56	Avg. Vel. (ft/s)	0.67	3.68	1.11
Max Chl Dpth (ft)	10.06	Hydr. Depth (ft)	1.91	7.80	4.00
Conv. Total (cfs)	70120.9	Conv. (cfs)	856.9	29716.9	39547.0
Length Wtd. (ft)	1047.90	Wetted Per. (ft)	20.24	32.61	263.94
Min Ch El (ft)	960.10	Shear (lb/sq ft)	0.10	0.40	0.22
Alpha	2.66	Stream Power (lb/ft s)	0.07	1.47	0.24
Frctn Loss (ft)	2.74	Cum Volume (acre-ft)	4.03	7.84	20.32
C & E Loss (ft)	0.11	Cum SA (acres)	2.26	1.11	6.02

Plan: Plan 01 Middle Big Creek 1 RS: 10390.71 Profile: PF 1

E.G. Elev (ft)	967.42	Element	Left OB	Channel	Right OB
Vel Head (ft)	1.19	Wt. n-Val.	0.100	0.045	0.100
W.S. Elev (ft)	966.23	Reach Len. (ft)	388.97	390.71	387.24
Crit W.S. (ft)		Flow Area (sq ft)	81.99	236.80	381.82
E.G. Slope (ft/ft)	0.007911	Area (sq ft)	81.99	236.80	381.82
Q Total (cfs)	3555.00	Flow (cfs)	149.82	2460.00	945.18
Top Width (ft)	233.47	Top Width (ft)	50.26	34.39	148.82
Vel Total (ft/s)	5.07	Avg. Vel. (ft/s)	1.83	10.39	2.48
Max Chl Dpth (ft)	8.13	Hydr. Depth (ft)	1.63	6.89	2.57
Conv. Total (cfs)	39969.0	Conv. (cfs)	1684.4	27657.9	10626.7
Length Wtd. (ft)	389.62	Wetted Per. (ft)	50.44	35.60	148.95
Min Ch El (ft)	958.10	Shear (lb/sq ft)	0.80	3.29	1.27
Alpha	2.97	Stream Power (lb/ft s)	1.47	34.13	3.13
Frctn Loss (ft)	2.65	Cum Volume (acre-ft)	2.74	2.09	3.03
C & E Loss (ft)	0.18	Cum SA (acres)	1.51	0.33	1.06

Plan: Plan 01 Middle Big Creek 1 RS: 10000 Profile: PF 1

E.G. Elev (ft)	964.58	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.58	Wt. n-Val.	0.100	0.045	0.100
W.S. Elev (ft)	964.00	Reach Len. (ft)			
Crit W.S. (ft)	963.38	Flow Area (sq ft)	531.84	229.59	299.36
E.G. Slope (ft/ft)	0.005918	Area (sq ft)	531.84	229.59	299.36
Q Total (cfs)	3555.00	Flow (cfs)	915.22	1879.74	760.04
Top Width (ft)	416.72	Top Width (ft)	287.83	38.67	90.22
Vel Total (ft/s)	3.35	Avg. Vel. (ft/s)	1.72	8.19	2.54
Max Chl Dpth (ft)	7.90	Hydr. Depth (ft)	1.85	5.94	3.32
Conv. Total (cfs)	46210.0	Conv. (cfs)	11896.6	24433.9	9879.4
Length Wtd. (ft)		Wetted Per. (ft)	287.94	39.68	90.44
Min Ch El (ft)	956.10	Shear (lb/sq ft)	0.68	2.14	1.22
Alpha	3.35	Stream Power (lb/ft s)	1.17	17.50	3.10
Frctn Loss (ft)		Cum Volume (acre-ft)			
C & E Loss (ft)		Cum SA (acres)			

Kensington Farms - Cross Section 1 (Sta. 100+00)

Station	Elevation
0.00	964.00
15.89	962.10
227.56	962.10
282.83	962.10
287.83	962.08
307.83	956.10
309.53	956.10
311.50	956.10
316.50	956.92
321.50	957.50
326.50	958.10
341.50	958.25
356.50	959.25
366.50	960.18
371.50	960.59
391.50	962.31
416.72	964.00

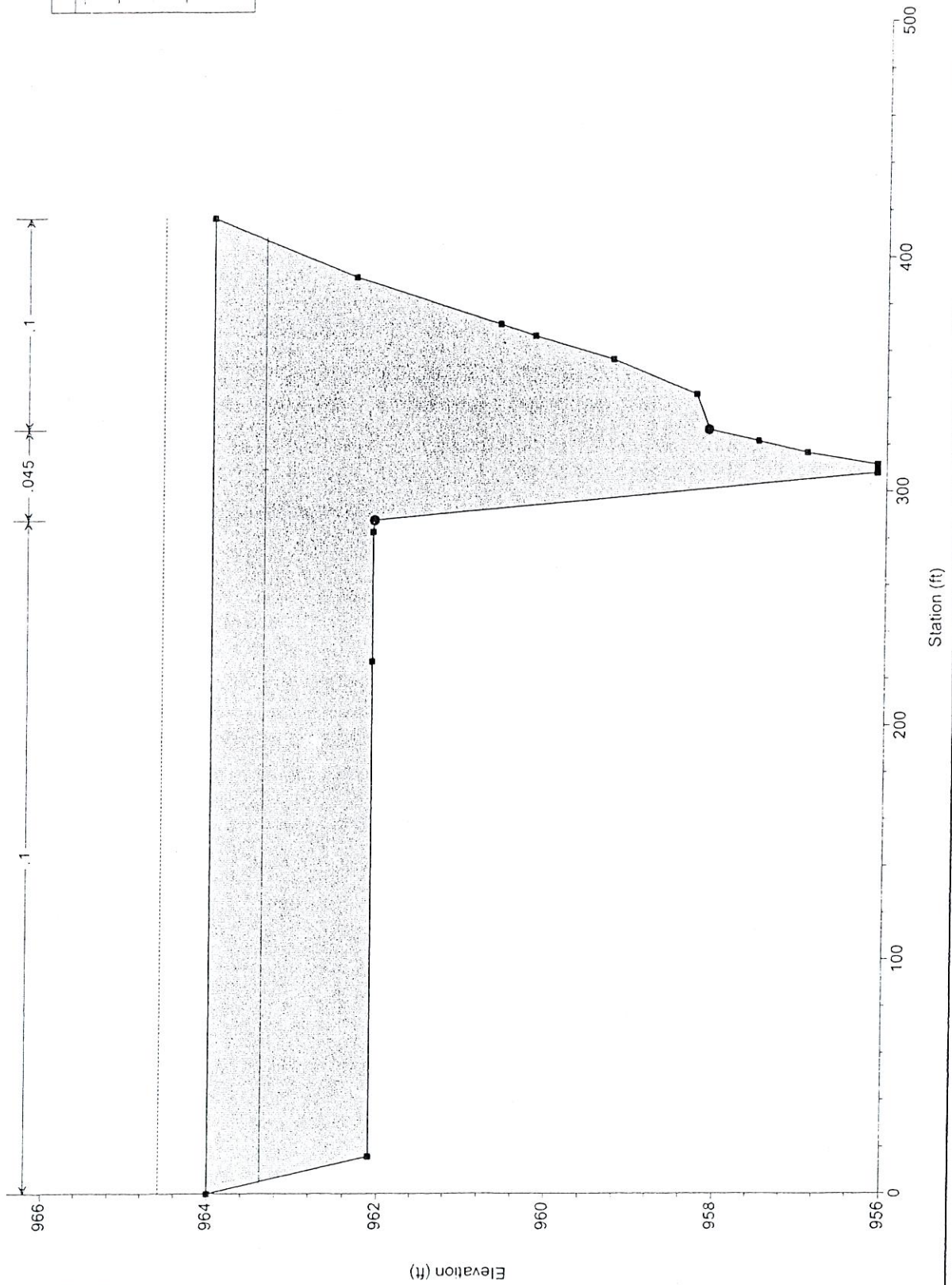
Downstream Reach Lengths		
LOB	Channel	ROB
0	0	0

Manning's n Value		
LOB	Channel	ROB
0.1	0.045	0.1

Main Channel Bank Stations		
Left Bank		Right Bank
0		0

Cont\Exp Coefficients		
Contraction		Expansion
0.1		0.3

Kensington Farms Plan: Plan 01 12/9/2004



Kensington Farms - Cross Section 2 (Sta. 103+90.71)

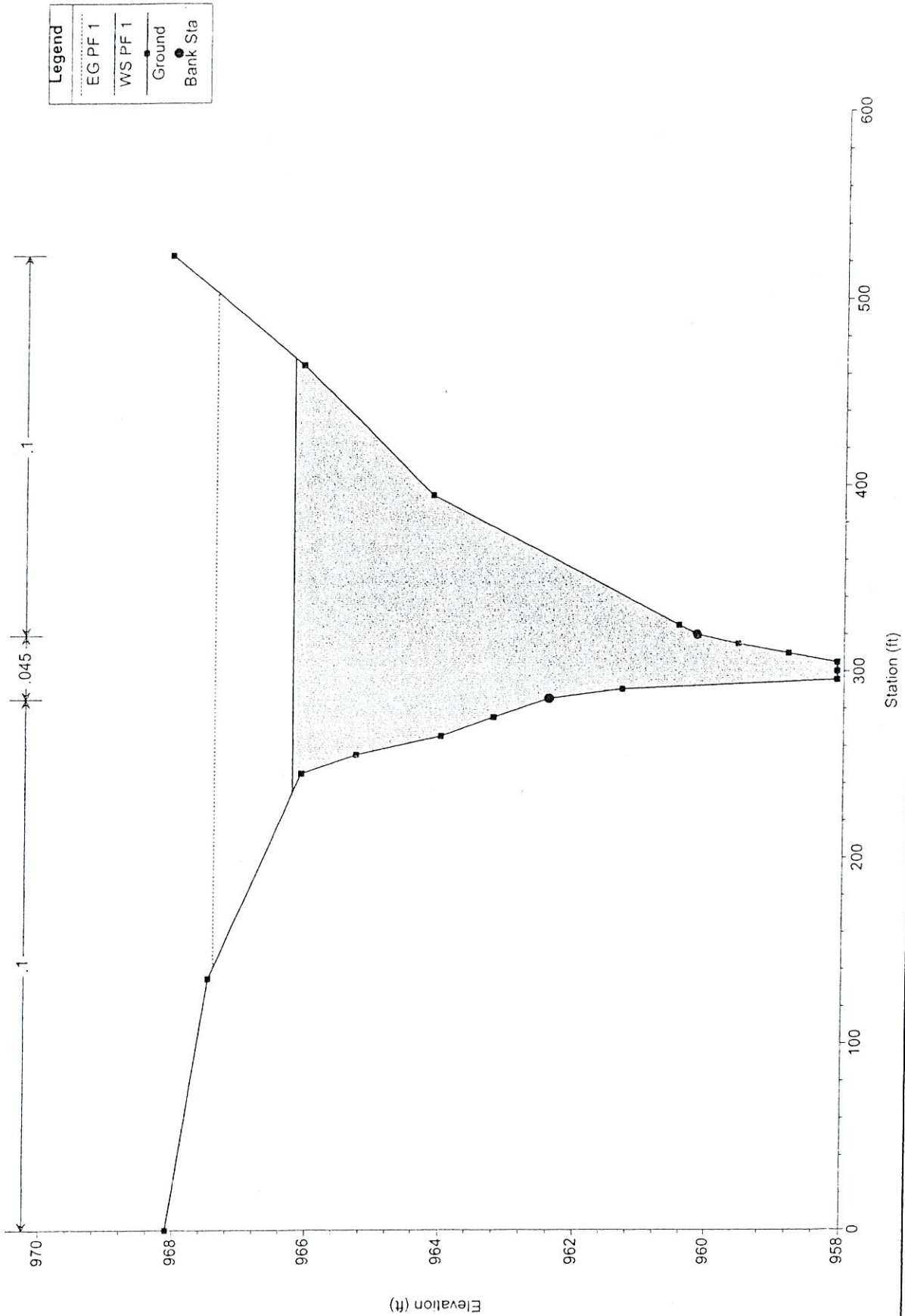
Station	Elevation
0.00	968.10
135.48	967.49
245.61	966.10
255.61	965.29
265.61	964.01
275.61	963.23
285.61	962.41
290.61	961.31
295.61	958.10
300.24	958.10
305.00	958.10
310.00	958.80
315.00	959.55
320.00	960.18
325.00	960.46
395.00	964.15
465.00	966.10
523.66	968.09

Downstream Reach Lengths		
LOB	Channel	ROB
388.97	390.71	387.24

Manning's n Value		
LOB	Channel	ROB
0.1	0.045	0.1

Main Channel Bank Stations		
Left Bank		Right Bank
285.61		320.00

Cont\Exp Coefficients		
Contraction		Expansion
0.1		0.3



Kensington Farms - Cross Section 3 (Sta. 114+44.64)

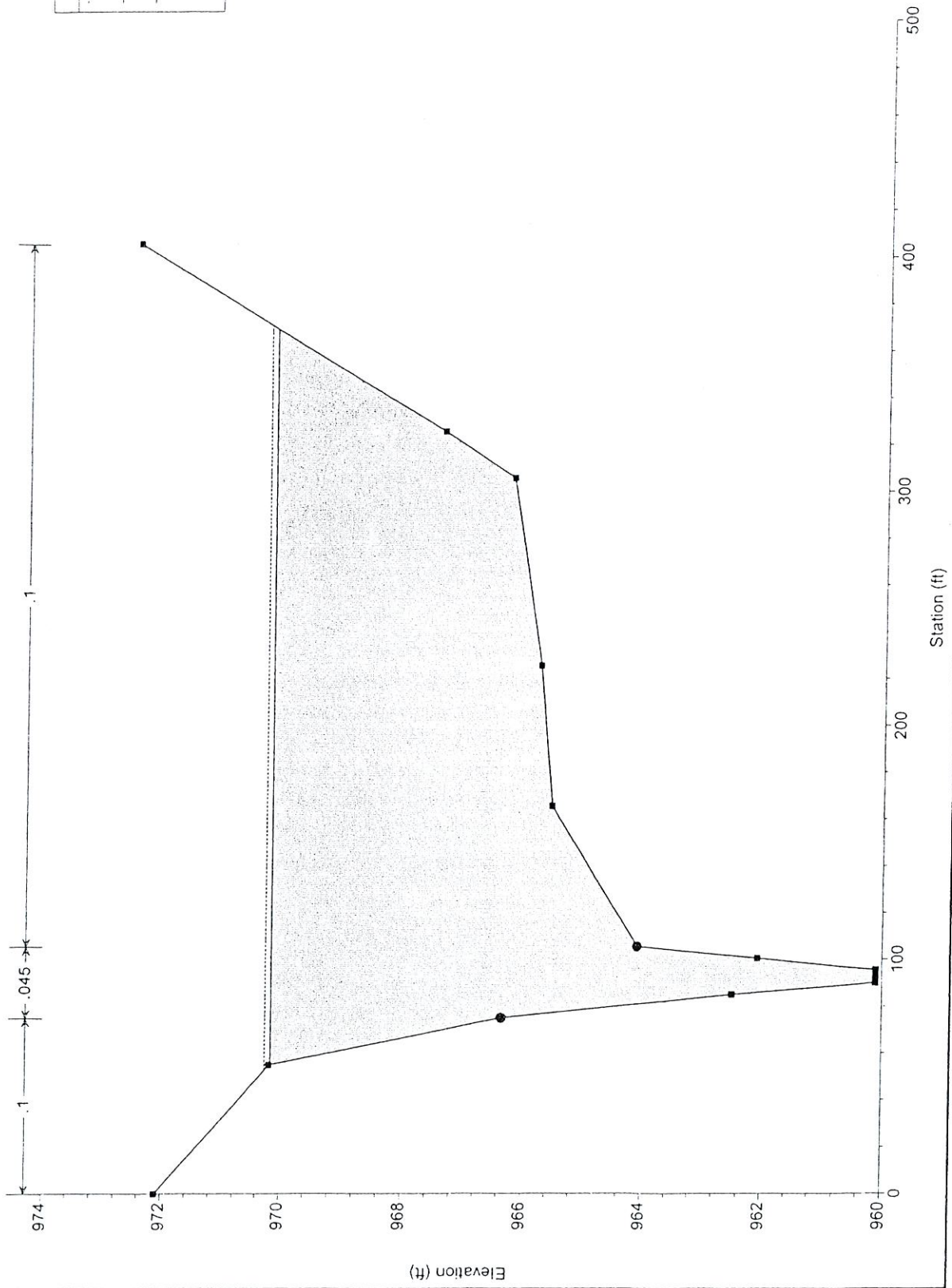
Station	Elevation
0.00	972.10
55.00	970.18
75.00	966.34
85.00	962.49
90.00	960.10
92.80	960.10
95.59	960.10
100.59	962.07
105.59	964.08
165.59	965.53
225.59	965.73
305.59	966.21
325.59	967.37
405.59	972.46

Downstream Reach Lengths		
LOB	Channel	ROB
937.39	1053.93	1047.53

Manning's n Value		
LOB	Channel	ROB
0.1	0.045	0.1

Main Channel Bank Stations		
Left Bank		Right Bank
75.00		105.59

Cont\Exp Coefficients		
Contraction		Expansion
0.1		0.3



Kensington Farms - Cross Section 4 (Sta. 117+84.67)

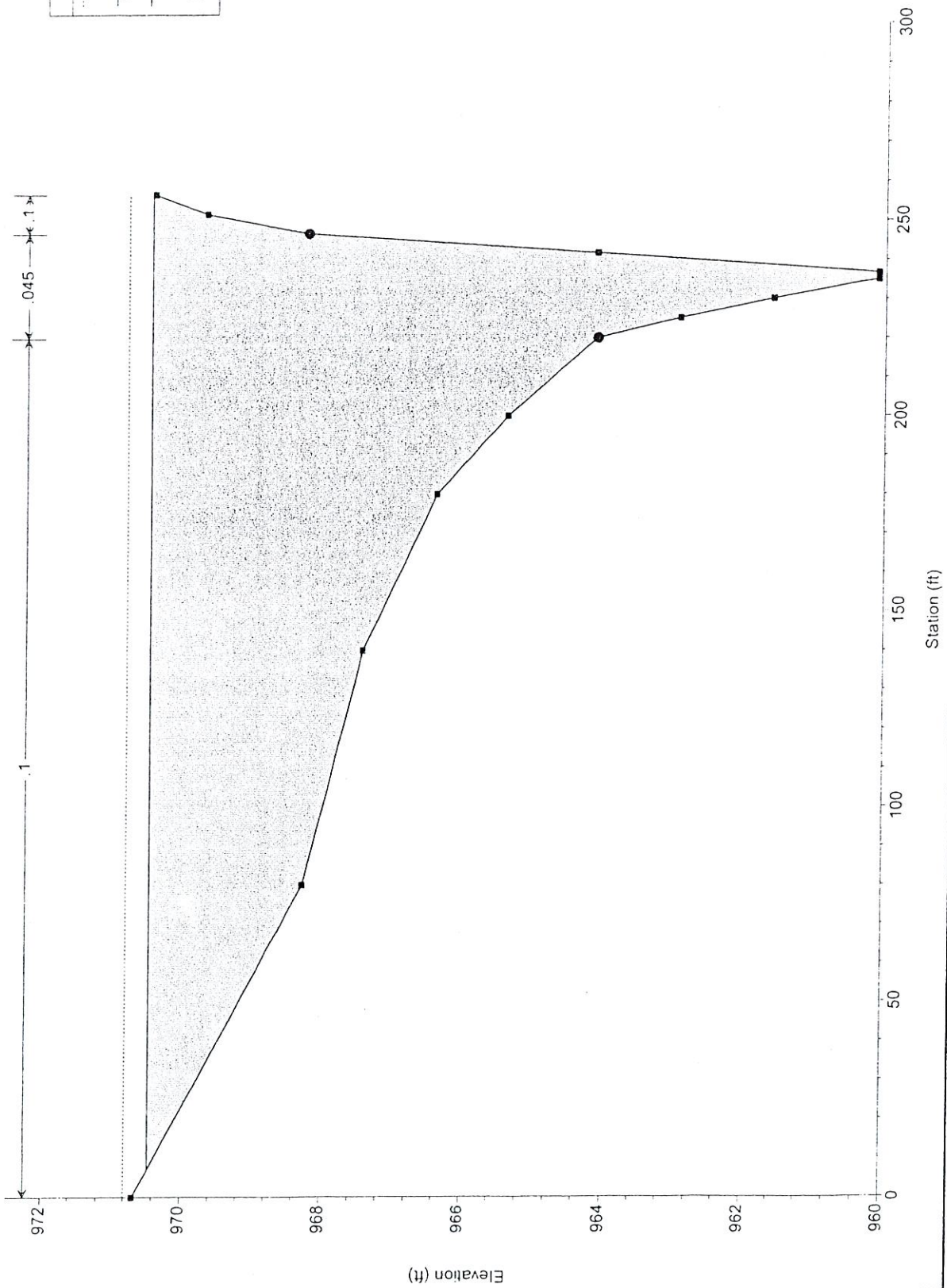
Station	Elevation
0.00	970.67
80.00	968.27
140.00	967.43
180.00	966.38
200.00	965.37
220.00	964.11
225.00	962.94
230.00	961.59
235.00	960.10
235.85	960.10
236.69	960.10
241.69	964.13
246.69	968.23
251.69	969.69
256.69	970.43

Downstream Reach Lengths		
LOB	Channel	ROB
341.45	340.03	336.49

Manning's n Value		
LOB	Channel	ROB
0.1	0.045	0.1

Main Channel Bank Stations		
Left Bank		Right Bank
220.00		246.69

Cont\Exp Coefficients		
Contraction		Expansion
0.1		0.3



Kensington Farms - Cross Section 5 (Sta. 121+52.17)

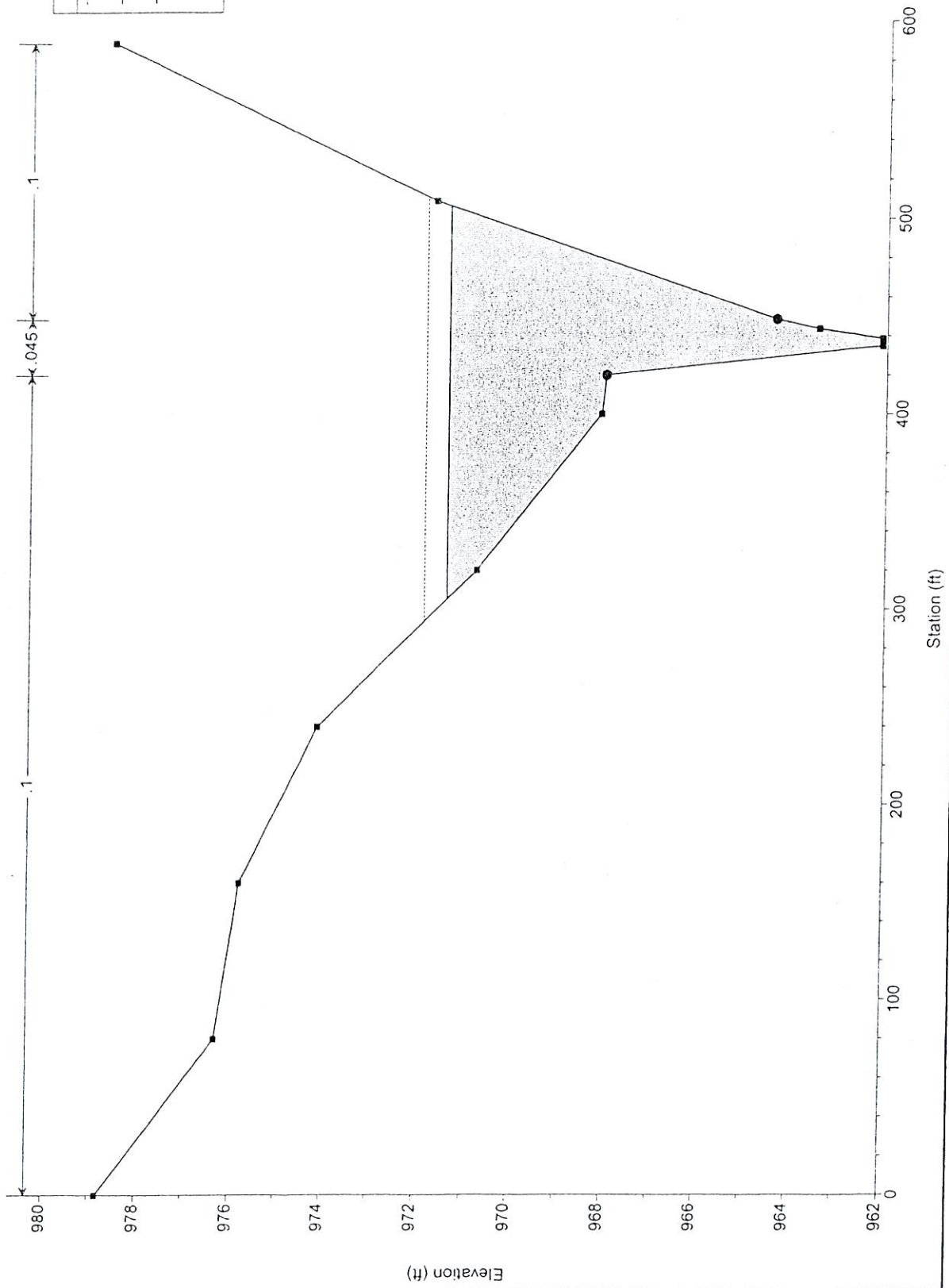
Station	Elevation
0.00	978.83
80.00	976.31
160.00	975.81
240.00	974.12
320.00	970.74
400.00	968.10
420.00	968.00
434.84	962.10
436.84	962.10
438.68	962.10
443.68	963.42
448.68	964.34
508.68	971.66
588.68	978.63

Downstream Reach Lengths		
LOB	Channel	ROB
355.18	368.04	368.32

Manning's n Value		
LOB	Channel	ROB
0.1	0.045	0.1

Main Channel Bank Stations		
Left Bank		Right Bank
420.00		448.68

Cont\Exp Coefficients		
Contraction		Expansion
0.1		0.3



Kensington Farms - Cross Section 6 (Sta. 126+34.20)

Station	Elevation
0.00	982.10
20.00	981.30
120.00	978.47
220.00	976.10
320.00	972.96
420.00	970.10
470.00	968.10
475.88	966.10
478.04	966.10
479.90	966.10
529.90	972.61
579.90	977.79
629.90	982.45

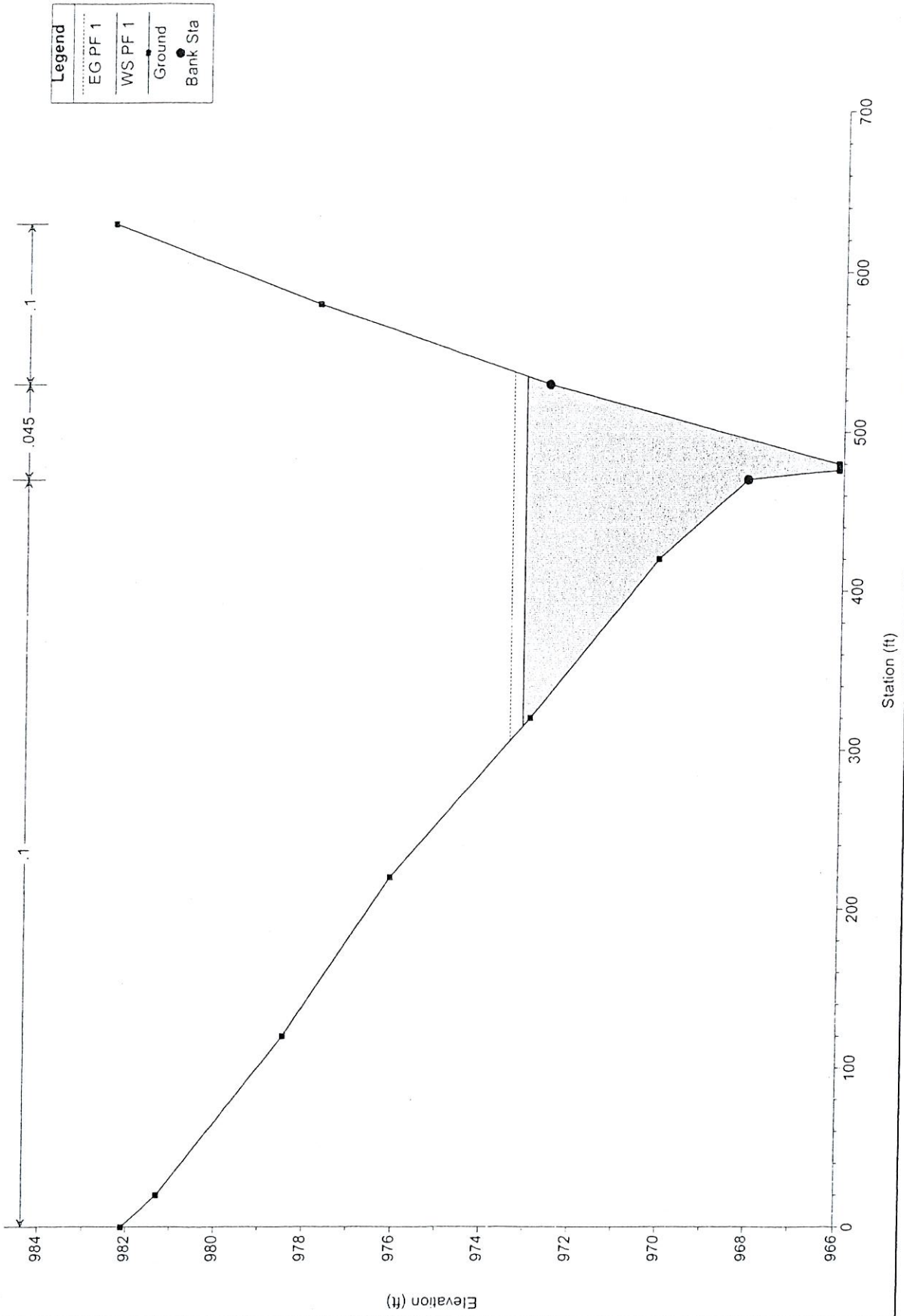
Downstream Reach Lengths		
LOB	Channel	ROB
478.50	481.49	470.93

Manning's n Value		
LOB	Channel	ROB
0.1	0.045	0.1

Main Channel Bank Stations		
Left Bank		Right Bank
470.00		529.90

Cont\Exp Coefficients		
Contraction		Expansion
0.1		0.3

Kensington Farms Plan: Plan 01 12/9/2004



Kensington Farms - Cross Section 7 (Sta. 130+26.14)

Station	Elevation
0.00	982.10
69.73	974.10
142.50	973.68
242.50	972.10
260.17	968.10
266.57	968.10
272.96	968.10
281.31	970.10
326.70	974.10
426.70	977.18
539.70	982.10

Downstream Reach Lengths		
LOB	Channel	ROB
394.03	391.94	389.66

Manning's n Value		
LOB	Channel	ROB
0.1	0.045	0.1

Main Channel Bank Stations		
Left Bank		Right Bank
242.50		281.31

Cont\Exp Coefficients		
Contraction		Expansion
0.1		0.3



Kensington Farms - Cross Section 8 (Sta. 134+72.19)

Station	Elevation
0.00	983.14
100.00	980.03
200.00	978.41
300.00	972.09
310.73	970.10
312.74	970.10
314.56	970.10
322.23	972.04
422.23	978.27
522.23	982.29

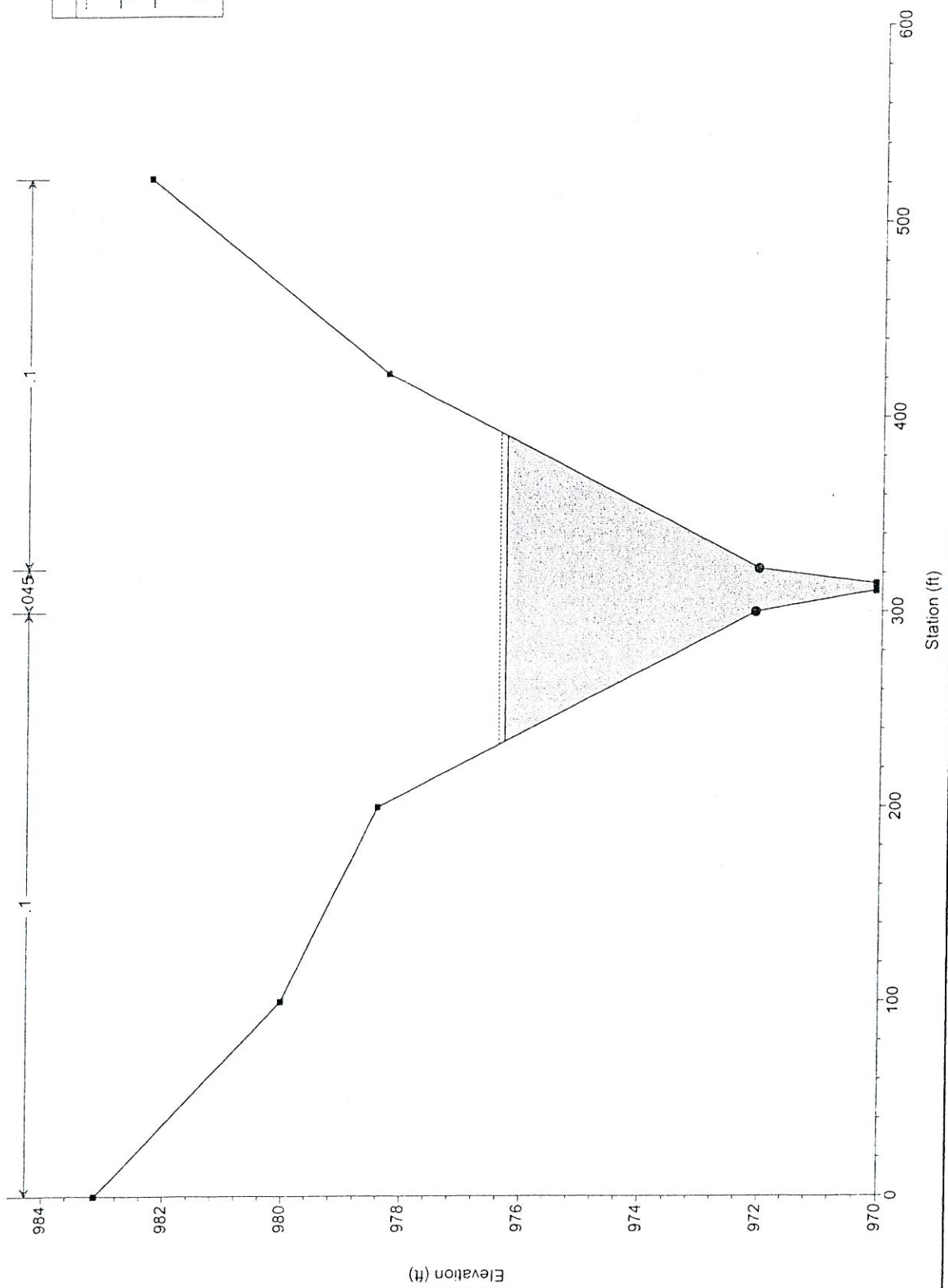
Downstream Reach Lengths		
LOB	Channel	ROB
412.59	168.90	460.38

Manning's n Value		
LOB	Channel	ROB
0.1	0.045	0.1

Main Channel Bank Stations		
Left Bank		Right Bank
300.00		322.23

Cont\Exp Coefficients		
Contraction		Expansion
0.1		0.3

Kensington Farms Plan: Plan 01 12/9/2004



Kensington Farms - Cross Section 9 (Sta. 136+41.09)

Station	Elevation
0.00	986.10
40.61	984.71
140.61	981.43
240.61	978.79
340.61	972.10
345.71	970.36
346.28	970.36
346.85	970.36
352.93	974.10
401.30	980.13
452.93	981.83
552.93	985.88

Downstream Reach Lengths		
LOB	Channel	ROB
173.43	168.90	166.92

Manning's n Value		
LOB	Channel	ROB
0.1	0.045	0.1

Main Channel Bank Stations		
Left Bank		Right Bank
340.61		352.93

Cont\Exp Coefficients		
Contraction		Expansion
0.1		0.3

Kensington Farms Plan: Plan 01 12/9/2004

