Stormwater Capacity Analysis for Backlick Run, City of Alexandria, Virginia

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Contents

Attachments

Executive Summary

The City of Alexandria, Virginia, has experienced repeated and increasingly frequent flooding events attributable to old infrastructure, inconsistent design criteria, and perhaps climate change. The purpose of the stormwater capacity analysis project is to provide a program for analyzing storm sewer capacity issues, identifying problem areas, developing and prioritizing solutions, and providing support for public outreach and education. The project is being implemented in phases by watershed. The watersheds include Backlick Run, Four Mile Run, Holmes Run, Cameron Run, Hooffs Run, Strawberry Run, Potomac River, and Taylor Run.

This technical memorandum focuses on hydrologic and hydraulic analyses of Backlick Run watershed using xpswmm. It summarizes the storm sewer system in the Backlick Run watershed, the model development steps, data sources and gaps, model assumptions, and the results, focusing on the capacity deficiencies

identified in the model. These deficiencies will be used as a basis for identifying and prioritizing problem areas during the next phase of the project.

The objective of this phase of the study is to identify the deficient stormwater collection system elements in Backlick Run during a 10-year return period rainfall event. During the Hooffs Run watershed modeling task, three different design storm scenarios and one historic event were investigated: the City's existing intensity-duration-frequency (IDF) curve, the updated IDF curve using the full record of historical precipitation data (1949 to 2008), the IDF curve projected for the year 2100 using various climate change scenarios, and the June 25–27, 2006 storm event. The results of the Hooffs Run analyses showed that the existing IDF design hyetograph was the most conservative of the design storms (produced the greatest amount of stormwater runoff and flooding), and produced a similar amount of the system flooding to the results from the historic event. Consequently, this scenario was chosen to be used to complete the stormwater capacity analysis for the other watersheds.

The Backlick Run watershed has a drainage area of 1.22 square miles located in the southwestern corner of the City, bounded to the west by Fairfax County and on the south by Cameron Run. The watershed is drained by Backlick Run and its tributaries from west to east and discharges to Cameron Run along with Holmes Run near Ben Brenman Park. The Backlick Run storm sewer system model is composed of 938 junctions and 941 segments of storm sewer pipe, totaling 15.7 miles.

The hydraulic model predicts that the Backlick Run storm sewer system is experiencing capacity deficiencies in several areas within the watershed. Approximately 9 percent of the analyzed pipes flood the ground surface, 13 percent have a hydraulic grade line within 2 feet of the surface, and 30 percent surcharge above the crown of the pipe. Comparing the peak runoff to the estimated inlet capacity of each catchment indicates that 50 percent of the catchments in the model may have insufficient inlet capacity. Maps and profiles of flooding areas are presented in this technical memorandum to assist in locating problem areas and understanding the capacity deficiencies of the drainage system.

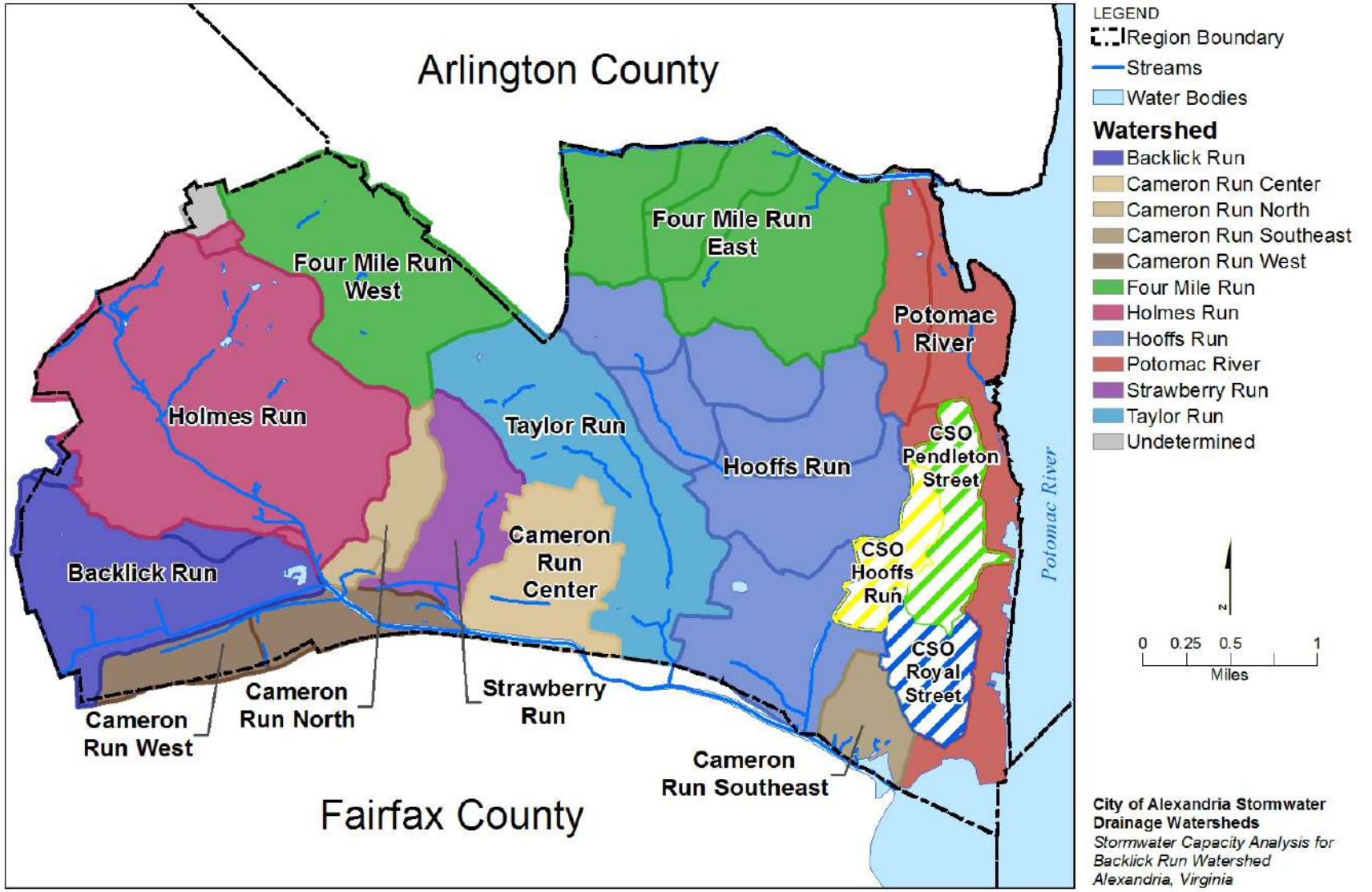
The hydraulic modeling results presented in this memorandum should be reviewed with the understanding that several assumptions were made to fill data gaps, primarily assumptions of inverts in pipes with diameters less than 24 inches.

Project Introduction

The City of Alexandria, Virginia, (City) has experienced repeated and increasingly frequent flooding events attributable to old infrastructure, inconsistent design criteria, and perhaps climate change. The purpose of this project is to provide a program for analyzing storm sewer capacity issues, identifying problem areas, developing and prioritizing solutions, and providing support for public outreach and education. The project is being implemented by watershed. The watersheds include Backlick Run, Four Mile Run, Holmes Run, Cameron Run, Hooffs Run, Strawberry Run, Potomac River, and Taylor Run.

The purpose of this task is to conduct stormwater capacity analysis for the City's existing stormwater collection system within the Backlick Run watershed. Figure 1 presents the various drainage sewersheds for the City of Alexandria. This technical memorandum describes the methodology and results of the stormwater capacity analysis for the stormwater collection system in the Backlick Run watershed identified in Figure 1. Additional memorandums will describe the results for additional watersheds in the City.

FIGURE 1
Stormwater Drainage Watersheds
City of Alexandria Storm Sewer Capacity Analysis – Backlick Run



Task 2 Objectives

The objective of this phase of the study was to identify the deficient stormwater collection system elements during a 10-year return period storm event. The stormwater collection system elements include the following:

- Closed conduits, such as gravity mains (storm drains) and culverts
- Open channels, such as streams and trapezoidal channels that connect two pipe systems
- Drainage inlets and junctions, such as roadside curb inlets, manholes, catch basins, ponds
- Flow regulating structures, such as weirs, orifices, and tide gates

Description of Existing Stormwater Collection System

The City maintains a geodatabase of all stormwater collection system elements, including conduits and drainage junction points. A checked-out copy of the Backlick Run geodatabase received from the City on December 21, 2012 was used as the basis of the stormwater collection system model.

Backlick Run watershed has a drainage area of 1.22 square miles that was subdivided into 208 catchments for modeling purposes. The watershed is located in the southwest corner of the City and bounded on the west by Fairfax County. The natural drainage of the Backlick Run watershed consist of Backlick Run stream running west to east from the Fairfax County boundary to the confluence of Holmes Run and Cameron Run. The stream system and a few drainage ditches coupled with the system of storm sewers drain the Backlick Run watershed from west to east and discharge into Cameron Run near Ben Brenman Park.

The geodatabase was thoroughly reviewed and updated with new survey data for conduits with diameter 24 inches and larger collected during Task 3, a Field Survey and Condition Assessment task. In some locations for which survey data were not available, the City's plan and as-built drawings were used to improve data quality and rectify system connectivity. The updated geodatabase was submitted to the City for incorporation (i.e., checked-in) into the City-wide stormwater collection system geodatabase. The updated stormwater collection system in the Backlick Run watershed contains the following elements:

- 1,105 pipe segments representing 96,628 linear feet of gravity mains (storm drains). Pipe diameter/ width varies from 8 to 96 inches for circular, rectangular, and elliptical[1].
- 1,158 drainage junction points:
  - 6 catch basins
  - 15 culvert points
  - 673 drainage inlets
  - 297 manholes
  - 127 nodes (blind connections)
  - 36 pipe inlet/outlets
  - 2 control devices
  - 2 storage basins (stormwater ponds)

The existing stormwater collection system includes two stormwater ponds and control devices. The Extended Stay property on Breckenridge Place in the northwest corner of the watershed has a privately-owned dry pond and control device that collects and detains runoff from the hotel and parking lot. There is also a publicly-owned wet pond in Brenman Park that receives discharge from the eastern half of the watershed.

In addition to the structures represented in the stormwater collection system geodatabase, a network of natural streams and open channels convey storm flows in the City's drainage network. In Backlick Run, the

[1] The geodatabase also includes a 276-inch (23-foot) diameter storage pipe. This storage facility is located under the Van Dorn Plaza parking lot. This facility is described in the 'Modeled and Analyzed System' section in this TM.

natural drainage network includes the Backlick Run main stem, two smaller open channels connecting the closed conduit system to the main stem, and a series of smaller open channels and ditches connecting segments of closed conduit storm sewers and culverts. The main stem and two connected open channels are represented separately in the City's geodatabase in a stream feature class but are not included in the capacity analysis. Smaller ditches and stream segments that complete hydraulic connectivity are included in the hydraulic model, but do not exist in the geodatabase.

Public/Private and Disconnected Drainage Systems

The City's geodatabase includes structures that are privately owned. Since the hydraulic analyses and identification of capacity deficiencies include only the public facilities as per direction from the City, the structures located in privately-owned parcels were identified and excluded from the model. The methodology that was used to accomplish this is documented in the meeting minutes presented in Attachment A.

Despite survey and review of available drawings and documents, small isolated systems remained in the database. These systems were identified and removed from the model due to lack of accurate information available to connect them to the drainage system. The disconnected systems consisted of only a few structures and did not connect to any larger downstream systems.

Modeled and Analyzed System

After reviewing and updating data in the City's geodatabase, the database was returned to the City and a copy of that geodatabase was used as the starting point for the hydraulic model. At the direction of the City, private and small disconnected systems were removed from the modeled system.

The modeled system represents an analysis of approximately 20 percent of the inlets as per the scope of work. Since drainage areas were not computed for each inlet in the model, many pipes in the model were upstream of runoff inputs and did not receive any flow. Therefore, approximately 434 pipes with diameter ranging from 8 to 24 inches and 35 pipes with diameter 27 to 48 inches in the upstream-most portions of the system were effectively eliminated from the hydraulic analysis. Only results pertaining to the analyzed system are included in this report. The analyzed system includes the following elements:

- 489 pipe segments representing 59,039 linear feet of gravity mains (storm sewers), or 61 percent of the total length of storm drains in the geodatabase.[2] Pipe diameter/width varies from 12 to 96 inches[3].
- 495 drainage junction points:
  - 2 catch basins
  - 9 culvert points
  - 214 drainage inlets
  - 209 manholes
  - 40 nodes (blind connections)
  - 19 pipe inlet/outlets
  - 2 storage nodes
  - 2 control devices
- 9 open channel segments

Two storage facilities are included in the Backlick Run xpswmm model: the pond in Brenman Park and an underground storage facility in the Van Dorn Plaza parking lot. The pond is included in the model as a storage node with a stepwise linear storage function based on contour data from plan drawings of Cameron Station

[2] Eight pipe segments are double barrels in the City's geodatabase represented by a single pipe segment in the model; therefore only 481 unique pipes are analyzed in the model and presented in the results.

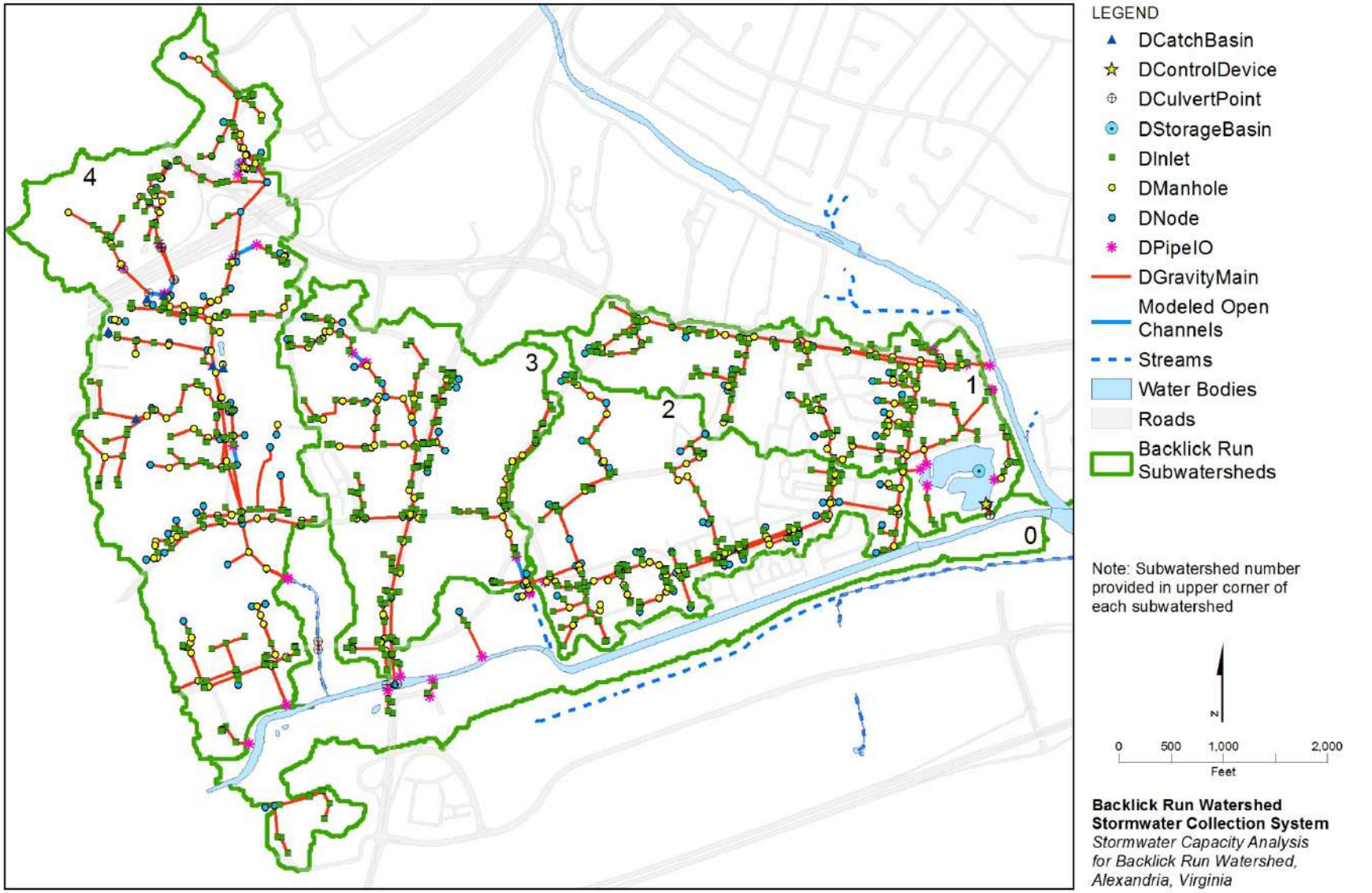
[3] The xpswmm model also includes the 276 inch Van Dorn Plaza storage facility.

East and West Parks. Outlet control is based on the same drawings, which provide the elevation and length of high flow and low flow weirs.

Based on field observations, the Van Dorn Plaza facility consists of a large-diameter corrugated metal storage pipe that discharges to a rectangular box via a high flow weir and a low flow orifice. These three separate components (the storage pipe, the outlet control, and the junction box), are included in the xpswmm model. This facility was difficult to inspect due to its location and limited access points, so assumptions have been made to incorporate it into the model. The storage pipe is assumed to be 200 feet long and 23 feet in diameter based on observations made in the junction box. The high flow weir is an arch shaped opening at the top of the large diameter storage pipe that was estimated to be about 2 feet tall at the highest point and about 13 feet long. The low flow orifice is an approximately 24-inch diameter circular pipe at the bottom of the large diameter storage pipe. The crest, crown, and invert of the weirs and of the storage pipe are based on estimations made in the field.

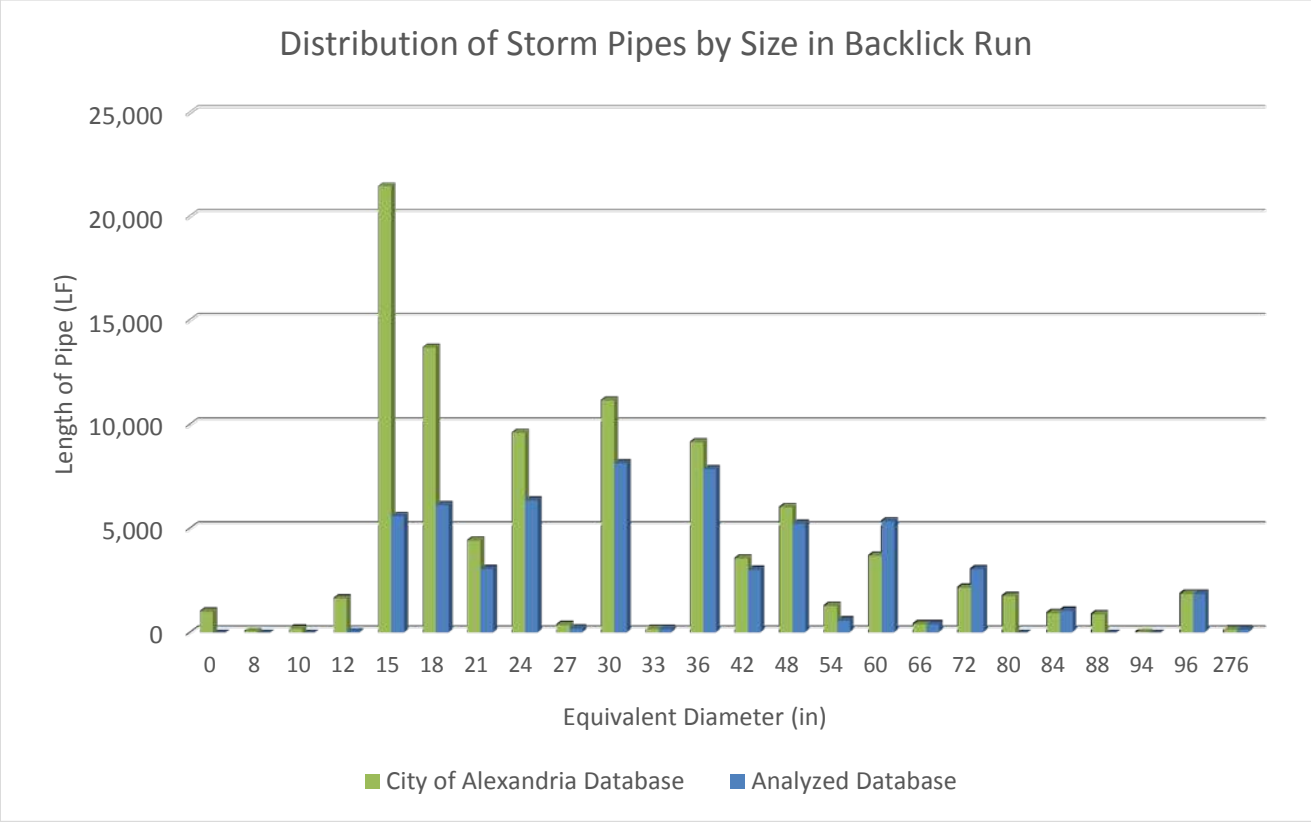
Figure 2 shows a map of the existing stormwater collections system in the Backlick Run watershed.

FIGURE 2
Existing Stormwater Collection System
City of Alexandria Storm Sewer Capacity Analysis – Backlick Run



The distribution by size of storm drains in the City's Backlick Run geodatabase and the storm drains analyzed in the Backlick Run model are presented in Figure 3.

FIGURE 3
Distribution of Storm Drains by Size
City of Alexandria Storm Sewer Capacity Analysis – Backlick Run



Data Gaps

The available data for the storm drains in the Backlick Run watershed were evaluated for data quality and completeness. The City's database was updated with data collected from the field survey. However, the field survey included only storm sewer structures connected to pipes with diameter 24 inches or greater (about 70% of the modeled system by length, which does not include private or disconnected structures). Approximately 30% of the modeled system (by length) consists of sewers smaller than 24 inches in diameter and was not surveyed as part of this study. Existing data in the City's most current database were used for modeling the portions of system that were not surveyed.

Some structures in the City's most current database are missing data that are critical for modeling storm sewer systems. Examples of data gaps include missing junction rim and/or invert elevation and pipe size and inverts. A typical missing pipe invert occurs at a location with a blind pipe connection where there is no access manhole, including junction rim and/or invert elevation and pipe size and upstream and/or downstream invert. The data gaps needed to be filled to develop a complete hydraulic model. The following standard approaches were adopted to fill the missing data:

- Missing data were inferred from the available data, if applicable. For example, a missing pipe size was assumed to equal the downstream pipe diameter.
- Pipe diameters at the most-upstream inlets were assumed to be 12 inches.
- A 6-inch-depth to crown was assumed for the most upstream inlets and DNodes.
- Interior point feature invert elevations were estimated by assuming that pipe slope is constant.

- At outfalls and some blind connections to upstream private systems, the slope from the next upstream or downstream pipe was used to extrapolate an invert for the outfall or blind connection.
- Limited data available in the GIS for ponds and the outlet control structures were supplemented with data from as-built plans.

In addition to filling in missing data, the data were reviewed for data quality and validity. Assumptions were made when the available data were not reasonable (e.g., a pipe crown was above the rim of a manhole). Additional information regarding the types of assumptions made to complete the hydraulic model are provided in the technical memorandum *Summary of Data Gaps and Assumptions in the Hooffs Run Watershed* (CH2M HILL, 2012), which was provided to the City in October 2012. The same approaches were applied to fill data gaps and resolve unreasonable data in the GIS data for the Backlick Run watershed, except where field survey data are available.

Modeling Approach

The Backlick Run watershed was analyzed using commercially available and public domain computer models that are industry accepted and widely used. The public domain software ArcHydro Tools for ArcGIS 10.0 (version 2.1) was used to aid delineation of catchments and to estimate hydrologic parameters, such as catchment drainage area, slope, and longest flow path. Other hydrologic parameters, such as catchment width and percent impervious, were estimated in ArcGIS after completing the catchment delineation. The private domain software xpswmm (version 2014, service pack 1) was used to simulate rainfall-runoff processes and the performance of the stormwater collection system. The xpswmm software is widely used and industry-accepted commercial stormwater management software. The core xpswmm simulation engine is based on the USEPA stormwater management model (SWMM) engine.

The City of Alexandria provided the required data listed below:

- BacklickRun_Dsewer_CH2MHill_122112.gdb, a checked-out copy of the Backlick Run geodatabase of the stormwater collection system
- Spring 2011 DVD, City GIS data (geodatabase and orthophotography) such as topographic data and land use

Hydrologic Modeling

The hydrologic modeling required two major types of inputs:

- **Hydrologic parameters:** Delineation of catchments and computation of hydrologic parameters such as drainage area, slope, width, and percent impervious for each catchment.
- **Design Hyetographs** - Development of a 24-hour synthetic rainfall distribution for the 10-year design storm event

Hydrologic Parameters

Hydrologic parameters were estimated using ArcHydro and Hydrologic Engineering Center (HEC)-GeoHMS.

The ArcHydro tools are a set of public domain utilities developed jointly by the Center for Research in Water Resources of the University of Texas at Austin (http://www.crwr.utexas.edu), and the Environmental Systems Research Institute (ESRI). These tools provide functionalities for terrain processing, watershed delineation, and attribute management. They operate on top of the ArcHydro data model in the ArcGIS environment. The model uses a digital elevation model (DEM) of the subject watershed to compute hydrologic parameters. The "burning in" technique allows the user to impose the drainage system on the terrain to better produce the catchment boundaries.

HEC-GeoHMS is geospatial hydrologic modeling software developed and maintained by the HEC of the U.S. Army Corps of Engineers. The model allows users to visualize spatial information, perform spatial

analysis, delineate subbasins, and estimate watershed hydrologic parameters. (U.S. Army Corps of Engineers, 2003).

In this study, 2-foot contour data provided by the City were used to create a DEM of the watershed and vicinity. ArcHydro tools were used to delineate the catchments (also referenced as subbasins in the tools). HEC-GeoHMS was used to compute hydrologic parameters, such as drainage area, slope, and longest flow path for each catchment. Width was derived using the catchment drainage area and longest flow path using the equation: width = (area/longest flow path). Percent impervious was estimated in ArcGIS using the delineated catchments and impervious coverage shapefiles provided by the City.

Updated subwatershed and watershed boundaries were developed using the catchment layer developed during the modeling process and returned to the City. Schematics of the hydrologic model for each subwatershed are presented in Attachment B. The schematics show the catchment ID, delineated boundaries, and longest flow path for each catchment as well as the DEM of the Backlick Run watershed. The hydrologic parameters for each subwatershed are also presented in Attachment B. The following are the major drainage characteristics for the Backlick Run watershed, based on the hydrologic model:

- Total drainage area is 1.22 square miles (780 acres)
- Drainage area divided into 4 subwatersheds containing 209 catchments, 177 of which are included in the model[4]
- 63 percent of the drainage area is impervious
- Average catchment area is 3.8 acres
- Average catchment slope is 0.07 feet/feet
- Average catchment width is 186 feet

Design Hyetograph

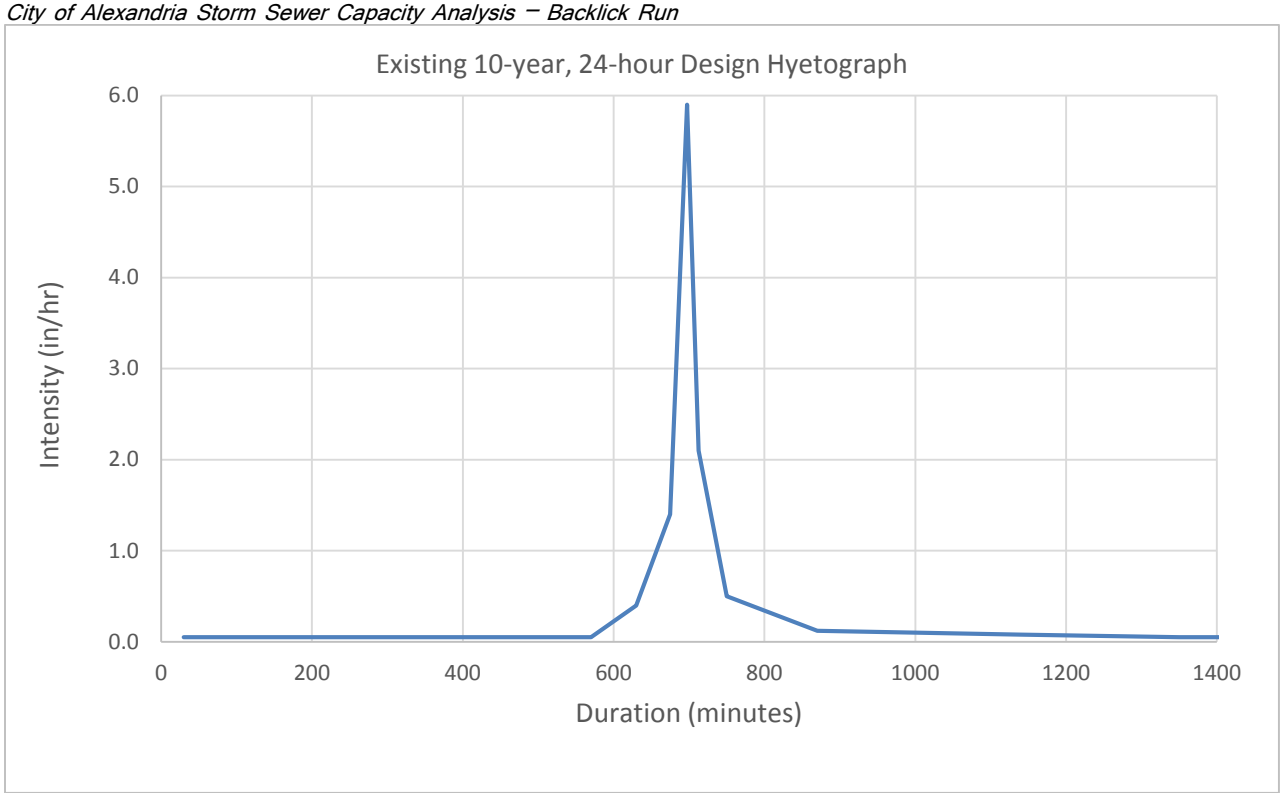
The 24-hour synthetic rainfall distribution for the 10-year design storm event was developed based on rainfall data from the existing intensity-duration-frequency (IDF) curve for the 10-year return period for Alexandria (City of Alexandria, 1989). Time of concentration values were computed for several inlets in the Hooffs Run pilot subwatershed and the Four Mile Run priority subwatershed. Based on these results, the peak rainfall intensity was selected from the IDF curve, based on a 15-minute time of concentration. A variable time interval approach was used to generate the design hyetograph. The design hyetograph was developed to yield maximum rainfall intensity at the approximate center of the 24-hour storm. The 24-hour rainfall total is 5.04 inches, and the peak intensity is 5.9 inches per hour (in/hr). Table 1 and Figure 4 present the existing 10-year, 24-hour design hyetograph.

[4] The xpswmm model includes 177 of the 209 catchments delineated in the Backlick Run watershed; 32 catchments drain directly to the stream or to small systems that are not included in the model and discharge directly to the stream.

TABLE 1
Existing 10-year 24-hour Design Hyetograph Data
City of Alexandria Storm Sewer Capacity Analysis – Backlick Run

Start Time (minutes)	Duration (minutes)	Absolute Rainfall Depth (inches)	Intensity (in/hr)
0	60	0.05	0.05
60	60	0.05	0.05
120	60	0.05	0.05
180	60	0.05	0.05
240	60	0.05	0.05
300	60	0.05	0.05
360	60	0.05	0.05
420	60	0.05	0.05
480	60	0.05	0.05
540	60	0.05	0.05
600	60	0.40	0.40
660	30	0.70	1.40
690	15	1.475	5.90
705	15	0.525	2.10
720	60	0.50	0.50
780	180	0.36	0.12
960	360	0.48	0.08
1320	60	0.05	0.05
1380	60	0.05	0.05

FIGURE 4
Existing 10-Year 24-Hour Design Hyetograph
City of Alexandria Storm Sewer Capacity Analysis – Backlick Run



Simulation of Stormwater Runoff

The xpswmm 2014 software was used to simulate rainfall-runoff processes from the Backlick Run watershed. The hydrologic parameters such as area, slope, width, and percent impervious for the 177 catchments listed in Attachment B were estimated using ArcGIS, ArcHydro Tools 10.0, as described in the previous section. These hydrologic parameters and the 10-year, 24-hour design hyetograph were used as input to the RUNOFF module of the xpswmm model. The U.S. Environmental Protection Agency (USEPA) SWMM Runoff Non-linear Reservoir Method was used to simulate the stormwater runoff from each catchment in response to the hyetograph.

Hydraulic Modeling

The xpswmm model was used to simulate the hydraulic performance of the stormwater collection system during a 10-year, 24-hour design storm event. Model input data included the following physical data:

- Junction (inlet, manhole, nodes, etc.) invert and rim elevations
- Closed and open conduit invert elevations, size, shape, material, and length
- Stormwater storage pond stage-storage relationships
- Control device (orifices, weirs, etc.) size, shape, and length

The data for the stormwater collection system were primarily imported into the model from the geodatabase provided by the City. This geodatabase was updated with survey data for structures that are attached to pipes that are 24 inches or larger in diameter and considered public. Private structures were not modeled, so any private runoff was applied to the next downstream model load point. All elevations (invert and rim) recorded in the geodatabase of the stormwater collection system are in NAVD 88 datum; therefore the xpswmm model was built in NAVD 88.

Entrance or exit loss coefficients were applied to pipes at connections where pipe size significantly increased or decreased. An exit loss coefficient of 0.15 was applied to the smaller (upstream) pipe where the downstream pipe was two or more times the size of the upstream pipe or the downstream pipe shape is different. An entrance loss coefficient of 0.1 was applied to the smaller (downstream) pipe where the downstream pipe was half the size, or smaller, of the upstream pipe.

The Backlick Run watershed is predominantly drained by the main stem channel of Backlick Run; however, the hydraulic model does not extend beyond the storm sewer outfalls to the channel. The system was modeled as a series of smaller disconnected systems with seven separate outfalls, which include:

- 6 outfalls to the main channel or short tributaries directly connected to the main channel
- 1 outfall to Holmes Run at Duke Street (activated during high flow conditions)

Of the 6 outfalls directly connected to the main channel, 5 were assigned a free discharge because the drainage area to the outfall is less than 60 percent of the total drainage area to that point on the main stem and the Backlick outfall is located sufficiently above or beyond the peak water surface elevation predicted by the USACE HEC-RAS model for a 10-year storm event. The fifth outfall on the main stem is a blind connection located within a culvert under Van Dorn Street. Because the drainage area of the stream upstream of the culvert includes a large portion of Fairfax County for which a hydrograph was not available, the culvert was not included in the model. Instead, the blind connection was set as an outfall and assigned a fixed backwater boundary condition based on the peak water surface elevation predicted by the USACE HEC-RAS model for a 10-year storm event.

The outfall to Holmes Run at Duke Street provides relief to the storm sewer system during high flow conditions. Stormwater runoff collected from the south side of Duke Street between Van Dorn Street and the Holmes Run channel normally discharges into the pond in Brenman Park. However, when the system becomes surcharged, flow is diverted to the Holmes Run outfall at the intersection of Duke Street and Somerville Street. The outfall into Holmes Run is set to a free discharge due to its location above the 10-year peak water surface elevation predicted by the USACE HEC-RAS model.

There are several smaller open channel reaches (e.g., road side swales, ditches, open channels connecting pipe systems, and stream reaches) in the Backlick Run watershed that are included in the model. These small reaches were added to the model to complete the hydraulic connectivity of the storm drainage system near the I-395/Duke Street intersection, adjacent to Yoakum Parkway, south of Stevenson Avenue between Whiting Street and Van Dorn Street, and south of Pickett Street at Cameron Station Boulevard. Cross sections were estimated using the DEM generated from the 2-foot contours available in the City's GIS data and length, slope, and Manning's n roughness values were estimated using aerial photos and contour data.

The primary objective of the hydraulic modeling was to analyze pipe capacities. Hydrographs from the RUNOFF module were entered directly into the underground storm sewer system. This approach does not model the flow restrictions caused by the surface inlets and provides a conservative or "worst case" evaluation of pipe capacities. Due to modeling software and data limitations, inlet capacity cannot be readily modeled in xpswmm and is instead being evaluated in a separate spreadsheet. The details of the model limitations encountered during this study and the external spreadsheet evaluation are provided in *Inlet Capacity Analysis for City of Alexandria Storm Sewer Capacity Analysis* (CH2M HILL, 2012a).

Model Results

Model results are summarized in the following sections.

Hydrologic Model Results

Peak discharge for each node where overland flow was loaded into the hydraulic model is provided in Attachment C.

Inlet Capacity Results

Inlet capacity was evaluated outside xpswmm due to limitations in the modeling software's capabilities. Details on the evaluation of the options for modeling inlet capacity are provided in *Inlet Capacity Analysis for City of Alexandria Storm Sewer Capacity Analysis* (CH2M HILL, 2012a), which was provided to the City in September 2012. The spreadsheet evaluation multiplies the maximum capacity of a single inlet, estimated to be 3.25 cfs based on an assumed standard gutter spread and road cross-section, by the total number of catch basins and inlets draining to a single runoff input point, the location where overland flow was plugged into the hydraulic model. The model has flow loaded into 164 locations with an average of 4 inlets per runoff input point. The estimated capacity for each load point was compared to the peak runoff generated in the RUNOFF module of xpswmm to determine whether the catchment has sufficient inlet capacity. Results suggest that about 50 percent or 82 of 164 model load points may be experiencing inlet capacity deficiencies.

The total inlets and catch basins count is based on the City's GIS data for Backlick Run watershed, including all private and disconnected inlets and catch basins. The City's GIS data does not include all private structures in the Backlick Run watershed since they are not always included in survey efforts. This effectively underestimates the City's available inlet capacity in this analysis. Inlet capacity results are presented in detail in Attachment C.

Hydraulic Model Results

Model results for the pipes and stream segments are summarized in the following sections. Detailed results are presented in Attachment D.

Pipe Capacity

The conveyance capacity of the existing stormwater collection system during the 10-year, 24-hour storm event was evaluated based on three criteria, listed in order of decreasing severity:

- If the hydraulic grade line (HGL) rose above the ground surface, the structure was considered flooded.
- If the HGL rose to within 2 feet of the ground surface, the structure was considered to have insufficient freeboard.

- If the HGL rose above the crown of the pipe but was more than 2 feet from the ground surface, the structure was considered surcharged.

Pipes were evaluated for these conditions at the upstream end. In some cases the water surface was within 2 feet of the ground surface, but within the pipe (not surcharging), because the crown of the pipe was less than 2 feet from the ground surface. In those cases, the pipes were not included in the "insufficient freeboard" category.

Additional details on the results are presented in the following section. The pipes with flooded, insufficient freeboard and surcharged conditions are summarized in Tables 2 and 3. Figure 5 shows the location of pipes experiencing flooding, insufficient freeboard, and surcharged conditions in Backlick Run watershed. Profiles of pipes displaying conditions of the pipes along the main storm sewer line within the Backlick Run watershed are provided in Attachment D. The profiles display:

- Vertical cross-sectional view of the conduits, including the inverts and crowns. They also illustrate the flow conditions such as partially full, full, or surcharged.
- Water surface elevation in the conduit (i.e., HGL)
- HGL in junctions such as manholes, inlets, and nodes
- HGL above the conduit crown (surcharged conditions)
- HGL above the ground (flooding)

Note that the profiles presented only show a snapshot of the system during the model simulation. These profiles will not always show the most severe flooding at each location. For example, the profile may not show the flooding symbol at a location even though surface flooding may occur either before or after the snapshot of the profile was taken.

The detailed model results are presented in tabular format in Attachment D. The results presented in this memorandum should be reviewed with the understanding that flow data were not available for model calibration, and several assumptions were made to fill data gaps, primarily, assumptions about pipe inverts where survey data were unavailable.

The model results presented in Table 2 show that 9 percent of the pipes flood the ground surface, 13% have a hydraulic grade line within 2 feet of the surface, and 30 percent surcharge above the crown of the pipe. Backlick Run model results show relatively little flooding compared with other City of Alexandria watersheds. The distribution of pipe (linear footage) by diameter in the Backlick Run watershed shows that a significant portion of the system is composed of larger diameter pipes; about 50% of the total length of pipe modeled in the Backlick Run watershed is 30 inches or larger, compared with only approximately 20% in previously-modeled watersheds. A significant portion of the drainage system discharging to the pond in Brenman Park is predicted to be surcharged during the 10-year, 24-hour storm event. This appears to be because of the pond's high normal ponding elevation compared to the elevation of the storm system connected to the pond. Field survey in this area revealed that the pipes discharging to the ponds are submerged and the pond backs up into the storm system under dry conditions.

TABLE 2

Watershed Modeling Results, Summarized by Pipe Size

City of Alexandria Storm Sewer Capacity Analysis – Backlick Run

	Sufficient Capacity			Surcharged			Insufficient Freeboard			Flooded		
Equivalent Pipe Diameter (ft)	**Count**	**Length (LF)**	**Percent of Total Length**	**Count**	**Length (LF)**	**Percent of Total Length**	**Count**	**Length (LF)**	**Percent of Total Length**	**Count**	**Length (LF)**	**Percent of Total Length**
Less than 2.0	64	7,303	13%	39	2,809	5%	21	2,152	4%	22	2,656	5%
2.0 to 2.75	63	6,488	11%	51	4,859	8%	21	2,408	4%	9	957	2%
3.0 to 4.9	59	8,692	15%	38	4,625	8%	17	2,273	4%	11	1,273	2%
5.0 and above	30	5,179	9%	32	4,597	8%	2	539	1%	2	445	1%
Total	**216**	**27,662**	**48%**	**160**	**16,890**	**30%**	**61**	**7,372**	**13%**	**44**	**5,331**	**9%**

Note: Table does not include pipes upstream of hydrologic load points in the model

Results are based on results at upstream end of pipe

ft = feet

LF = linear feet

TABLE 3

Watershed Model Results, Summary by Capacity

City of Alexandria Storm Sewer Capacity Analysis – Backlick Run

				Duration (hr)				Volume (ft^3)[a]			
Capacity	**Conduit Count**	**Conduit Length (LF)**	**Percent of Total Length**	**Max.**	**Min.**	**Avg.**	**Total**	**Max.**	**Min.**	**Avg.**	**Total**
Sufficient Capacity	216	27,662	48%	-	-	-	-	-	-	-	-
Surcharged[b]	160	16,890	30%	53.8	0.1	1.8	408	-	-	-	-
Insufficient Freeboard	61	7,372	13%	-	-	-	-	-	-	-	-
Flooded	44	5,331	9%	1.9	0.0	0.4	18	45,691	17	5,246	230,825

Notes: All results presented for pipe segments based on capacity at upstream end of pipe.

[a]Flooded volume

[b]Duration of surcharged flow includes time during which conduits have insufficient freeboard or are flooded at the upstream end.

ft^3 = cubic feet

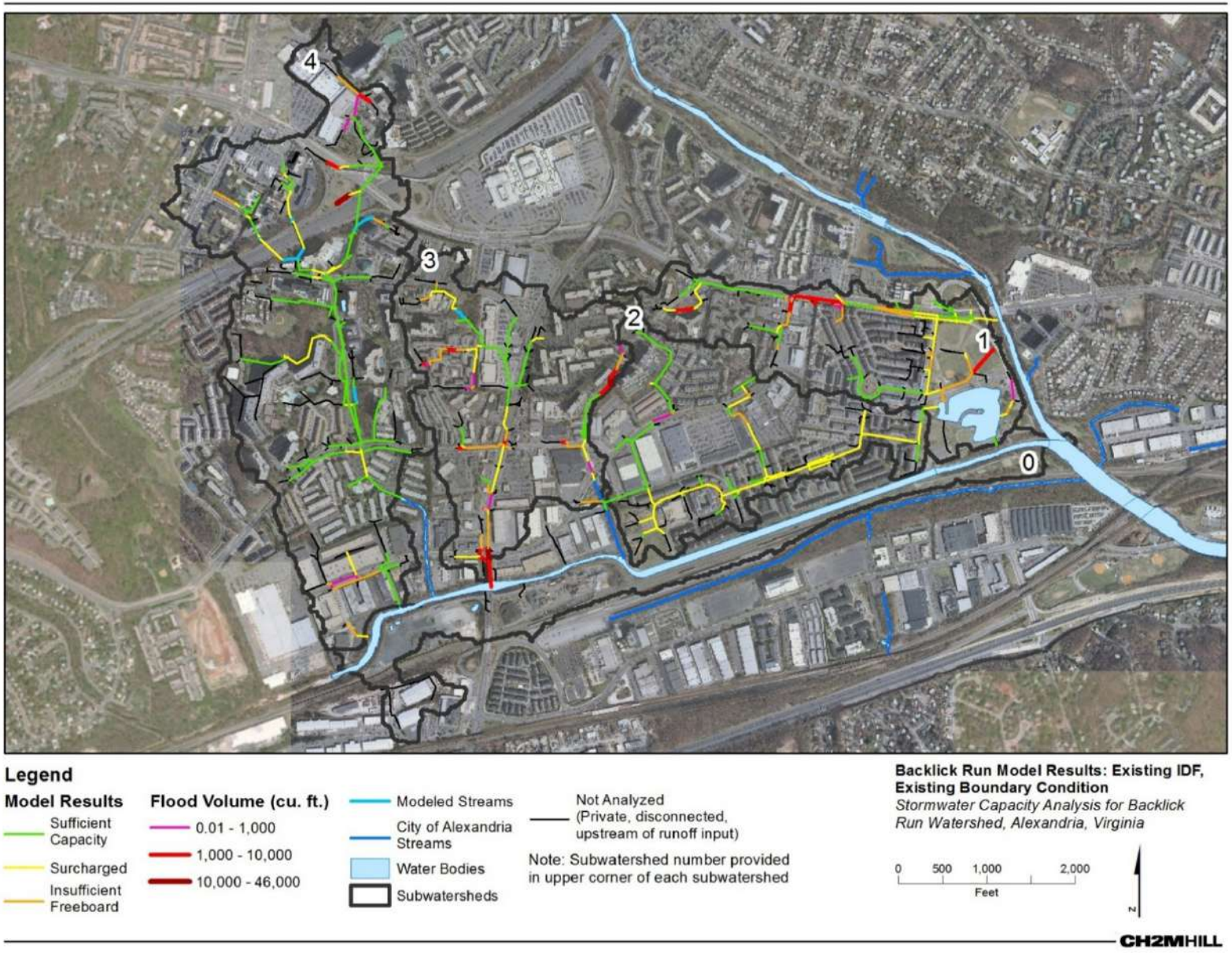
hr = hour

LF = linear feet

FIGURE 5

Backlick Run Model Results – 10-Year, 24-Hour Based on Existing IDF Curve

City of Alexandria Storm Sewer Capacity Analysis – Backlick Run

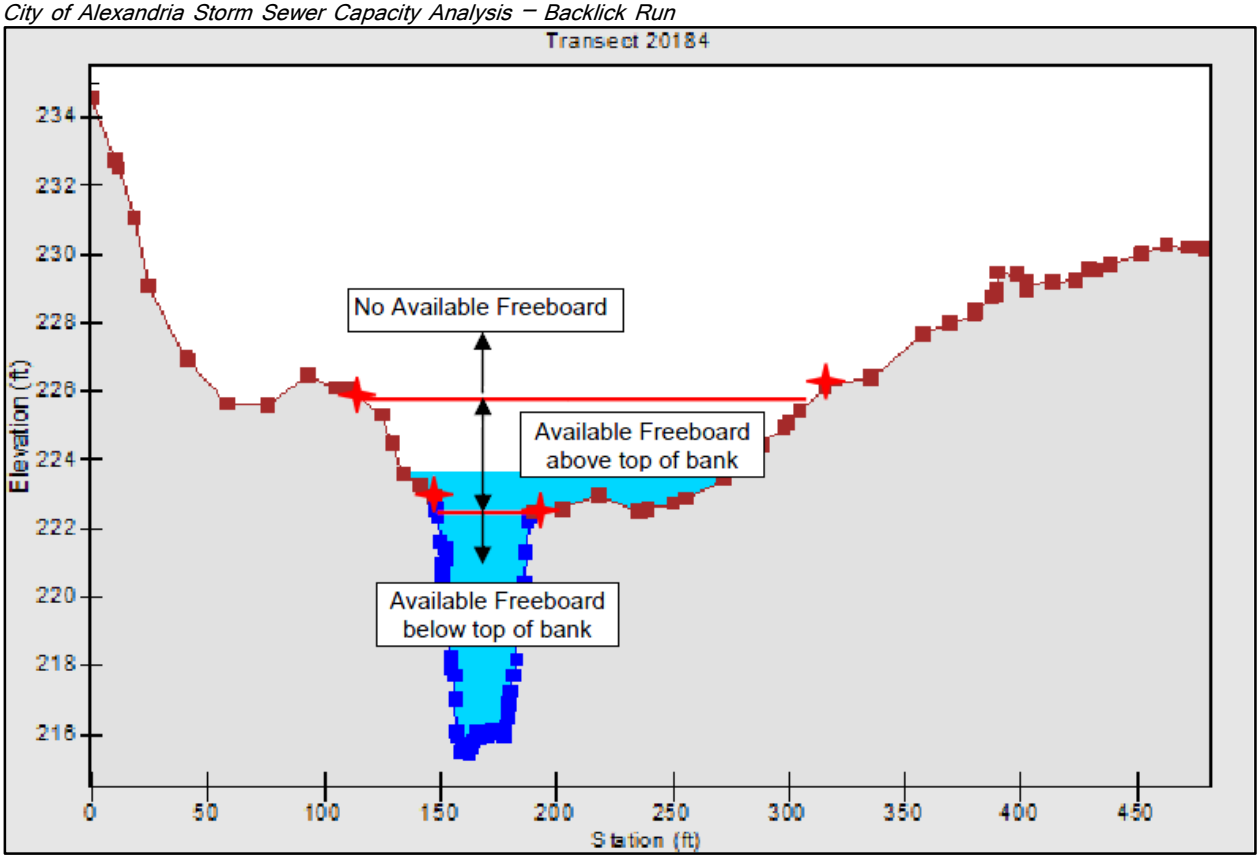


Open Channel Results

Water surface levels generated by the model were compared to two points defined on each cross section: top of cross section and top of bank. These points are defined in Figure 6. The conveyance at each cross section was then defined as falling into one of three categories:

- No available freeboard: HGL above the top of cross section
- Available freeboard above top of bank: HGL above the top of bank yet remained below the top of cross section
- Available freeboard below top of bank: HGL below the top of bank

FIGURE 6
Sample Cross Section
City of Alexandria Storm Sewer Capacity Analysis – Backlick Run



The Backlick Run hydraulic model contains nine open channel segments:

- Six short segments near the I-395/Duke Street intersection completing connectivity across I-395
- A small natural swale adjacent to Yoakum Parkway between Stevenson Avenue and Edsall Road
- A natural swale south of Stevenson Avenue between the Juvenile Detention Center and Van Dorn Plaza
- A ditch connecting two culverts south of Pickett Street at Cameron Station

The open channels included in the Backlick Run model are not included in the USACE HEC-RAS Model, so all data on open-channel segments were defined using topographic data provided by the City of Alexandria. While included, open channels were not the focus of this modeling effort, and therefore the capacity of open channels will not be reported in terms other than those described above. Results for stream segments are summarized in Table 4.

TABLE 4
Summary Results for Open Channels in Backlick Run
City of Alexandria Storm Sewer Capacity Analysis – Backlick Run

Scenario	Linear Feet of Stream		
	Available Freeboard Below Top of Bank	Available Freeboard Above Top of Bank	No Available Freeboard
Existing IDF, existing boundary conditions	296	974	0

Summary

The hydraulic model predicts that a significant portion, about 52 percent, of the Backlick Run watershed is experiencing capacity-related deficiencies during the 10-year, 24-hour design storm. The model results show that 9 percent of the pipes flood the ground surface, 13 percent have a hydraulic grade line within 2 feet of the surface, and 30 percent surcharge above the crown of the pipe. Comparing the peak runoff to the estimated inlet capacity of each catchment indicates that 50 percent of the catchments in the model may have insufficient inlet capacity. Maps and profiles of flooding areas are presented in Attachment D of this technical memorandum to assist in locating problem areas and understanding the capacity deficiencies of the drainage system.

The hydraulic modeling results presented in this memorandum should be reviewed with the understanding that several assumptions were made to fill data gaps, primarily assumptions of inverts in pipes with diameter less than 24 inches.

References

These documents were consulted in the preparation of this memorandum. Not all are cited in the text.

City of Alexandria. 1989. *Design and Construction Standards*. Department of Transportation & Environmental Services. July.

City of Alexandria. 2011. City of Alexandria GIS data. Spring.

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CH2M HILL. 2009b. Comparison of Model Hyetograph Generation and Hydrologic Computation Methods. Prepared for City of Alexandria Transportation & Environmental Services Department. July 14.

CH2M HILL. 2009c. *Sea Level Rise Potential for the City of Alexandria, Virginia.* Prepared for City of Alexandria Transportation & Environmental Services Department. June 12.

CH2M HILL. 2011. *Rainfall Frequency and Global Change Model Options for the City of Alexandria*. Prepared for City of Alexandria Transportation & Environmental Services Department. August 30.

CH2M HILL. 2012a. *Inlet Capacity Analysis for City of Alexandria Storm Sewer Capacity Analysis*. Prepared for the City of Alexandria Transportation & Environmental Services Department. September 12.

CH2M HILL. 2012b. *Summary of Data Gaps and Assumptions in the Hooffs Run Watershed,* Prepared for the City of Alexandria Transportation & Environmental Services Department. October 22.

CH2M HILL. 2016. *Stormwater Capacity Analysis for Hooffs Run Watershed, City of Alexandria, Virginia.* Prepared for the City of Alexandria Transportation & Environmental Services Department. February.

U.S. Army Corps of Engineers (USACE). 2003. *User's Manual, Geospatial Hydrologic Modeling Extension HEC-GeoHMS*. Hydrologic Engineering Center, the US Army Corps of Engineers. Version 1.1. December.

Attachment A
Methodology for Identifying Public vs. Private Structures: August 6, 2009, Meeting Summary

City of Alexandria Storm Sewer Capacity Analysis Project – Task Order 1

Meeting, August 6, 2009 (2:30-3:00 pm)

ATTENDEES:

Craig Perl/City of Alexandria
Laurens van der Tak/CH2M HILL
Cheri Salas/ CH2M HILL

FROM: Cheri Salas/CH2M HILL

DATE: August 7, 2009

PROJECT NUMBER: 383412

Meeting Purpose

Review memorandum dated July 31, 2009, entitled Evaluation of modeling issues discussed during July 27, 2009 Progress Meeting

- Discuss results of initial public\private structure determinations
- Review initial evaluation of survey data quality
- Discuss altered approach to filling data gaps associated with missing inlet inverts

Meeting Review

Private vs. Public Structures

It was difficult to readily identify structures as private or public, based solely on the parcel layer because of potential errors in the structure locations. The memorandum includes several examples. Several of these include individual public structures that are upstream of larger private storm sewer areas. Craig will share these with Suzanne and others to confirm a path forward. It was agreed that regardless of the path forward on future sewersheds, we would not change the model for the pilot sewershed, but will not attempt to evaluate capacity limitations in the private areas. Craig will confirm which areas in the memo examples should be evaluated.

As we move into the remainder of Hooffs Run CH2M HILL will identify large areas of private sewers based on a broad visual review of the sewersheds, CH2M HILL will recommend a starting point for the hydraulic model (pour point for hydrologic basin) and allow the City to review the recommendations prior to beginning filling data gaps or modeling.

Stormwater ponds were discussed. These are mostly, if not all, private facilities; however they should have significant impact on the peak flows in the system. It was recognized that there is significant effort associated with obtaining the data for these ponds, and adding it to

the model. The one pond in the pilot sewershed was retrofitted since the as-built plans; therefore a site visit may be required to obtain appropriate outlet dimensions.

Survey Data Quality

We do not foresee any significant data issues in the Pilot sewershed related to surveyed inverts; however it may be a bigger issue as we move into flatter sewersheds. This issue will be tabled until we move on to other sewersheds

Filling Data Gaps in Inlet Inverts

As we were filling data gaps we recommended using a 1-foot depth to invert for all inlets for which the data were not available. In approximately 15 of the 153 inlets for which invert data were not available, the pipe diameter was larger than 12-inches, resulting in model errors. A revised approach of using the pipe diameter plus 6-inches as the assumed depth to invert is recommended, however it is unclear whether this approach will be appropriate for the locations in question. CH2M HILL will provide a Google Earth Map of these inlets and Craig will review, and possibly conduct field inspections. CH2M HILL will not continue modeling of the pilot shed until results of this review are received.

Action Items

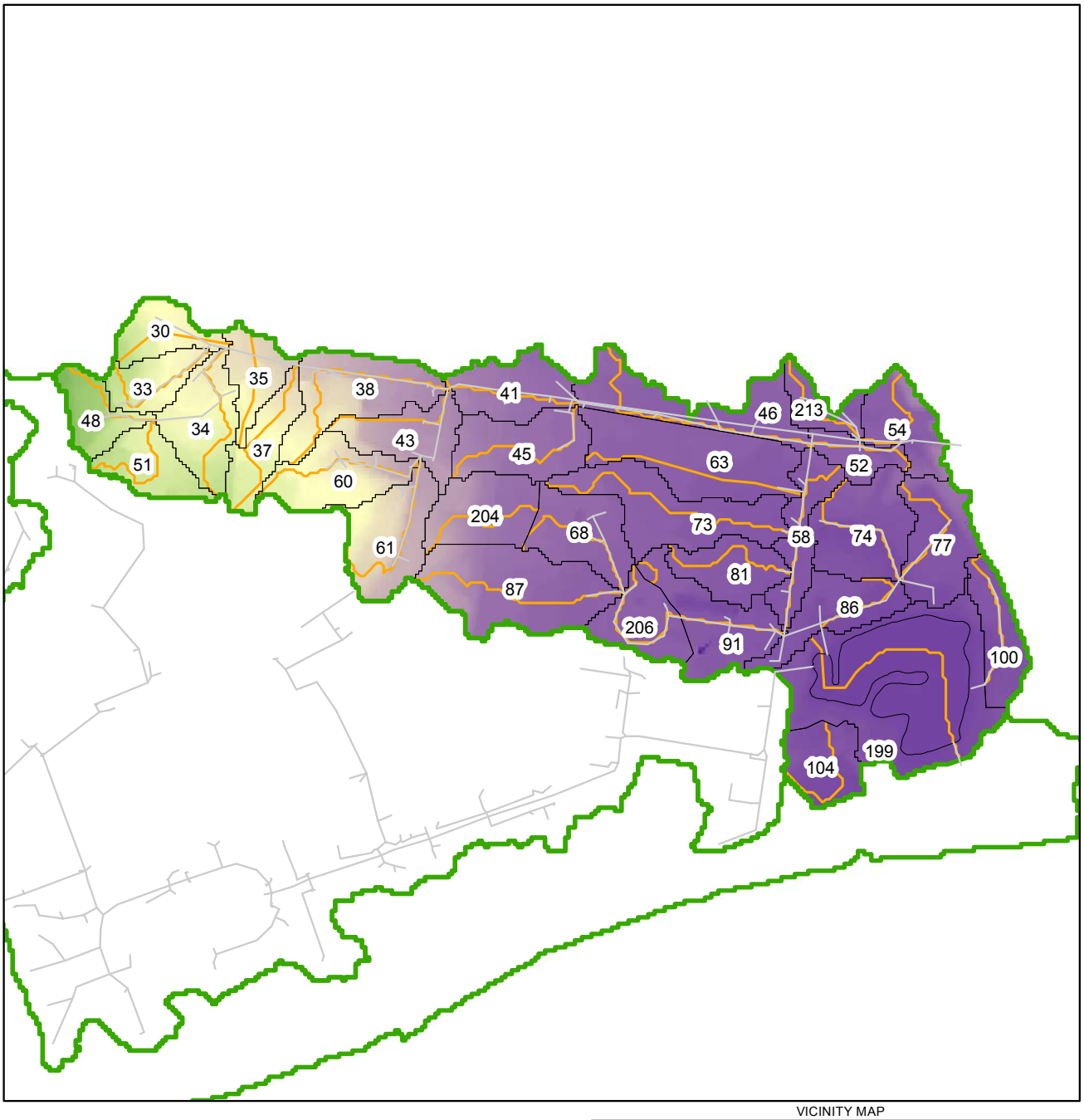
Craig will share July 31, 2009 memo with additional City staff and determine extent of capacity evaluation in pilot area. He will also confirm recommended path forward.

Craig will determine preferred approach to inclusion of stormwater ponds in the model.

Cheri will provide Google Earth maps of locations where a 1-foot depth to invert was not sufficient.

Craig will review these sites and provide input on an appropriate assumption moving forward.

Attachment B
Hydrologic Model Schematic and Parameters



LEGEND

DEM Elevation (ft)

High : 265

Low : 25

DGravityMain

Longest Flow Path

Modeled Catchments

Subwatersheds

0 800 1,600

Feet

N

VICINITY MAP

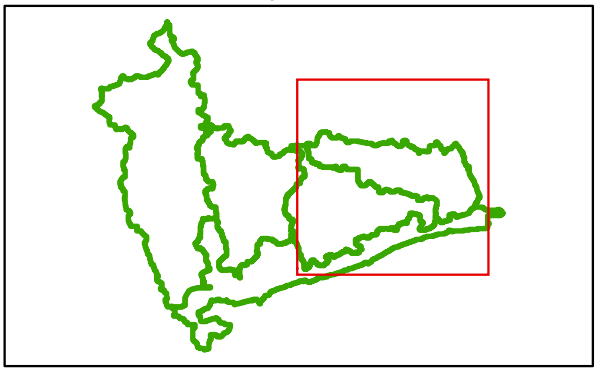
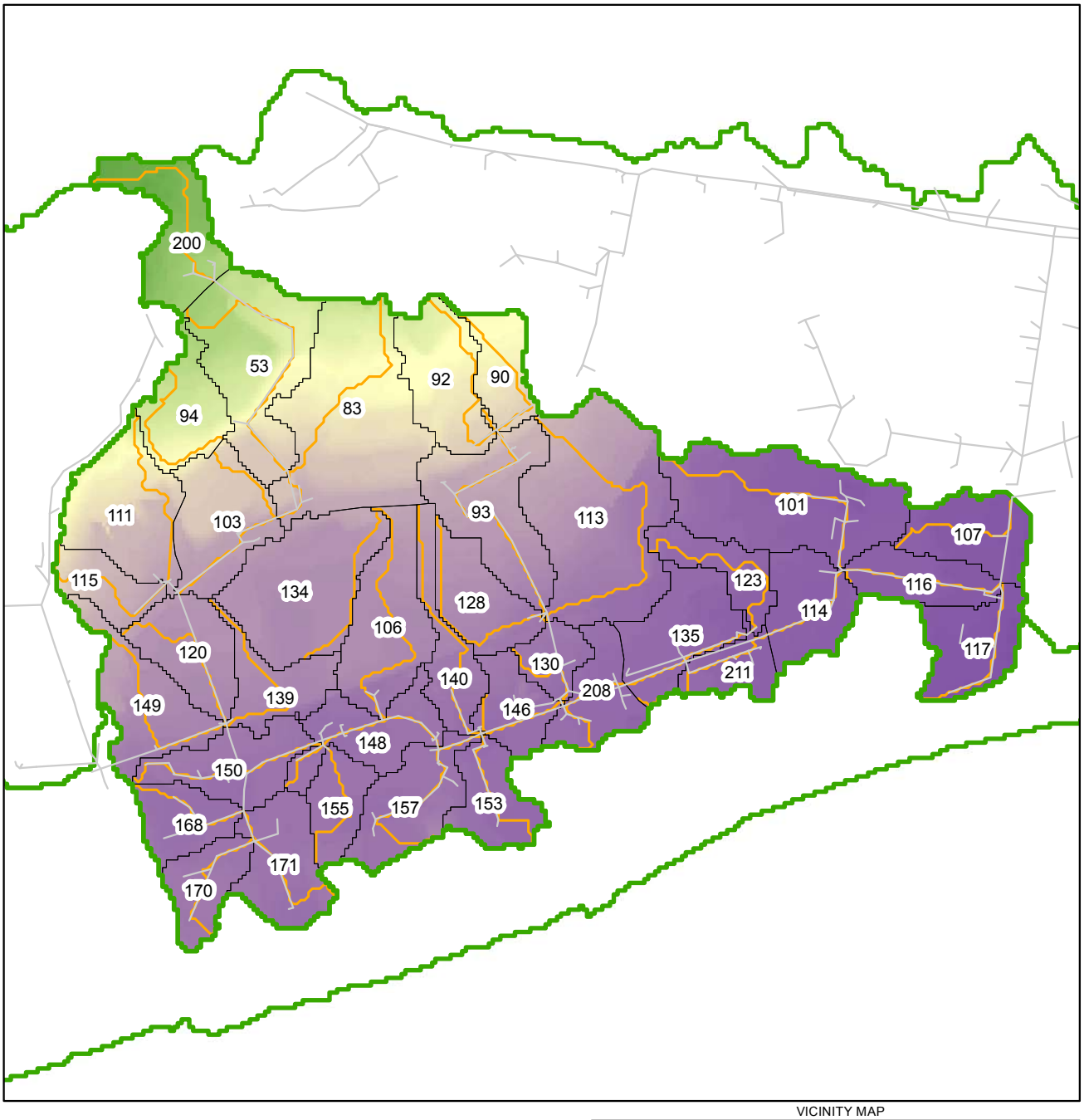


FIGURE 1
Backlick Run Subwatershed 1 Catchments
Stormwater Capacity Analysis for Backlick Run Watershed, City of Alexandria, Virginia
City of Alexandria Storm Sewer Capacity Analysis



LEGEND

DEM Elevation (ft)

High : 265

Low : 25

DGravityMain

Longest Flow Path

Modeled Catchments

Subwatersheds

0 750 1,500

Feet

N

VICINITY MAP

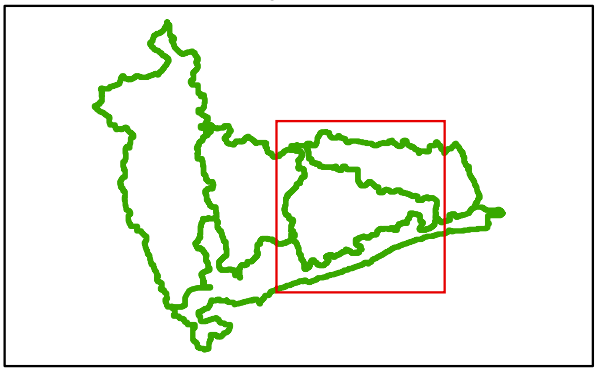
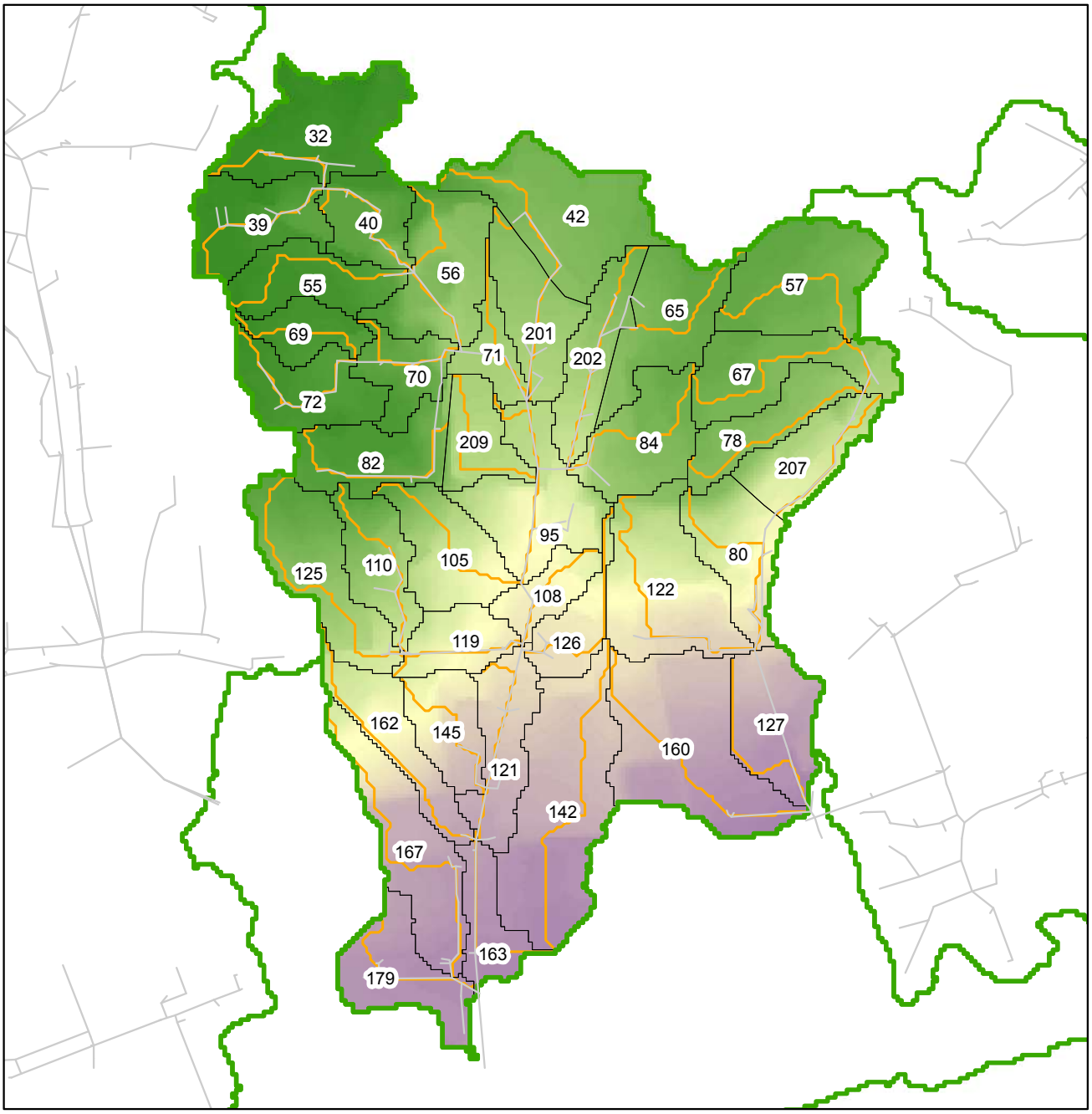
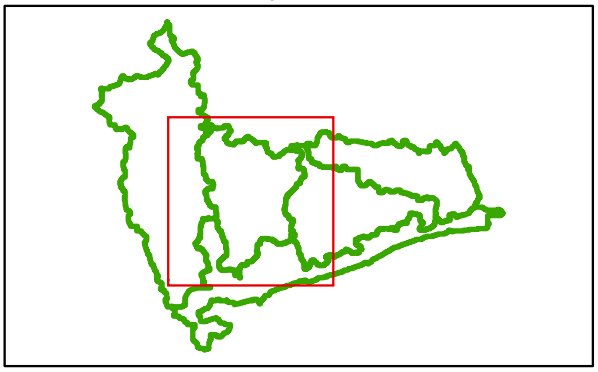


FIGURE 2
Backlick Run Subwatershed 2 Catchments
Stormwater Capacity Analysis for Backlick Run Watershed, City of Alexandria, Virginia
City of Alexandria Storm Sewer Capacity Analysis



VICINITY MAP



LEGEND

DEM Elevation (ft)

High : 265

Low : 25

DGravityMain

Longest Flow Path

Modeled Catchments

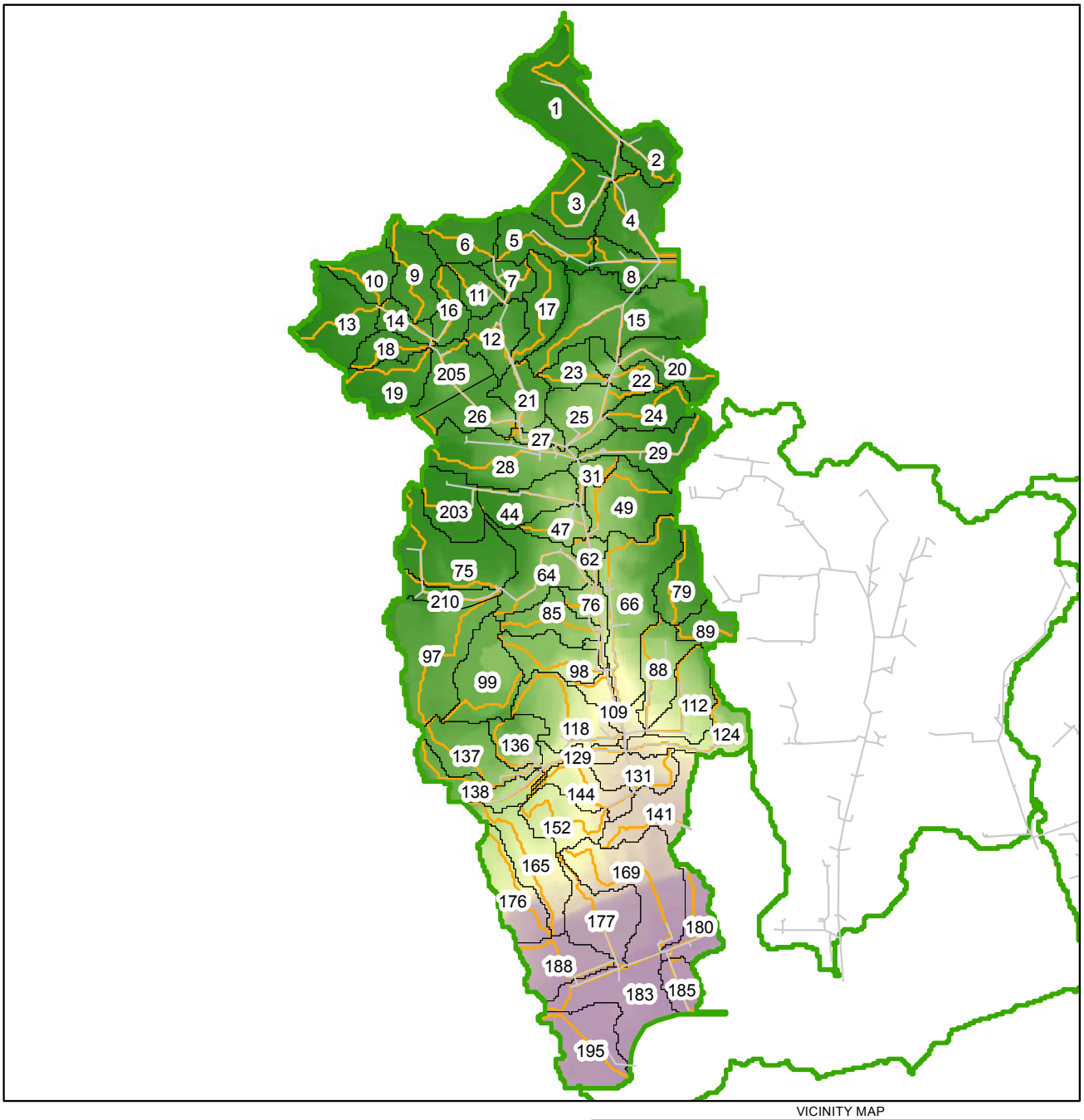
Subwatersheds

0 750 1,500

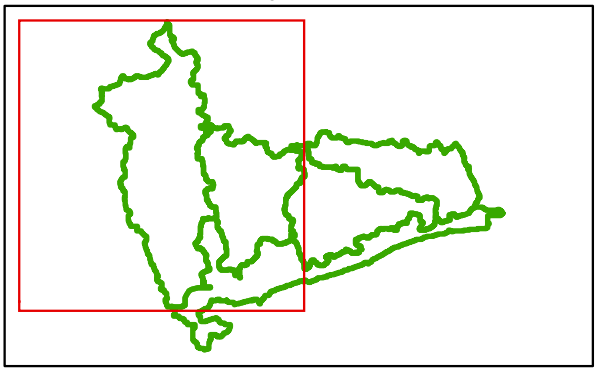
Feet

N

FIGURE 3
Backlick Run Subwatershed 3 Catchments
Stormwater Capacity Analysis for Backlick Run Watershed, City of Alexandria, Virginia
City of Alexandria Storm Sewer Capacity Analysis



VICINITY MAP



LEGEND

DEM Elevation (ft)

High : 265

Low : 25

DGravityMain

Longest Flow Path

Modeled Catchments

Subwatersheds

0 1,000 2,000

Feet

N

FIGURE 4
Backlick Run Subwatershed 4 Catchments
Stormwater Capacity Analysis for Backlick Run Watershed, City of Alexandria, Virginia
City of Alexandria Storm Sewer Capacity Analysis

TABLE 1

Infiltration Data

Parameter	Value
Average Capillary Suction (in)	8.27
Initial Moisture Deficit	0.154
Saturated Hydraulic Conductivity (in/hr)	0.2

TABLE 2

Hydrologic Parameters for Backlick Run Catchments

Subwatershed	HydroID	Area (ac)	Basin Slope (%)	Width	Percent Impervious	Model Load Point
1	30	2.035	9.893	156.7	53.12	003961IN
1	33	1.989	12.519	120.3	60.43	003965IN
1	34	3.357	7.508	169.7	66.88	003972IN
1	35	2.045	9.036	168.0	76.58	001274SMH
1	37	2.381	9.503	122.4	67.70	001275SMH
1	38	4.411	9.486	165.5	74.52	003954IN
1	41	3.022	3.266	198.6	81.97	001266SMH
1	43	2.851	8.463	179.1	81.27	004077IN
1	45	3.678	3.696	186.2	74.28	001283SMH
1	46	4.162	2.128	138.6	67.08	002173IN
1	48	2.040	13.684	146.4	62.21	004091IN
1	51	2.366	7.183	143.4	66.19	003969IN
1	52	1.395	3.394	113.7	25.81	002178IN
1	54	2.665	11.064	184.8	42.14	002200IN
1	58	2.515	2.253	122.8	42.55	000257ND
1	60	3.373	11.591	159.5	63.71	004060IN
1	61	3.858	11.429	182.6	71.15	004072IN
1	63	5.838	2.105	246.0	66.82	002169IN
1	68	3.326	5.012	198.0	65.76	001285SMH
1	73	5.134	2.246	169.6	67.59	002164IN
1	74	4.194	4.752	235.5	1.69	002183IN
1	77	3.611	6.329	228.0	22.27	002188IN
1	81	2.562	2.210	152.6	70.84	002155IN
1	86	2.970	3.015	233.8	28.01	000745SMH
1	87	6.111	5.617	253.8	75.86	002269ND
1	91	3.780	5.078	247.0	76.59	000732SMH
1	100	2.461	2.249	152.1	45.23	002130IN
1	104	2.502	4.993	160.0	33.25	000004PD
1	199	6.014	6.296	191.4	22.18	000004PD
1	204	3.317	5.012	219.1	77.63	001286SMH
1	206	2.573	5.078	149.9	56.04	001311SMH
1	213	1.420	3.038	105.1	44.16	000748SMH
2	53	6.147	10.226	208.9	54.38	004098IN
2	83	8.829	8.952	313.9	65.60	004050IN

TABLE 2

Hydrologic Parameters for Backlick Run Catchments

Subwatershed	HydroID	Area (ac)	Basin Slope (%)	Width	Percent Impervious	Model Load Point
2	90	2.102	6.368	118.5	64.65	000506ND
2	92	3.600	7.784	180.2	58.64	000406ND
2	93	5.000	7.288	172.4	74.52	001314SMH
2	94	2.794	11.464	155.4	64.53	000511ND
2	101	7.355	2.326	291.3	72.79	001290SMH
2	103	4.012	9.307	189.4	72.41	001307SMH
2	106	4.515	3.749	167.9	81.26	003442IN
2	107	2.986	2.034	196.0	58.34	000727SMH
2	111	4.660	13.341	246.8	63.18	004048IN
2	113	9.215	5.574	278.8	87.24	004082IN
2	114	2.936	1.492	286.4	75.48	001752SMH
2	115	1.829	7.623	109.3	81.30	004087IN
2	116	2.412	1.215	147.7	74.38	000725SMH
2	117	2.996	2.841	184.9	50.37	002140IN
2	120	3.151	3.306	178.0	97.62	002289ND
2	123	2.056	2.692	97.5	69.94	005041IN
2	128	2.929	3.725	137.7	90.20	000513ND
2	130	1.384	2.885	149.7	67.99	004047IN
2	134	6.064	3.361	359.7	89.64	002282ND
2	135	3.678	2.185	238.3	71.43	001301SMH
2	139	2.386	4.527	125.4	86.21	001315SMH
2	140	2.415	3.742	95.8	82.53	003476IN
2	146	2.051	3.728	171.9	72.26	004008IN
2	148	3.115	2.019	165.7	69.25	001123SMH
2	149	3.719	5.545	168.7	83.46	003509SMH
2	150	3.202	3.165	155.1	64.74	003428IN
2	153	2.397	2.990	172.1	66.46	003477IN
2	155	1.916	1.288	139.7	74.53	003453IN
2	157	3.435	2.658	159.8	62.80	001132SMH
2	168	2.118	2.727	177.3	26.16	001119SMH
2	170	2.138	2.726	148.0	23.95	001118SMH
2	171	3.301	1.614	211.3	46.59	003419IN
2	200	3.647	10.226	172.9	62.90	004105IN
2	208	2.561	2.185	200.8	73.53	002301ND
2	211	1.645	1.492	142.0	77.20	001748SMH
3	32	5.165	2.936	372.9	79.13	001348SMH
3	39	3.512	6.463	207.6	70.13	001353SMH
3	40	2.541	12.265	167.9	29.00	004339IN
3	42	5.943	5.031	329.4	81.68	009940IN
3	55	3.027	5.484	148.2	72.51	002927ND
3	56	4.447	14.787	228.8	44.77	009952IN
3	57	5.052	4.509	264.1	72.70	004103IN
3	65	3.977	7.482	274.5	72.89	000565ND

TABLE 2

Hydrologic Parameters for Backlick Run Catchments

Subwatershed	HydroID	Area (ac)	Basin Slope (%)	Width	Percent Impervious	Model Load Point
3	67	3.977	6.689	155.7	50.54	004103IN
3	69	1.834	5.346	130.4	65.49	004928SMH
3	70	2.159	12.053	169.5	68.92	002924ND
3	71	1.544	3.961	91.9	94.75	004921SMH
3	72	3.280	4.225	171.5	75.21	005080IN
3	78	2.758	8.600	137.9	72.70	004096IN
3	80	3.407	16.625	164.1	55.59	001758SMH
3	82	3.537	11.688	168.2	67.12	004915SMH
3	84	3.729	8.980	195.8	64.09	001433SMH
3	95	4.742	12.634	223.4	56.09	004396IN
3	105	3.507	14.570	192.2	55.55	001437SMH
3	108	1.699	8.609	137.5	71.22	001432SMH
3	110	2.774	12.428	143.3	60.17	005064IN
3	119	2.118	10.888	159.3	68.98	001439SMH
3	121	3.270	5.700	166.3	83.88	001431SMH
3	122	5.821	12.277	221.5	79.23	005053IN
3	125	4.659	9.053	172.5	66.86	001441SMH
3	126	1.952	5.772	97.0	80.94	001769SMH
3	127	3.709	7.487	193.4	77.11	001756SMH
3	142	7.955	4.903	249.5	91.10	001033SMH
3	145	2.521	12.092	158.1	67.20	003091IN
3	160	7.531	6.898	267.6	84.46	003105IN
3	162	2.980	8.726	114.8	75.50	003089IN
3	163	2.097	2.491	119.6	87.98	001033SMH
3	167	4.824	6.584	146.1	82.65	003085IN
3	179	3.471	2.458	224.8	72.54	001109SMH
3	201	3.257	5.031	227.6	87.57	004919SMH
3	202	2.981	7.482	129.7	72.66	004373IN
3	207	2.936	16.625	193.3	56.51	004097IN
3	209	2.186	11.688	131.7	86.09	001761SMH
4	1	9.013	1.796	235.9	84.50	004689IN
4	2	2.732	1.916	215.9	87.59	004659IN
4	3	4.458	2.806	166.4	83.65	004324IN
4	4	4.587	4.507	210.0	47.50	001507SMH
4	5	3.796	5.542	190.0	75.79	004334IN
4	6	2.934	1.626	213.4	92.30	004126IN
4	7	1.612	2.361	124.1	75.93	004127IN
4	8	2.784	14.926	167.0	23.56	004330IN
4	9	3.920	2.659	185.9	57.17	004144IN
4	10	2.583	2.266	202.2	66.67	001334SMH
4	11	1.849	2.717	142.0	45.21	004124IN
4	12	3.115	6.345	210.7	68.99	004341IN
4	13	5.057	3.330	286.8	56.16	001334SMH

TABLE 2

Hydrologic Parameters for Backlick Run Catchments

Subwatershed	HydroID	Area (ac)	Basin Slope (%)	Width	Percent Impervious	Model Load Point
4	14	1.534	3.581	126.8	56.00	004144IN
4	15	9.670	13.636	342.0	37.90	009933IN
4	16	2.237	2.988	149.9	58.29	004142IN
4	17	3.626	8.868	153.9	46.11	000296IO
4	18	1.782	4.326	117.9	36.93	004139IN
4	19	3.962	4.648	227.5	48.86	004139IN
4	20	3.280	14.112	178.4	46.49	004274IN
4	21	2.572	12.243	192.1	33.13	000284IO
4	22	1.942	15.894	161.8	43.77	002058ND
4	23	1.942	11.916	163.0	33.11	004286IN
4	24	2.836	6.962	156.6	76.48	000542ND
4	25	4.013	11.756	209.6	58.14	001362SMH
4	26	3.295	11.804	215.1	45.43	000228CP
4	27	0.987	9.726	83.6	34.04	001375SMH
4	28	6.358	10.039	247.6	53.10	001370SMH
4	29	4.747	5.522	200.6	70.51	004307IN
4	31	1.219	8.358	101.0	73.50	004305IN
4	44	3.517	6.656	217.5	24.65	001329SMH
4	47	1.963	16.396	141.8	13.70	009930IN
4	49	5.305	13.517	238.7	57.64	000645CB
4	62	1.007	4.069	104.5	52.23	003560SMH
4	64	4.954	11.113	196.4	41.66	005107IN
4	66	8.709	15.998	214.6	42.43	001770SMH
4	75	6.885	7.651	224.5	21.95	000540ND
4	76	1.880	12.250	89.2	47.18	000675ND
4	79	3.264	7.800	181.5	59.16	002296ND
4	85	3.027	7.617	152.2	68.52	002921ND
4	88	3.585	14.363	172.5	56.93	002296ND
4	89	1.782	6.395	127.3	76.15	002296ND
4	97	8.199	6.951	295.0	69.39	001337SMH
4	98	3.425	13.117	173.3	17.52	001764SMH
4	99	5.238	8.154	283.5	29.04	001764SMH
4	109	2.185	8.477	118.6	38.40	003555SMH
4	112	3.729	15.353	178.6	66.24	004346IN
4	118	5.196	13.986	174.6	56.62	005087IN
4	124	3.419	12.182	114.4	49.34	004914SMH
4	129	1.477	10.273	81.3	54.84	001773SMH
4	131	2.732	6.454	205.2	60.73	001783SMH
4	136	2.515	17.831	167.9	50.74	004344IN
4	137	4.122	8.028	157.9	69.02	001445SMH
4	138	3.140	10.026	116.5	50.86	001772SMH
4	141	4.117	6.040	246.3	54.09	003554SMH
4	144	2.929	8.753	115.3	49.81	002297ND

TABLE 2

Hydrologic Parameters for Backlick Run Catchments

Subwatershed	HydroID	Area (ac)	Basin Slope (%)	Width	Percent Impervious	Model Load Point
4	152	3.543	8.472	155.4	57.72	002297ND
4	165	4.979	11.136	168.3	57.72	003058IN
4	169	8.607	6.623	257.1	68.41	003045IN
4	176	3.982	11.846	183.9	59.57	003058IN
4	177	4.830	7.860	209.0	82.73	003070IN
4	180	2.924	3.058	145.0	83.55	001098SMH
4	183	5.956	1.482	254.7	88.37	003053IN
4	185	1.870	2.980	114.4	86.52	001101SMH
4	188	3.786	3.152	184.7	89.67	003058IN
4	195	5.413	1.434	284.2	83.02	003064IN
4	203	3.709	6.656	265.8	43.95	001429SMH
4	205	3.202	11.804	272.5	39.94	004138IN
4	210	1.739	7.853	91.3	53.65	004172IN

Note: HydroID is a unique identifier created by ArcHydro

Attachment C
Inlet Capacity Results

TABLE 1

Detailed Inlet Capacity Results for Backlick Run

Sub-shed	Model Load Point	Total Drainage Area (ac)	Total Throat Count	Total Inlet Capacity (cfs)	Peak Runoff (cfs)	Inlet Capacity
1	002130IN	2.461	6	19.5	9.6	
1	000004PD	2.502	3	9.8	60.2	Insufficient
1	004933SMH	2.515	10	32.5	9.0	
1	001266SMH	3.022	4	13.0	17.1	Insufficient
1	001283SMH	3.678	4	13.0	19.6	Insufficient
1	000732SMH	3.78	6	19.5	21.0	Insufficient
1	000745SMH	2.97	5	16.3	10.2	
1	001274SMH	2.045	1	3.3	11.6	Insufficient
1	001275SMH	2.381	0	0.0	12.7	Insufficient
1	001285SMH	3.326	8	26.0	17.1	
1	001286SMH	3.317	1	3.3	18.6	Insufficient
1	001311SMH	2.573	9	29.3	12.2	
1	002155IN	2.562	5	16.3	13.1	
1	002164IN	5.134	3	9.8	23.6	Insufficient
1	002169IN	5.838	6	19.5	27.5	Insufficient
1	002173IN	4.162	4	13.0	19.0	Insufficient
1	002178IN	1.395	2	6.5	4.8	
1	002183IN	4.194	5	16.3	8.0	
1	002188IN	3.611	4	13.0	12.0	
1	002200IN	2.665	5	16.3	12.3	
1	000748SMH	1.42	4	13.0	5.9	
1	002269ND	6.111	3	9.8	32.9	Insufficient
1	003954IN	4.411	9	29.3	23.9	
1	003961IN	2.035	3	9.8	10.3	Insufficient
1	003965IN	1.989	5	16.3	10.4	
1	003969IN	2.366	0	0.0	12.5	Insufficient
1	003972IN	3.357	7	22.8	17.5	
1	004060IN	3.373	10	32.5	17.5	
1	004072IN	3.858	7	22.8	21.0	
1	004077IN	2.851	8	26.0	16.3	
1	004091IN	2.04	5	16.3	11.0	
2	000406ND	3.6	0	0.0	17.6	Insufficient
2	000506ND	2.102	1	3.3	10.8	Insufficient
2	000511ND	2.794	0	0.0	14.8	Insufficient
2	000513ND	2.929	0	0.0	16.9	Insufficient
2	000725SMH	2.412	2	6.5	12.3	Insufficient
2	000727SMH	2.986	1	3.3	13.7	Insufficient
2	001118SMH	2.138	3	9.8	6.4	
2	001119SMH	2.118	2	6.5	7.1	Insufficient
2	001123SMH	3.115	13	42.3	15.5	
2	001132SMH	3.435	8	26.0	16.0	
2	001290SMH	7.355	9	29.3	36.6	Insufficient
2	001301SMH	3.678	4	13.0	19.1	Insufficient
2	001307SMH	4.012	9	29.3	21.8	
2	001314SMH	5	14	45.5	26.5	
2	001315SMH	2.386	0	0.0	13.7	Insufficient
2	001748SMH	1.645	3	9.8	9.0	
2	001752SMH	2.936	2	6.5	16.0	Insufficient
2	002140IN	2.996	4	13.0	12.8	
2	002282ND	6.064	0	0.0	35.2	Insufficient
2	002289ND	3.151	0	0.0	18.5	Insufficient
2	002301ND	2.561	8	26.0	13.8	
2	003419IN	3.301	5	16.3	12.8	

TABLE 1

Detailed Inlet Capacity Results for Backlick Run

Sub-shed	Model Load Point	Total Drainage Area (ac)	Total Throat Count	Total Inlet Capacity (cfs)	Peak Runoff (cfs)	Inlet Capacity
2	003428IN	3.202	14	45.5	15.5	
2	003442IN	4.515	2	6.5	24.5	Insufficient
2	003453IN	1.916	4	13.0	10.1	
2	003476IN	2.415	2	6.5	13.3	Insufficient
2	003477IN	2.397	5	16.3	12.3	
2	003509SMH	3.719	1	3.3	21.1	Insufficient
2	004008IN	2.051	6	19.5	11.2	
2	004047IN	1.384	4	13.0	7.5	
2	004048IN	4.66	4	13.0	24.5	Insufficient
2	004050IN	8.829	3	9.8	44.3	Insufficient
2	004082IN	9.215	1	3.3	51.8	Insufficient
2	004087IN	1.829	3	9.8	10.4	Insufficient
2	004098IN	6.147	3	9.8	27.8	Insufficient
2	004105IN	3.647	5	16.3	18.7	Insufficient
2	005041IN	2.056	1	3.3	10.3	Insufficient
3	000565ND	3.977	0	0.0	22.0	Insufficient
3	001033SMH	10.052	4	13.0	57.3	Insufficient
3	001109SMH	3.471	9	29.3	18.3	
3	001348SMH	5.165	7	22.8	28.8	Insufficient
3	001353SMH	3.512	6	19.5	18.9	
3	001431SMH	3.27	6	19.5	18.7	
3	001432SMH	1.699	3	9.8	9.5	
3	001433SMH	3.729	2	6.5	19.3	Insufficient
3	001437SMH	3.507	0	0.0	17.7	Insufficient
3	001439SMH	2.118	3	9.8	11.7	Insufficient
3	001441SMH	4.659	3	9.8	23.7	Insufficient
3	001756SMH	3.709	4	13.0	20.7	Insufficient
3	001758SMH	3.407	5	16.3	17.1	Insufficient
3	002928ND	2.186	2	6.5	12.7	Insufficient
3	001769SMH	1.952	4	13.0	11.0	
3	002924ND	2.159	4	13.0	12.0	
3	002927ND	3.027	0	0.0	16.1	Insufficient
3	003085IN	4.824	6	19.5	26.6	Insufficient
3	003089IN	2.98	2	6.5	16.2	Insufficient
3	003091IN	2.521	4	13.0	13.7	Insufficient
3	003105IN	7.531	6	19.5	42.5	Insufficient
3	004096IN	2.758	0	0.0	15.0	Insufficient
3	004097IN	2.936	5	16.3	15.4	
3	004103IN	9.029	3	9.8	43.9	Insufficient
3	004339IN	2.541	3	9.8	10.4	Insufficient
3	004373IN	2.981	20	65.1	16.0	
3	004396IN	4.742	19	61.8	23.3	
3	004915SMH	3.537	4	13.0	18.8	Insufficient
3	004919SMH	3.257	5	16.3	19.0	Insufficient
3	004921SMH	1.544	0	0.0	9.1	Insufficient
3	004928SMH	1.834	0	0.0	9.6	Insufficient
3	005053IN	5.821	7	22.8	32.7	Insufficient
3	005064IN	2.774	8	26.0	14.2	
3	005080IN	3.28	5	16.3	17.7	Insufficient
3	009940IN	5.943	4	13.0	33.6	Insufficient
3	009952IN	4.447	1	3.3	20.4	Insufficient
4	000228CP	3.295	2	6.5	15.6	Insufficient
4	000284IO	2.572	0	0.0	11.3	Insufficient

TABLE 1

Detailed Inlet Capacity Results for Backlick Run

Sub-shed	Model Load Point	Total Drainage Area (ac)	Total Throat Count	Total Inlet Capacity (cfs)	Peak Runoff (cfs)	Inlet Capacity
4	000296IO	3.626	0	0.0	15.4	Insufficient
4	000540ND	6.885	3	9.8	18.2	Insufficient
4	000542ND	2.836	0	0.0	15.8	Insufficient
4	000645CB	5.305	1	3.3	26.4	Insufficient
4	000675ND	1.88	1	3.3	8.5	Insufficient
4	001098SMH	2.924	7	22.8	16.4	
4	001101SMH	1.87	0	0.0	10.7	Insufficient
4	001329SMH	3.517	1	3.3	12.1	Insufficient
4	001334SMH	7.64	0	0.0	36.3	Insufficient
4	001337SMH	8.199	10	32.5	41.9	Insufficient
4	001362SMH	4.013	2	6.5	20.2	Insufficient
4	001370SMH	6.358	11	35.8	28.9	
4	001375SMH	0.987	2	6.5	4.4	
4	001429SMH	3.709	3	9.8	16.7	Insufficient
4	001445SMH	4.122	0	0.0	21.3	Insufficient
4	001507SMH	4.587	6	19.5	18.7	
4	001764SMH	8.663	7	22.8	30.2	Insufficient
4	001770SMH	8.709	5	16.3	33.4	Insufficient
4	001772SMH	3.14	3	9.8	13.8	Insufficient
4	001773SMH	1.477	3	9.8	7.2	
4	001783SMH	2.732	0	0.0	14.1	Insufficient
4	002058ND	1.942	0	0.0	9.7	Insufficient
4	002296ND	8.631	0	0.0	44.2	Insufficient
4	002297ND	6.472	0	0.0	29.6	Insufficient
4	002921ND	3.027	6	19.5	16.0	
4	003045IN	8.607	3	9.8	42.5	Insufficient
4	003053IN	5.956	7	22.8	32.7	Insufficient
4	003058IN	12.747	8	26.0	65.1	Insufficient
4	003064IN	5.413	6	19.5	29.3	Insufficient
4	003070IN	4.83	4	13.0	27.4	Insufficient
4	003554SMH	4.117	0	0.0	19.5	Insufficient
4	003555SMH	2.185	3	9.8	8.9	
4	003560SMH	1.007	1	3.3	5.0	Insufficient
4	004124IN	1.849	4	13.0	7.8	
4	004126IN	2.934	0	0.0	17.0	Insufficient
4	004127IN	1.612	5	16.3	8.8	
4	004138IN	3.202	2	6.5	15.3	Insufficient
4	004139IN	5.744	1	3.3	24.2	Insufficient
4	004142IN	2.237	2	6.5	10.6	Insufficient
4	004144IN	5.454	3	9.8	24.7	Insufficient
4	004172IN	1.739	3	9.8	8.2	
4	004274IN	3.28	7	22.8	15.4	
4	004286IN	1.942	1	3.3	8.8	Insufficient
4	004305IN	1.219	1	3.3	6.9	Insufficient
4	004307IN	4.747	8	26.0	24.6	
4	004324IN	4.458	4	13.0	24.2	Insufficient
4	004330IN	2.784	3	9.8	10.8	Insufficient
4	004334IN	3.796	8	26.0	20.7	
4	004341IN	3.115	4	13.0	16.8	Insufficient
4	004344IN	2.515	3	9.8	12.8	Insufficient
4	004346IN	3.729	6	19.5	19.9	Insufficient
4	004659IN	2.732	6	19.5	15.7	
4	004689IN	9.013	4	13.0	45.5	Insufficient

TABLE 1

Detailed Inlet Capacity Results for Backlick Run

Sub-shed	Model Load Point	Total Drainage Area (ac)	Total Throat Count	Total Inlet Capacity (cfs)	Peak Runoff (cfs)	Inlet Capacity
4	004914SMH	3.419	3	9.8	14.8	Insufficient
4	005087IN	5.196	5	16.3	24.6	Insufficient
4	005107IN	4.954	5	16.3	20.2	Insufficient
4	009930IN	1.963	2	6.5	7.5	Insufficient
4	009933IN	9.67	2	6.5	37.4	Insufficient

Attachment D
Detailed Model Results

TABLE 1

Backlick Run Detailed Hydraulic Model Results

		Junction FaciltiyID						Duration of Surcharge (hrs)		Surcharge/ Depth Above Crown (ft)		Insufficient Freeboard/ Depth Below Rim (ft)		Duration of Flooding (hrs)		Flooded Volume (ft3)		
Subshed	DGravityMain FacilityID	US	DS	Length (ft)	Diameter/ Height x Width (ft)	Maximum Flow (ft3/s)	Maximum Velocity (fps)	US	DS	US	DS	US	DS	US	DS	US	DS	Summary Pipe Condition
1	001003STMP	002155IN	002159IN	66	2.5	13.07	6.03	0.2	0.7	1.1	2.8	-	-	0.0	0.0	0	0	Surcharged
1	001013STMP	002160IN	002159IN	134	3.5	88.27	9.04	0.6	0.7	8.3	8.3	1.0	-	0.0	0.0	0	0	Insufficient Freeboard
1	001014STMP	004933SMH	002160IN	44	3.5	88.29	9.05	53.4	0.6	7.6	8.0	-	1.0	0.0	0.0	0	0	Surcharged
1	001017STMP	004935SMH	002162IN	146	3.5	57.65	5.93	0.4	0.7	7.1	6.8	-	1.2	0.0	0.0	0	0	Surcharged
1	001018STMP	002164IN	004933SMH	76	2.5	23.53	4.7	53.4	53.4	7.7	8.6	1.1	-	0.0	0.0	0	0	Insufficient Freeboard
1	002037STMP	000730SMH	000004PD	172	8	466.42	9.04	0.7	6.2	0.9	2.4	-	0.5	0.0	0.0	0	0	Surcharged
1	002041STMP	000731SMH	000746SMH	42	4	97.72	8.02	0.1	0.1	0.2	0.4	-	-	0.0	0.0	0	0	Surcharged
1	002042STMP	000732SMH	000731SMH	210	4	97.68	8.32	0	0.1	-	0.2	-	-	0.0	0.0	0	0	Sufficient Capacity
1	002092STMP	002153IN	000746SMH	201	4.5	-101.21	6.3	0.6	0.1	7.6	6.3	-	-	0.0	0.0	0	0	Surcharged
1	002093STMP	002159IN	002153IN	89	3.5	101.27	10.37	0.7	0.6	8.5	8.6	-	-	0.0	0.0	0	0	Surcharged
1	002095STMP	002169IN	004935SMH	124	2.5	27.34	8.87	0.1	0.4	0.3	2.1	-	-	0.0	0.0	0	0	Surcharged
1	002103STMP	004930SMH	002173IN	38	2.5	18.23	7.82	0.5	0.7	1.7	3.2	1.6	1.1	0.0	0.0	0	0	Insufficient Freeboard
1	002107STMP	002189IN	002190IN	124	2.5	14.97	3.01	53.7	53.8	4.8	4.8	0.2	0.7	0.0	0.0	0	0	Insufficient Freeboard
1	002108STMP	002190IN	000745SMH	187	2.5	14.94	3	53.8	53.4	5.2	6.0	0.7	2.0	0.0	0.0	0	0	Insufficient Freeboard
1	002181STMP	002177IN	002175IN	132	3.5	46.71	4.83	1.2	0.5	5.5	6.2	-	-	0.0	0.0	0	0	Surcharged
1	002183STMP	000743SMH	002177IN	58	2	46.67	14.67	0.5	1.2	5.7	5.5	-	-	0.0	0.0	0	0	Surcharged
1	002184STMP	000743SMH	002178IN	217	3	48.65	6.82	0.5	0.2	1.1	0.9	-	-	0.0	0.0	0	0	Surcharged
1	002186STMP	002178IN	002179IN	142	3	55.5	8.09	0.2	0.2	0.9	0.8	-	-	0.0	0.0	0	0	Surcharged
1	002192STMP	002183IN	002184IN	73	1.5	-7.97	4.43	5.1	1.6	4.3	3.0	-	1.5	0.0	0.0	0	0	Surcharged
1	002193STMP	002184IN	002185IN	166	1.75	7.95	3.27	1.6	14.4	2.8	4.2	1.5	0.4	0.0	0.0	0	0	Insufficient Freeboard
1	002194STMP	002185IN	002189IN	111	2.5	14.98	3.03	14.4	53.7	3.5	4.6	0.4	0.2	0.0	0.0	0	0	Insufficient Freeboard
1	002195STMP	002188IN	002185IN	356	1.25	7.74	6.2	0.8	14.4	Flooded	4.5	Flooded	0.4	0.7	0.0	3322	0	Flooded
1	003090STMP	000748SMH	000682SMH	62	2	5.75	3.8	0	0	0.3	0.4	-	-	0.0	0.0	0	0	Surcharged
1	003099STMP	000682SMH	002178IN	30	1.5	6.64	4.94	0	0.2	0.9	2.0	-	-	0.0	0.0	0	0	Surcharged
1	003512STMP	002130IN	002131IN	236	1.25	8.77	7.01	0.3	0.5	Flooded	2.6	Flooded	1.9	0.1	0.0	117	0	Flooded
1	003513STMP	002131IN	000720SMH	22	1.25	8.62	7.43	0.5	0.8	2.6	3.0	1.9	-	0.0	0.0	0	0	Insufficient Freeboard
1	003515STMP	000720SMH	002133IN	83	1.25	8.6	6.91	0.8	6.8	3.1	3.6	-	1.6	0.0	0.0	0	0	Surcharged
1	003516STMP	002133IN	000721SMH	70	1.25	8.59	6.88	6.8	32.8	3.8	2.9	1.6	-	0.0	0.0	0	0	Insufficient Freeboard
1	003517STMP	000721SMH	000004PD	64	1.5	-8.57	4.8	32.8	6.2	3.1	2.3	-	0.5	0.0	0.0	0	0	Surcharged
1	003518STMP	000043CP	000044CP	105	5	502.06	13.94	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
1	003540STMP	000746SMH	000745SMH	176	4.5	-195.32	12.18	0.1	53.4	6.3	4.0	-	2.0	0.0	0.0	0	0	Surcharged
1	003541STMP	000745SMH	000004PD	144	5	219.7	11.14	53.4	6.2	3.5	4.0	2.0	0.5	0.0	0.0	0	0	Insufficient Freeboard
1	003543STMP	000744SMH	002180IN	49	4	-120.01	9.55	0	0	0.0	-	-	-	0.0	0.0	0	0	Surcharged
1	003586STMP	002180IN	000162IO	219	4	120.12	9.42	0	0	0.3	-	-	-	0.0	0.0	0	0	Surcharged
1	004397STMP	003954IN	001276SMH	45	2.5	100.14	25	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
1	004399STMP	001276SMH	001277SMH	100	3	100.18	16.46	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
1	004400STMP	001277SMH	001271SMH	141	3	100.19	18.66	0	0.2	-	1.3	-	0.4	0.0	0.0	0	0	Sufficient Capacity
1	004402STMP	003959IN	001278SMH	47	2	32.66	13.38	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
1	004403STMP	003961IN	001279SMH	39	1.5	10.31	11.86	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
1	004404STMP	003960IN	003959IN	66	2	32.63	10.57	0	0	0.1	-	-	-	0.0	0.0	0	0	Surcharged
1	004408STMP	003963IN	001279SMH	30	1.5	10.38	9.28	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
1	004409STMP	003964IN	003963IN	159	1.5	10.37	9.98	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
1	004410STMP	003965IN	003964IN	86	1.5	10.39	12.6	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
1	004748STMP	001274SMH	001275SMH	169	2.5	64.45	19.99	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
1	004749STMP	001275SMH	003953IN	32	2.5	76.81	19.43	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
1	004751STMP	003953IN	003954IN	170	2.5	76.87	19.14	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
1	004755STMP	003968IN	003969IN	89	1.25	10.9	9.33	0.4	0.5	7.0	Flooded	-	Flooded	0.0	0.4	0	3429	Surcharged
1	004757STMP	003972IN	001282SMH	23	1.5	32.8	18.4	0.1	0	1.3	0.2	-	-	0.0	0.0	0	0	Surcharged
1	004758STMP	003974IN	003972IN	102	1.25	15.74	12.6	0.5	0.1	4.2	0.5	-	-	0.0	0.0	0	0	Surcharged

TABLE 1

Backlick Run Detailed Hydraulic Model Results

		Junction FaciltiyID						Duration of Surcharge (hrs)		Surcharge/ Depth Above Crown (ft)		Insufficient Freeboard/ Depth Below Rim (ft)		Duration of Flooding (hrs)		Flooded Volume (ft3)		
Subshed	DGravityMain FacilityID	US	DS	Length (ft)	Diameter/ Height x Width (ft)	Maximum Flow (ft3/s)	Maximum Velocity (fps)	US	DS	US	DS	US	DS	US	DS	US	DS	Summary Pipe Condition
1	004760STMP	003969IN	003974IN	219	1.25	15.74	12.26	0.5	0.5	Flooded	4.0	Flooded	-	0.4	0.0	3429	0	Flooded
1	005447STMP	004085SMH	003992IN	114	3.5	68.16	8.7	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
1	005448STMP	003992IN	001288SMH	88	3.5	68.31	8.76	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
1	005451STMP	001311SMH	000732SMH	279	3.5	78.87	9.64	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
1	005463STMP	004051IN	001311SMH	91	3.5	67.91	7.68	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
1	005464STMP	001288SMH	004051IN	85	3.5	68.23	8.99	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
1	005471STMP	004077IN	003948IN	121	2	43.68	13.72	0.5	0.5	Flooded	3.1	Flooded	0.3	0.4	0.0	7748	0	Flooded
1	005472STMP	004072IN	004071IN	66	1.5	20.84	11.75	0.1	0	0.9	-	1.8	-	0.0	0.0	0	0	Insufficient Freeboard
1	005476STMP	004060IN	004066IN	167	1.25	17.43	18.68	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
1	005481STMP	004066IN	004069IN	158	1.5	17.43	14.64	0	0.1	-	0.5	-	-	0.0	0.0	0	0	Sufficient Capacity
1	005483STMP	004069IN	004068IN	49	1.75	17.44	8.91	0.1	0	0.4	0.6	-	-	0.0	0.0	0	0	Surcharged
1	005484STMP	004071IN	004070IN	87	1.5	20.85	13.91	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
1	005485STMP	004070IN	004073IN	140	1.75	20.89	12.37	0	0.2	-	1.9	-	0.3	0.0	0.0	0	0	Sufficient Capacity
1	005486STMP	004068IN	004073IN	65	1.75	17.46	10.73	0	0.2	0.7	1.7	-	0.3	0.0	0.0	0	0	Surcharged
1	005489STMP	004073IN	004079IN	60	2	33.72	13.17	0.2	0	2.0	2.7	0.3	1.6	0.0	0.0	0	0	Insufficient Freeboard
1	005492STMP	004079IN	004077IN	153	2	33.7	11.73	0	0.5	2.9	Flooded	1.6	Flooded	0.0	0.4	0	7748	Insufficient Freeboard
1	005960STMP	001267SMH	001268SMH	54	3	126.67	20.72	0.4	0.4	Flooded	Flooded	Flooded	Flooded	0.2	0.3	2073	4769	Flooded
1	005961STMP	001269SMH	001267SMH	57	3	97.9	16.64	0.3	0.4	Flooded	Flooded	Flooded	Flooded	0.1	0.2	380	2073	Flooded
1	005962STMP	003948IN	001267SMH	45	2	44.16	13.96	0.5	0.4	3.1	Flooded	0.3	Flooded	0.0	0.2	0	2073	Insufficient Freeboard
1	005969STMP	001278SMH	001274SMH	258	2.5	53.1	18.49	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
1	005975STMP	001285SMH	001310SMH	262	3.5	35.47	6.74	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
1	005976STMP	003983IN	001285SMH	20	3.5	-18.56	3.95	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
1	005977STMP	001286SMH	003983IN	37	3.5	18.57	6.4	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
1	005985STMP	003990IN	003989IN	21	3	32.91	7.81	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
1	005986STMP	003989IN	001310SMH	26	3	32.87	7.09	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
1	005987STMP	003991IN	003990IN	45	3	32.94	8.34	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
1	006011STMP	004091IN	003968IN	48	1.5	10.91	12.83	0	0.4	0.3	2.9	-	-	0.0	0.0	0	0	Surcharged
1	014586STMP	002173IN	002172IN	145	3	65.75	9.27	0.7	0	2.7	2.4	1.1	-	0.0	0.0	0	0	Insufficient Freeboard
1	014587STMP	002172IN	000743SMH	272	3	65.83	9.31	0	0.5	2.4	1.2	-	-	0.0	0.0	0	0	Surcharged
1	014588STMP	002179IN	000744SMH	67	3	55.54	8.93	0.2	0	0.5	0.5	-	-	0.0	0.0	0	0	Surcharged
1	014589STMP	000682SMH	000744SMH	191	3	54.36	8.82	0	0	-	1.0	-	-	0.0	0.0	0	0	Sufficient Capacity
1	014592STMP	001271SMH	001269SMH	39	3	100.16	15.84	0.2	0.3	1.6	Flooded	0.4	Flooded	0.0	0.1	0	380	Insufficient Freeboard
1	014595STMP	001282SMH	001281SMH	137	2	32.73	10.33	0	0	1.3	0.3	-	-	0.0	0.0	0	0	Surcharged
1	014596STMP	001281SMH	003960IN	46	2	32.61	10.36	0	0	0.5	-	-	-	0.0	0.0	0	0	Surcharged
1	014597STMP	000683SMH	000743SMH	43	2	26.3	8.25	0	0.5	5.5	5.5	-	-	0.0	0.0	0	0	Surcharged
1	014601STMP	001279SMH	001278SMH	87	1.5	20.6	12.78	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
1	014618STMP	009077IN	002173IN	73	3	55.74	7.87	0.6	0.7	2.0	2.4	0.5	1.1	0.0	0.0	0	0	Insufficient Freeboard
1	014623STMP	002200IN	000744SMH	52	1.5	12.33	16.74	0	0	-	2.5	-	-	0.0	0.0	0	0	Sufficient Capacity
1	014632STMP	004932SMH	009077IN	218	3	55.73	8.24	0.6	0.6	1.8	1.8	0.6	0.5	0.0	0.0	0	0	Insufficient Freeboard
1	014633STMP	000683SMH	000682SMH	213	3	50.37	8.08	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
1	014657STMP	001310SMH	004085SMH	135	3.5	68.03	8.06	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
1	014686STMP	002269ND	003991IN	85	3	32.91	9.13	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
1	014702STMP	002175IN	004935SMH	33	3.5	46.83	4.84	0.5	0.4	6.4	6.6	-	-	0.0	0.0	0	0	Surcharged
1	014703STMP	002162IN	004933SMH	41	3.5	57.37	5.9	0.7	53.4	6.8	7.6	1.2	-	0.0	0.0	0	0	Insufficient Freeboard
1	015063STMP	004929SMH	000683SMH	269	3	63.49	8.74	0	0	0.3	-	-	-	0.0	0.0	0	0	Surcharged
1	015064STMP	004930SMH	004929SMH	166	3	62.85	8.85	0.5	0	1.2	0.3	1.6	-	0.0	0.0	0	0	Insufficient Freeboard
1	015065STMP	004931SMH	004930SMH	275	3	59.47	8.37	0.6	0.5	1.7	1.2	0.8	1.6	0.0	0.0	0	0	Insufficient Freeboard
1	015066STMP	001264SMH	004931SMH	364	3	91.4	13.18	0.6	0.6	2.1	1.7	1.2	0.8	0.0	0.0	0	0	Insufficient Freeboard
1	015067STMP	001265SMH	001264SMH	23	3	115.13	16.2	0.6	0.6	2.6	2.1	0.6	1.2	0.0	0.0	0	0	Insufficient Freeboard

TABLE 1

Backlick Run Detailed Hydraulic Model Results

		Junction FaciltiyID						Duration of Surcharge (hrs)		Surcharge/ Depth Above Crown (ft)		Insufficient Freeboard/ Depth Below Rim (ft)		Duration of Flooding (hrs)		Flooded Volume (ft3)		
Subshed	DGravityMain FacilityID	US	DS	Length (ft)	Diameter/ Height x Width (ft)	Maximum Flow (ft3/s)	Maximum Velocity (fps)	US	DS	US	DS	US	DS	US	DS	US	DS	Summary Pipe Condition
1	015068STMP	001261SMH	001265SMH	98	3	105.55	14.83	0.6	0.6	Flooded	2.6	Flooded	0.6	0.5	0.0	9228	0	Flooded
1	015069STMP	001266SMH	001261SMH	238	3	112	16.12	0.5	0.6	Flooded	Flooded	Flooded	Flooded	0.4	0.5	6507	9228	Flooded
1	015070STMP	001268SMH	001266SMH	180	3	117.25	17.7	0.4	0.5	Flooded	Flooded	Flooded	Flooded	0.3	0.4	4769	6507	Flooded
1	015071STMP	001263SMH	001264SMH	9	1.25	23.77	-18.97	0	0.6	0.1	3.8	-	1.2	0.0	0.0	0	0	Surcharged
1	015072SMTP	001263SMH	001262SMH	30	2	23.78	11.5	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
1	015073STMP	001262SMH	004932SMH	331	3	23.92	7.82	0	0.6	-	1.8	-	0.6	0.0	0.0	0	0	Sufficient Capacity
1	015074STMP	001283SMH	001265SMH	59	1.5	26.59	14.87	0.7	0.6	Flooded	4.1	Flooded	0.6	0.4	0.0	439	0	Flooded
1	015076STMP	004931SMH	004932SMH	7	3	36.76	6.07	0.6	0.6	1.7	1.8	0.8	0.6	0.0	0.0	0	0	Insufficient Freeboard
1	015078STMP	004929SMH	002172IN	38	1.5	-1.56	2.45	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
2	003528STMP	002140IN	000723SMH	194	4.5	11.04	1.51	0	0.4	-	0.7	-	-	0.0	0.0	0	0	Sufficient Capacity
2	003529STMP	000723SMH	000724SMH	21	4	-11.38	-3.75	0.4	0.7	1.6	1.5	-	-	0.0	0.0	0	0	Surcharged
2	003530STMP	000724SMH	000726SMH	30	4	-16.83	5.27	0.7	0	2.2	3.2	-	-	0.0	0.0	0	0	Surcharged
2	003531STMP	000725SMH	000726SMH	40	7	448.71	12.26	0	0	-	0.4	-	-	0.0	0.0	0	0	Sufficient Capacity
2	003534STMP	000726SMH	000727SMH	200	8	455.82	9.21	0	0	0.0	-	-	-	0.0	0.0	0	0	Surcharged
2	003535STMP	000727SMH	000730SMH	154	8	466.9	9.46	0	0.7	-	0.9	-	-	0.0	0.0	0	0	Sufficient Capacity
2	004358STMP	001315SMH	004234SMH	51	2.5	-152.49	30.5	0	0	8.0	-	-	-	0.0	0.0	0	0	Surcharged
2	004364STMP	001118SMH	003421IN	54	1.25	6.39	9.02	0	0.1	-	0.4	-	-	0.0	0.0	0	0	Sufficient Capacity
2	004376STMP	003441IN	003429IN	84	5	151.51	11.28	0.1	0.1	0.3	0.6	-	-	0.0	0.0	0	0	Surcharged
2	004377STMP	003426IN	003428IN	63	3.5	30.99	3.98	0.2	0.1	2.2	2.4	-	-	0.0	0.0	0	0	Surcharged
2	004379STMP	003429IN	003428IN	42	5	148.85	10.89	0.1	0.1	0.8	1.2	-	-	0.0	0.0	0	0	Surcharged
2	004381STMP	003442IN	003443IN	68	2.5	24.52	13	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
2	004841STMP	004934SMH	001299SMH	341	6	251.93	10.79	0	0.2	1.9	2.2	-	-	0.0	0.0	0	0	Surcharged
2	004842STMP	003476IN	003475IN	136	1.5	13.15	8.12	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
2	004846STMP	001142SMH	001141SMH	53	2	13.17	7.89	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
2	004849STMP	003475IN	001142SMH	26	2	13.15	7.15	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
2	004850STMP	001139SMH	001140SMH	54	2	12.28	8.3	0	0	-	0.2	-	-	0.0	0.0	0	0	Sufficient Capacity
2	004854STMP	003477IN	001139SMH	25	2	-12.26	6.22	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
2	005352STMP	001292SMH	001293SMH	25	2.5	33.03	7.13	0.3	0.4	2.9	2.9	-	-	0.0	0.0	0	0	Surcharged
2	005353STMP	001294SMH	001293SMH	26	7	408.13	10.58	0.4	0.4	3.1	3.2	-	-	0.0	0.0	0	0	Surcharged
2	005355STMP	004008IN	004009IN	142	2	11.14	5.79	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
2	005356STMP	004009IN	004010IN	19	2	11.15	5.91	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
2	005357STMP	004010IN	001298SMH	15	2	11.16	8.05	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
2	005358STMP	001299SMH	000519ND	64	7	365.95	13.2	0.2	0.2	1.2	1.5	-	-	0.0	0.0	0	0	Surcharged
2	005365STMP	001301SMH	001303SMH	20	3.5	28.44	2.94	0.2	0.3	5.7	5.9	-	-	0.0	0.0	0	0	Surcharged
2	005369STMP	001304SMH	001303SMH	46	3.5	13.58	2.19	0.4	0.3	5.4	5.9	-	-	0.0	0.0	0	0	Surcharged
2	005370STMP	002262ND	001751SMH	301	6	394.32	13.88	0.3	0.3	4.4	3.5	-	-	0.0	0.0	0	0	Surcharged
2	005371STMP	001746SMH	001301SMH	228	2.5	12.15	4.94	0.3	0.2	2.8	6.2	-	-	0.0	0.0	0	0	Surcharged
2	005372STMP	005040IN	001746SMH	19	2	12.19	9.73	0.3	0.3	2.2	3.0	-	-	0.0	0.0	0	0	Surcharged
2	005374STMP	001305SMH	001306SMH	141	1.75	22.45	9.28	0.3	0.3	2.0	0.6	-	-	0.0	0.0	0	0	Surcharged
2	005375STMP	001306SMH	004022IN	146	1.75	22.45	9.57	0.3	0	0.6	-	-	-	0.0	0.0	0	0	Surcharged
2	005376STMP	000384ND	001295SMH	72	2	13.55	4.88	0.2	0.2	1.6	2.0	-	-	0.0	0.0	0	0	Surcharged
2	005379A	001296SMH	000383ND	11	2	-13.65	-4.29	0.3	0.4	3.7	3.9	-	-	0.0	0.0	0	0	Surcharged
2	005379B	000383ND	001297SMH	28	2	-13.93	-4.38	0.4	0.3	3.9	4.2	-	-	0.0	0.0	0	0	Surcharged
2	005381STMP	001297SMH	004005IN	47	2.5	14.02	-3.54	0.3	0.2	3.4	2.9	-	-	0.0	0.0	0	0	Surcharged
2	005382STMP	004047IN	004005IN	102	4	118.91	14.47	0	0.2	0.8	1.6	-	-	0.0	0.0	0	0	Surcharged
2	005385STMP	001307SMH	004029IN	322	4	124.35	13.37	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
2	005386STMP	004035IN	001307SMH	41	4	102.01	11.1	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
2	005387STMP	004050IN	004049IN	33	2.5	44.83	14.02	0.1	0.1	1.1	Flooded	1.1	Flooded	0.0	0.0	0	153	Insufficient Freeboard
2	005395STMP	004048IN	004029IN	58	2.5	34.73	13.39	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity

TABLE 1

Backlick Run Detailed Hydraulic Model Results

		Junction FaciltiyID						Duration of Surcharge (hrs)		Surcharge/ Depth Above Crown (ft)		Insufficient Freeboard/ Depth Below Rim (ft)		Duration of Flooding (hrs)		Flooded Volume (ft3)		
Subshed	DGravityMain FacilityID	US	DS	Length (ft)	Diameter/ Height x Width (ft)	Maximum Flow (ft3/s)	Maximum Velocity (fps)	US	DS	US	DS	US	DS	US	DS	US	DS	Summary Pipe Condition
2	005445STMP	001308SMH	004049IN	159	3	60.88	15.53	0	0.1	-	Flooded	-	Flooded	0.0	0.0	0	153	Sufficient Capacity
2	005446STMP	004049IN	004035IN	256	3	101.94	14.36	0.1	0	Flooded	-	Flooded	-	0.0	0.0	153	0	Flooded
2	005449STMP	001291SMH	001292SMH	176	2.5	33.15	8.43	0.1	0.3	1.0	1.5	-	-	0.0	0.0	0	0	Surcharged
2	005450STMP	001293SMH	000505ND	59	7	438.93	11.37	0.4	0.4	3.2	3.1	-	-	0.0	0.0	0	0	Surcharged
2	005457STMP	001747SMH	005040IN	42	1.5	11.49	11.25	0.2	0.3	1.3	2.6	-	-	0.0	0.0	0	0	Surcharged
2	005458STMP	005041IN	001747SMH	49	1.25	10.36	8.39	0.2	0.2	1.9	1.5	-	-	0.0	0.0	0	0	Surcharged
2	005459STMP	001748SMH	001750SMH	68	3	9.15	4.68	0.2	0.1	3.8	4.2	-	-	0.0	0.0	0	0	Surcharged
2	005465STMP	000406ND	004063IN	116	6	17.57	8.71	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
2	005466STMP	000506ND	004063IN	171	6	10.77	6.47	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
2	005479STMP	004063IN	004040IN	99	1.5	22.49	12.6	0	0.3	4.1	1.7	-	1.5	0.0	0.0	0	0	Surcharged
2	005494STMP	004082IN	004047IN	222	4	113.82	22.85	0	0	-	0.8	-	-	0.0	0.0	0	0	Sufficient Capacity
2	005495STMP	000513ND	004082IN	78	2.5	16.88	12.68	0	0	-	-	2.0	-	0.0	0.0	0	0	Sufficient Capacity
2	005496STMP	004087IN	004048IN	188	1.5	10.39	8.74	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
2	005497STMP	002289ND	001315SMH	270	4	178.03	18.97	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
2	005498STMP	004022IN	001313SMH	105	1.75	22.84	13.65	0	0.1	-	1.8	-	1.8	0.0	0.0	0	0	Sufficient Capacity
2	005520STMP	003443IN	001123SMH	36	3	24.47	12.6	0	0.2	-	4.5	-	-	0.0	0.0	0	0	Sufficient Capacity
2	005521STMP	001124SMH	001123SMH	162	5	187.82	9.64	0.2	0.2	2.7	2.3	-	-	0.0	0.0	0	0	Surcharged
2	005530STMP	001119SMH	003427IN	172	3	10.66	3.82	0.1	0.1	1.2	2.0	-	-	0.0	0.0	0	0	Surcharged
2	005531STMP	003427IN	003426IN	83	3.5	28.54	5.38	0.1	0.2	1.5	1.9	-	-	0.0	0.0	0	0	Surcharged
2	005536STMP	003421IN	003420IN	161	1.25	6.36	6.78	0.1	0.1	0.9	2.9	-	-	0.0	0.0	0	0	Surcharged
2	005537STMP	003420IN	003427IN	128	2.5	18.3	5.55	0.1	0.1	1.9	2.3	-	-	0.0	0.0	0	0	Surcharged
2	005539STMP	003419IN	003420IN	103	2	12.56	7.25	0.1	0.1	1.0	2.0	-	-	0.0	0.0	0	0	Surcharged
2	005551STMP	001132SMH	001133SMH	92	2.5	15.83	6.54	0	0	-	0.1	-	-	0.0	0.0	0	0	Sufficient Capacity
2	005553STMP	001133SMH	001134SMH	43	2.5	16.07	5.73	0	0	0.9	1.1	-	-	0.0	0.0	0	0	Surcharged
2	005555STMP	001134SMH	003461IN	40	2.5	16.3	5.81	0	0.1	1.1	1.2	-	-	0.0	0.0	0	0	Surcharged
2	005557STMP	003453IN	003452IN	28	1.75	10.05	6.89	0	0	-	0.2	-	-	0.0	0.0	0	0	Sufficient Capacity
2	005558STMP	003452IN	001128SMH	21	1.75	10.02	8.8	0	0.2	1.7	5.3	-	-	0.0	0.0	0	0	Surcharged
2	005560STMP	001128SMH	001124SMH	87	5	188.16	10.88	0.2	0.2	2.0	2.7	-	-	0.0	0.0	0	0	Surcharged
2	005561STMP	003428IN	001126SMH	78	5	185	11.08	0.1	0.2	1.4	1.5	-	-	0.0	0.0	0	0	Surcharged
2	005562STMP	001126SMH	001128SMH	253	5	182.15	11.02	0.2	0.2	1.5	2.0	-	-	0.0	0.0	0	0	Surcharged
2	005563STMP	001123SMH	001138SMH	67	5	223.85	11.89	0.2	0.2	2.5	2.3	-	-	0.0	0.0	0	0	Surcharged
2	005564STMP	001138SMH	001137SMH	95	5	222.55	12.36	0.2	0.2	2.3	2.7	-	-	0.0	0.0	0	0	Surcharged
2	005569STMP	001137SMH	001135SMH	83	5	220.91	11.76	0.2	0	2.7	2.4	-	-	0.0	0.0	0	0	Surcharged
2	005570STMP	003464IN	001136SMH	54	3	16.28	5.85	0	0	1.4	5.1	-	-	0.0	0.0	0	0	Surcharged
2	005571STMP	003461IN	003464IN	42	2.5	16.28	5.62	0.1	0	1.5	1.6	-	-	0.0	0.0	0	0	Surcharged
2	005572STMP	001135SMH	001136SMH	46	5	219.95	12.44	0	0	2.4	3.1	-	-	0.0	0.0	0	0	Surcharged
2	005575STMP	001140SMH	004934SMH	49	2.5	12.93	9.36	0	0	0.2	1.6	-	-	0.0	0.0	0	0	Surcharged
2	005576STMP	001141SMH	004934SMH	18	2.5	13.17	5.72	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
2	005993STMP	001290SMH	001291SMH	80	2.5	34.91	7.27	0.1	0.1	1.0	0.7	-	-	0.0	0.0	0	0	Surcharged
2	006005STMP	004040IN	001305SMH	52	1.5	22.47	12.55	0.3	0.3	3.4	1.7	1.5	-	0.0	0.0	0	0	Insufficient Freeboard
2	006009STMP	004090IN	001318SMH	36	2.5	18.68	15.34	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
2	006010STMP	004105IN	004090IN	87	2.5	18.66	12.92	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
2	006017STMP	002256ND	001320SMH	109	2.5	18.69	14.46	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
2	006018STMP	001318SMH	001319SMH	168	2.5	18.67	14.37	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
2	006019STMP	000511ND	004099IN	54	1.25	14.77	11.97	0.1	0	1.2	-	-	-	0.0	0.0	0	0	Surcharged
2	006020STMP	004100IN	001308SMH	101	3	60.76	21.6	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
2	006021STMP	004099IN	004100IN	141	2.5	60.67	17.56	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
2	006022STMP	004098IN	004099IN	147	2.5	45.8	21.65	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
2	006023STMP	001320SMH	004098IN	177	2.5	18.67	9.52	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity

TABLE 1

Backlick Run Detailed Hydraulic Model Results

		Junction FaciltiyID						Duration of Surcharge (hrs)		Surcharge/ Depth Above Crown (ft)		Insufficient Freeboard/ Depth Below Rim (ft)		Duration of Flooding (hrs)		Flooded Volume (ft3)		
Subshed	DGravityMain FacilityID	US	DS	Length (ft)	Diameter/ Height x Width (ft)	Maximum Flow (ft3/s)	Maximum Velocity (fps)	US	DS	US	DS	US	DS	US	DS	US	DS	Summary Pipe Condition
2	006035STMP	001313SMH	001314SMH	99	2	23.24	12	0.1	0.3	2.0	3.8	1.8	1.7	0.0	0.0	0	0	Insufficient Freeboard
2	006036STMP	001314SMH	004080IN	154	2	46.43	14.6	0.3	0.1	4.1	1.5	1.7	-	0.0	0.0	0	0	Insufficient Freeboard
2	006037STMP	004080IN	004081IN	149	2	46.43	15.66	0.1	0.2	2.0	1.3	-	-	0.0	0.0	0	0	Surcharged
2	006038STMP	004081IN	004082IN	166	2	46.43	14.96	0.2	0	1.7	-	-	-	0.0	0.0	0	0	Surcharged
2	007491STMP	001750SMH	001304SMH	182	3	11.22	2.64	0.1	0.4	4.8	5.4	-	-	0.0	0.0	0	0	Surcharged
2	007492STMP	001751SMH	001752SMH	39	7	-394.33	10.22	0.3	0.3	2.9	2.7	-	-	0.0	0.0	0	0	Surcharged
2	007493STMP	001752SMH	001294SMH	111	7	408.17	10.6	0.3	0.4	2.7	3.1	-	-	0.0	0.0	0	0	Surcharged
2	013335STMP	001315SMH	003509SMH	294	6	72.05	5.13	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
2	013336STMP	003509SMH	001025SMH	234	6	92.72	5.48	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
2	014649STMP	001136SMH	002261ND	99	5	234.05	12.02	0	0.2	3.1	2.7	-	-	0.0	0.0	0	0	Surcharged
2	014650STMP	002261ND	004934SMH	83	6	232.31	10.09	0.2	0	1.7	1.9	-	-	0.0	0.0	0	0	Surcharged
2	014651STMP	000505ND	000725SMH	542	6	438.89	15.42	0.4	0	4.1	0.7	-	-	0.0	0.0	0	0	Surcharged
2	014652STMP	001298SMH	001299SMH	33	5	-122.47	6.22	0	0.2	3.9	3.2	-	-	0.0	0.0	0	0	Surcharged
2	014653STMP	001295SMH	002301ND	28	2	13.86	4.9	0.2	0.2	2.3	7.0	-	-	0.0	0.0	0	0	Surcharged
2	014654STMP	000519ND	002301ND	169	7	359.07	12.89	0.2	0.2	1.5	2.0	-	-	0.0	0.0	0	0	Surcharged
2	014655STMP	002301ND	001303SMH	282	7	363.29	12.45	0.2	0.3	2.0	3.0	-	-	0.0	0.0	0	0	Surcharged
2	014656STMP	001303SMH	002262ND	305	7	394.37	11.78	0.3	0.3	3.0	3.4	-	-	0.0	0.0	0	0	Surcharged
2	014676STMP	004234SMH	003441IN	41	4	152.32	14.03	0	0.1	1.1	1.3	-	-	0.0	0.0	0	0	Surcharged
2	014695STMP	001319SMH	002256ND	160	2.5	18.69	14.44	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
2	014696STMP	004029IN	002289ND	283	4	159.47	18.39	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
2	014697STMP	000384ND	001296SMH	44	2	-13.55	-4.27	0.2	0.3	2.8	3.2	-	-	0.0	0.0	0	0	Surcharged
2	014706STMP	004005IN	001298SMH	47	5	112.38	10.26	0.2	0	1.4	3.7	-	-	0.0	0.0	0	0	Surcharged
3	004092STMP	003082IN	001031SMH	43	2.5	35.41	10.63	0.6	0.7	Flooded	Flooded	Flooded	Flooded	0.4	0.4	1336	2893	Flooded
3	004094STMP	001030SMH	001111SMH	48	2	20.61	6.51	0.6	0.6	Flooded	Flooded	Flooded	Flooded	0.4	0.4	2710	1268	Flooded
3	004095STMP	003085IN	001030SMH	160	2	26.37	8.31	0.5	0.6	3.0	Flooded	1.8	Flooded	0.0	0.4	0	2710	Insufficient Freeboard
3	004096STMP	003090IN	001023SMH	45	1.25	15.42	12.39	0.3	0.2	3.2	3.1	1.0	-	0.0	0.0	0	0	Insufficient Freeboard
3	004097STMP	001431SMH	003095IN	302	4	297.5	25.8	0.2	0.3	3.7	Flooded	-	Flooded	0.0	0.2	0	686	Surcharged
3	004100STMP	000364ND	001033SMH	395	5	321.94	16.35	0.3	0.7	1.6	Flooded	1.7	Flooded	0.0	0.5	0	45249	Insufficient Freeboard
3	004112STMP	001109SMH	003082IN	282	2.5	18.19	5.13	0.2	0.6	0.9	Flooded	-	Flooded	0.0	0.4	0	1336	Surcharged
3	004114STMP	001111SMH	003082IN	59	2.5	20.99	5.17	0.6	0.6	Flooded	Flooded	Flooded	Flooded	0.4	0.4	1268	1336	Flooded
3	004116STMP	003091IN	003092IN	87	1.25	13.68	12.51	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
3	004354STMP	001031SMH	001034SMH	74	3	40.06	5.62	0.7	1.2	Flooded	Flooded	Flooded	Flooded	0.4	0.3	2893	1825	Flooded
3	004355STMP	001033SMH	001034SMH	155	5	308.7	15.62	0.7	1.2	Flooded	Flooded	Flooded	Flooded	0.5	0.3	45249	1825	Flooded
3	004785STMP	003092IN	003093IN	50	1.25	13.73	15.63	0	0.2	-	1.8	-	1.9	0.0	0.0	0	0	Sufficient Capacity
3	004786STMP	003093IN	003094IN	66	1.25	13.78	13.89	0.2	0.3	1.8	3.0	1.9	0.2	0.0	0.0	0	0	Insufficient Freeboard
3	004788STMP	003094IN	003095IN	46	2	14.27	8.5	0.3	0.3	2.8	Flooded	0.2	Flooded	0.0	0.2	0	686	Insufficient Freeboard
3	004795STMP	003089IN	003090IN	19	1.25	15.49	13.24	0.3	0.3	Flooded	2.9	Flooded	1.0	0.1	0.0	163	0	Flooded
3	004801STMP	003105IN	001026SMH	242	2.25	42.3	10.59	0.3	0	3.0	-	2.0	-	0.0	0.0	0	0	Insufficient Freeboard
3	004802STMP	001026SMH	001025SMH	28	2.5	116.61	26.99	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
3	004804STMP	001025SMH	001024SMH	52	6	206.72	9.72	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
3	004805STMP	001024SMH	000215IO	31	6	-206.75	10.23	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
3	004806STMP	003095IN	001023SMH	204	4	309.6	24.52	0.3	0.2	Flooded	1.6	Flooded	-	0.2	0.0	686	0	Flooded
3	004818STMP	001034SMH	000378ND	290	5	332.38	16.83	1.2	72	Flooded	2.7	Flooded	-	0.3	0.0	1825	0	Flooded
3	004895STMP	001348SMH	004262IN	45	1.25	22.73	18.15	0.5	0	4.5	-	0.5	-	0.0	0.0	0	0	Insufficient Freeboard
3	004897STMP	001437SMH	001432SMH	87	4	241.76	24.06	0.2	0.2	3.4	4.7	-	0.1	0.0	0.0	0	0	Surcharged
3	004898STMP	001432SMH	004357IN	115	4	249.62	20.18	0.2	0.3	4.9	Flooded	0.1	Flooded	0.0	0.2	0	3897	Insufficient Freeboard
3	004900STMP	001439SMH	004400IN	41	2	41.33	15.45	0.2	0.3	4.3	4.7	0.2	1.3	0.0	0.0	0	0	Insufficient Freeboard
3	004901STMP	001440SMH	001439SMH	361	1.5	30.59	18.28	0.3	0.2	3.8	4.3	0.2	0.2	0.0	0.0	0	0	Insufficient Freeboard
3	004902STMP	004402IN	001440SMH	14	1.25	13.58	10.89	0.2	0.3	Flooded	3.0	Flooded	0.2	0.1	0.0	71	0	Flooded

TABLE 1

Backlick Run Detailed Hydraulic Model Results

Subshed	DGravityMain FacilityID	Junction FaciltiyID		Length (ft)	Diameter/ Height x Width (ft)	Maximum Flow (ft3/s)	Maximum Velocity (fps)	Duration of Surcharge (hrs)		Surcharge/ Depth Above Crown (ft)		Insufficient Freeboard/ Depth Below Rim (ft)		Duration of Flooding (hrs)		Flooded Volume (ft3)		Summary Pipe Condition
		US	DS					US	DS	US	DS	US	DS	US	DS	US	DS	
3	005507STMP	004339IN	004340IN	114	2.5	50.3	10.16	0.1	0.1	0.3	0.1	-	-	0.0	0.0	0	0	Surcharged
3	006008STMP	004083IN	000279IO	16	2.5	74.25	15.38	0.4	0	0.6	-	-	-	0.0	0.0	0	0	Surcharged
3	006015STMP	004103IN	004095IN	90	1.5	41.3	25.42	0.1	0.1	Flooded	0.4	Flooded	1.9	0.1	0.0	332	0	Flooded
3	006025STMP	001317SMH	001316SMH	176	1.25	19.27	14.99	2.2	0	Flooded	-	Flooded	-	1.1	0.0	1414	0	Flooded
3	006026STMP	004088IN	001317SMH	10	1.25	20.14	15.43	2.2	2.2	Flooded	Flooded	Flooded	Flooded	1.9	1.1	45691	1414	Flooded
3	006027STMP	004097IN	004088IN	66	2	39.93	12.33	1.9	2.2	Flooded	Flooded	Flooded	Flooded	1.2	1.9	23229	45691	Flooded
3	006028STMP	004095IN	004096IN	196	1.75	38.71	18.53	0.1	0.8	0.3	Flooded	1.9	Flooded	0.0	0.3	0	2204	Insufficient Freeboard
3	006030STMP	004096IN	004097IN	114	2	48.82	15.26	0.8	1.9	Flooded	Flooded	Flooded	Flooded	0.3	1.2	2204	23229	Flooded
3	006032STMP	004086IN	004083IN	70	2.5	74.25	15.08	0	0.4	1.3	0.6	-	-	0.0	0.0	0	0	Surcharged
3	006127STMP	004262IN	001350SMH	52	1.25	22.74	26.21	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
3	006128STMP	001349SMH	001350SMH	42	1.75	-17.92	7.34	0.4	0	4.2	3.6	-	-	0.0	0.0	0	0	Surcharged
3	006129STMP	001351SMH	001349SMH	69	1.75	17.89	7.33	0.4	0.4	4.3	4.2	-	-	0.0	0.0	0	0	Surcharged
3	006131STMP	001352SMH	001351SMH	33	1.75	17.88	8.61	0.3	0.4	3.6	4.3	1.6	-	0.0	0.0	0	0	Insufficient Freeboard
3	006132STMP	001353SMH	001352SMH	81	1.25	17.88	15.68	0.1	0.3	3.1	3.6	0.8	1.6	0.0	0.0	0	0	Insufficient Freeboard
3	006162STMP	004400IN	001438SMH	47	2	41.27	13.1	0.3	0.3	5.1	4.8	1.3	1.2	0.0	0.0	0	0	Insufficient Freeboard
3	006163STMP	004404IN	004402IN	59	1.25	14.02	14.69	0.1	0.2	1.6	Flooded	-	Flooded	0.0	0.1	0	71	Surcharged
3	006315STMP	004340IN	000286IO	38	2.5	50.32	10.96	0.1	0	0.1	-	-	-	0.0	0.0	0	0	Surcharged
3	006585STMP	004357IN	001438SMH	53	4	248.34	23.35	0.3	0.3	Flooded	4.8	Flooded	1.2	0.2	0.0	3897	0	Flooded
3	006595STMP	004378IN	004377IN	81	1.5	21.83	12.31	0	0	0.9	-	-	-	0.0	0.0	0	0	Surcharged
3	006599STMP	004377IN	004373IN	146	1.75	21.82	16.74	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
3	006600STMP	004373IN	004370IN	173	1.75	37.58	18.57	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
3	006602STMP	001433SMH	004368IN	35	1.5	19.33	21.01	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
3	006603STMP	004368IN	004369IN	46	1.5	19.35	16.1	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
3	006605STMP	004370IN	004369IN	207	1.75	37.58	18.32	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
3	006606STMP	004369IN	004392IN	50	2.5	56.44	21.92	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
3	006614STMP	004396IN	004397IN	151	4	225.08	20.53	0.2	0.2	0.9	1.1	-	1.4	0.0	0.0	0	0	Surcharged
3	006615STMP	004397IN	004398IN	16	4.5	225.16	19.64	0.2	0.2	1.6	1.8	1.4	-	0.0	0.0	0	0	Insufficient Freeboard
3	006617STMP	004398IN	001437SMH	46	4.5	225.22	19.86	0.2	0.2	1.8	2.2	-	-	0.0	0.0	0	0	Surcharged
3	007503STMP	005053IN	005054IN	43	1.5	25.21	14.11	0.5	0.4	Flooded	1.0	Flooded	1.0	0.3	0.0	3492	0	Flooded
3	007504STMP	005054IN	005055IN	18	1.5	25.21	14.16	0.4	0.2	1.1	1.0	1.0	1.3	0.0	0.0	0	0	Insufficient Freeboard
3	007505STMP	005056IN	001754SMH	172	2	26.85	11.41	0.2	0.2	2.6	4.7	1.8	-	0.0	0.0	0	0	Insufficient Freeboard
3	007506STMP	001765SMH	005056IN	40	2	25.91	14.08	0.2	0.2	1.0	2.0	1.4	1.8	0.0	0.0	0	0	Insufficient Freeboard
3	007507STMP	001754SMH	001756SMH	178	2	58.02	21.72	0.2	0.4	4.7	Flooded	-	Flooded	0.0	0.2	0	739	Surcharged
3	007508STMP	001755SMH	001754SMH	87	2	35.51	14.37	0.1	0.2	2.0	2.7	-	-	0.0	0.0	0	0	Surcharged
3	007509STMP	005060IN	001755SMH	15	1.25	-0.41	1.18	0	0.1	-	0.3	-	-	0.0	0.0	0	0	Sufficient Capacity
3	007510STMP	001756SMH	004086IN	146	2	74.25	23.06	0.4	0	Flooded	1.3	Flooded	-	0.2	0.0	739	0	Flooded
3	007511STMP	001757SMH	005057IN	81	1.75	19.27	14.17	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
3	007512STMP	001316SMH	001757SMH	115	1.5	19.27	13.32	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
3	007513STMP	005057IN	001758SMH	103	1.75	19.27	15.29	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
3	007514STMP	001758SMH	001755SMH	278	1.75	35.67	18.39	0	0.1	-	1.8	-	-	0.0	0.0	0	0	Sufficient Capacity
3	007515STMP	005058IN	001759SMH	50	1.25	0	0	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
3	007516STMP	001759SMH	005059IN	44	1.25	0	0	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
3	007517STMP	005059IN	001760SMH	24	1.5	0	0	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
3	007518STMP	002279ND	005060IN	30	1.25	0	0	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
3	007522STMP	005064IN	005065IN	122	1.25	14.18	15.07	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
3	007523STMP	005065IN	004404IN	84	1.25	14.14	16.65	0	0.1	-	1.6	-	-	0.0	0.0	0	0	Sufficient Capacity
3	007528STMP	005080IN	005081IN	28	1.25	12.89	10.41	0.5	0.5	Flooded	Flooded	Flooded	Flooded	0.5	0.4	3046	559	Flooded
3	007529STMP	004392IN	001761SMH	60	2.5	56.45	18.02	0	0	-	0.5	-	-	0.0	0.0	0	0	Sufficient Capacity
3	007530STMP	001761SMH	004396IN	235	4	206.84	21.5	0	0.2	-	0.8	-	-	0.0	0.0	0	0	Sufficient Capacity

TABLE 1

Backlick Run Detailed Hydraulic Model Results

		Junction FaciltiyID						Duration of Surcharge (hrs)		Surcharge/ Depth Above Crown (ft)		Insufficient Freeboard/ Depth Below Rim (ft)		Duration of Flooding (hrs)		Flooded Volume (ft3)		
Subshed	DGravityMain FacilityID	US	DS	Length (ft)	Diameter/ Height x Width (ft)	Maximum Flow (ft3/s)	Maximum Velocity (fps)	US	DS	US	DS	US	DS	US	DS	US	DS	Summary Pipe Condition
3	007548STMP	001769SMH	000669ND	89	1.5	10.03	5.6	0.4	0.3	5.9	7.0	0.2	-	0.0	0.0	0	0	Insufficient Freeboard
3	014659STMP	001760SMH	002279ND	44	1.75	0	0	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
3	014660STMP	001350SMH	002059ND	98	2	40.29	12.7	0	0.1	3.3	1.0	-	-	0.0	0.0	0	0	Surcharged
3	014661STMP	002059ND	004339IN	147	2.5	40.34	8.28	0.1	0.1	0.5	0.3	-	-	0.0	0.0	0	0	Surcharged
3	014691STMP	005055IN	001765SMH	14	2	25.3	8.12	0.2	0.2	0.7	0.6	1.3	1.4	0.0	0.0	0	0	Insufficient Freeboard
3	014693A	001438SMH	000669ND	22	4	281.15	22.42	0.3	0.3	4.8	4.5	1.2	-	0.0	0.0	0	0	Insufficient Freeboard
3	014693B	000669ND	001431SMH	246	4	286.56	23.99	0.3	0.2	4.5	3.5	-	-	0.0	0.0	0	0	Surcharged
3	014699STMP	001023SMH	000364ND	42	5	323.02	18.14	0.2	0.3	1.2	1.6	-	1.7	0.0	0.0	0	0	Surcharged
3	015001STMP	000577IO	001026SMH	16	2.5	74.34	21.78	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
3	015007STMP	001441SMH	001440SMH	84	1.25	21.05	16.8	0.3	0.3	Flooded	4.0	Flooded	0.2	0.3	0.0	2378	0	Flooded
3	015012STMP	004915SMH	004916SMH	63	1.25	14.49	13.21	0.4	0.4	Flooded	5.7	Flooded	0.5	0.3	0.0	814	0	Flooded
3	015013STMP	004916SMH	004917SMH	36	1.25	14.07	13.02	0.4	0.4	5.7	Flooded	0.5	Flooded	0.0	0.3	0	165	Insufficient Freeboard
3	015014STMP	004917SMH	004918SMH	164	1.25	14.08	12.86	0.4	0.4	Flooded	7.5	Flooded	-	0.3	0.0	165	0	Flooded
3	015018STMP	009940IN	009941IN	60	2.5	33.63	17	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
3	015019STMP	009941IN	009942IN	100	2.5	33.66	16.88	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
3	015020STMP	009942IN	004919SMH	218	2.75	33.6	16.45	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
3	015023STMP	004919SMH	004920SMH	173	3	52.36	17.3	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
3	015026STMP	004921SMH	004920SMH	192	3.5	133.05	21.73	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
3	015027STMP	004920SMH	002928ND	55	4	185.47	26.47	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
3	015030STMP	004924SMH	004923SMH	39	1.25	39.49	30.01	0.4	0.5	15.1	6.7	0.3	-	0.0	0.0	0	0	Insufficient Freeboard
3	015031STMP	004923SMH	002922ND	65	1.5	39.49	21.8	0.5	0	6.5	0.7	-	-	0.0	0.0	0	0	Surcharged
3	015032STMP	002922ND	004921SMH	168	3.5	124.4	19.7	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
3	015033STMP	000565ND	004378IN	69	1.25	21.81	17.25	0.3	0	6.4	1.1	-	-	0.0	0.0	0	0	Surcharged
3	015034STMP	002927ND	004925SMH	117	1.5	16.13	23.03	0	0	-	-	1.4	-	0.0	0.0	0	0	Sufficient Capacity
3	015037STMP	009952IN	002923ND	48	3.5	84.78	21.64	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
3	015038STMP	002923ND	002922ND	138	3.5	84.77	20.15	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
3	015039STMP	000578IO	004925SMH	20	2.5	50.27	16.91	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
3	015041STMP	004925SMH	009952IN	180	3.5	65.33	20.5	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
3	015042STMP	009953IN	004924SMH	92	1.25	14.18	14.18	0.4	0.4	8.7	14.9	-	0.3	0.0	0.0	0	0	Surcharged
3	015043STMP	004926SMH	009953IN	17	1.25	14.14	11.13	0.4	0.4	9.1	8.7	-	-	0.0	0.0	0	0	Surcharged
3	015044STMP	004918SMH	004926SMH	163	1.25	14.1	12.39	0.4	0.4	7.5	9.1	-	-	0.0	0.0	0	0	Surcharged
3	015045STMP	005081IN	004927SMH	52	1.25	12.93	12.23	0.5	0.5	Flooded	2.5	Flooded	1.1	0.4	0.0	559	0	Flooded
3	015046STMP	004927SMH	009954IN	276	1.25	12.95	12.04	0.5	0.5	2.5	7.4	1.1	0.5	0.0	0.0	0	0	Insufficient Freeboard
3	015047STMP	009954IN	004928SMH	68	1.25	13.53	11.16	0.5	0.5	7.4	Flooded	0.5	Flooded	0.0	0.4	0	2432	Insufficient Freeboard
3	015048STMP	004928SMH	009948IN	111	1.25	18.86	14.76	0.5	0.5	Flooded	8.0	Flooded	1.9	0.4	0.0	2432	0	Flooded
3	015050STMP	009948IN	002924ND	117	1.25	18.97	15.12	0.5	0.3	8.0	7.5	1.9	-	0.0	0.0	0	0	Insufficient Freeboard
3	015052STMP	002924ND	004924SMH	106	1.25	26.52	20.14	0.3	0.4	15.0	8.5	-	0.3	0.0	0.0	0	0	Surcharged
3	015058STMP	002928ND	VanDornDS	200	23	177.33	3.81	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
4	002598STMP	001426SMH	001427SMH	93	2	25.61	9.42	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
4	002599STMP	001427SMH	001393SMH	98	5	25.61	7.92	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
4	002835STMP	001102SMH	003053IN	39	3	60.33	8.5	0.2	0.1	Flooded	2.1	Flooded	0.3	0.1	0.0	135	0	Flooded
4	004027STMP	001098SMH	001100SMH	161	2.5	15.89	6.1	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
4	004029STMP	003048IN	001100SMH	35	5	163.37	8.97	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
4	004030STMP	001101SMH	000216IO	401	5.5	190.22	9.23	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
4	004032STMP	003070IN	003054IN	273	3	27.53	4.29	0.1	0.2	1.9	Flooded	-	Flooded	0.0	0.1	0	222	Surcharged
4	004034STMP	003063IN	001103SMH	59	2.5	32.85	6.65	0.1	0.1	Flooded	2.2	Flooded	0.1	0.0	0.0	17	0	Flooded
4	004037STMP	003069IN	000580IO	132	1.75	22.97	9.55	0.3	0	0.9	-	-	-	0.0	0.0	0	0	Surcharged
4	004042STMP	003064IN	003069IN	177	1.75	22.98	9.43	0.4	0.3	3.9	0.9	0.4	-	0.0	0.0	0	0	Insufficient Freeboard
4	004090STMP	003053IN	003051IN	278	3.5	120.35	12.5	0.1	0	2.5	-	0.3	-	0.0	0.0	0	0	Insufficient Freeboard

TABLE 1

Backlick Run Detailed Hydraulic Model Results

Subshed	DGravityMain FacilityID	Junction FaciltiyID		Length (ft)	Diameter/ Height x Width (ft)	Maximum Flow (ft3/s)	Maximum Velocity (fps)	Duration of Surcharge (hrs)		Surcharge/ Depth Above Crown (ft)		Insufficient Freeboard/ Depth Below Rim (ft)		Duration of Flooding (hrs)		Flooded Volume (ft3)		Summary Pipe Condition
		US	DS					US	DS	US	DS	US	DS	US	DS	US	DS	
4	004420A	000284IO	001373SMH	33	5	159.88	18.31	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
4	004420B	001373SMH	001374SMH	87	5	159.96	19.66	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
4	004423STMP	001374SMH	001375SMH	137	5	160.07	14.27	0	0.3	-	0.7	-	-	0.0	0.0	0	0	Sufficient Capacity
4	004424STMP	001375SMH	001363SMH	165	5	-165.13	8.43	0.3	0	0.7	-	-	-	0.0	0.0	0	0	Surcharged
4	004667STMP	000283IO	001361SMH	28	5.5	114.26	12.76	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
4	004668STMP	001361SMH	004287IN	296	5	132.58	13.47	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
4	004669STMP	004286IN	001361SMH	60	1.5	8.79	10.32	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
4	004670STMP	004287IN	001372SMH	102	5	147.91	10.19	0	0.4	-	0.9	-	-	0.0	0.0	0	0	Sufficient Capacity
4	004671STMP	004288IN	004287IN	11	2.5	15.77	8.71	0	0	-	0.8	-	-	0.0	0.0	0	0	Sufficient Capacity
4	004672STMP	000542ND	004288IN	59	1.5	15.77	26.31	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
4	004673STMP	001372SMH	001363SMH	199	5	-148.14	7.61	0.4	0	0.9	-	-	-	0.0	0.0	0	0	Surcharged
4	004713STMP	003054IN	001102SMH	20	3	-59.86	8.43	0.2	0.2	Flooded	Flooded	Flooded	Flooded	0.1	0.1	222	135	Flooded
4	004719STMP	003058IN	003063IN	50	3	-65.2	9.18	0.1	0.1	2.2	Flooded	0.6	Flooded	0.0	0.0	0	17	Insufficient Freeboard
4	004728STMP	003045IN	001099SMH	106	2.5	42.48	9.36	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
4	004732STMP	001103SMH	003053IN	300	2.5	32.72	6.63	0.1	0.1	2.4	2.2	0.1	0.3	0.0	0.0	0	0	Insufficient Freeboard
4	004733STMP	003063IN	003054IN	301	2.5	31.65	6.79	0.1	0.2	Flooded	Flooded	Flooded	Flooded	0.0	0.1	17	222	Flooded
4	004735STMP	001099SMH	003047IN	105	3	42.67	8.8	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
4	004736STMP	003047IN	003048IN	61	3	42.9	8.45	0	0	-	0.2	-	-	0.0	0.0	0	0	Sufficient Capacity
4	004764STMP	001366SMH	001367SMH	92	1.5	24.51	18.74	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
4	004765STMP	004307IN	001366SMH	267	1.5	24.5	21.42	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
4	004767STMP	001367SMH	001364SMH	75	3	24.51	14.87	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
4	004781STMP	003051IN	003048IN	22	3.5	120.39	14.52	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
4	004782STMP	001100SMH	001101SMH	26	5.5	-179.24	8.36	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
4	004905STMP	001445SMH	001447SMH	153	1.5	21.25	14.58	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
4	004906STMP	001447SMH	001448SMH	57	2.5	21.28	15.42	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
4	004907STMP	001448SMH	004344IN	62	2.5	21.28	14.6	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
4	004908STMP	004352IN	003555SMH	81	2.5	63.64	17.98	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
4	004909STMP	004351IN	004352IN	71	2.5	63.57	19.99	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
4	004910STMP	001449SMH	004353IN	84	2.5	24.59	9.77	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
4	005405STMP	004329IN	004330IN	164	1.25	10.02	10.2	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
4	005406STMP	004332IN	004329IN	53	1.25	10.02	8.31	0.8	0	0.6	-	-	-	0.0	0.0	0	0	Surcharged
4	005407STMP	004330IN	000588ND	219	1.5	20.42	17.53	0	0	-	0.2	-	-	0.0	0.0	0	0	Sufficient Capacity
4	005411STMP	004333IN	004332IN	53	1.25	10.02	8.14	0.8	0.8	0.8	0.4	-	-	0.0	0.0	0	0	Surcharged
4	005412STMP	004334IN	004333IN	151	1.25	10.02	8.06	0.8	0.8	Flooded	0.6	Flooded	-	0.8	0.0	7620	0	Flooded
4	005503STMP	001393SMH	001394SMH	26	2	30.13	12.68	0	0.1	1.1	1.4	-	-	0.0	0.0	0	0	Surcharged
4	005504STMP	001394SMH	001395SMH	113	2	30.1	12.72	0.1	0.2	1.5	2.6	-	-	0.0	0.0	0	0	Surcharged
4	005506STMP	004274IN	004276IN	70	1.5	15.37	14.08	0	0.1	-	2.9	-	0.8	0.0	0.0	0	0	Sufficient Capacity
4	006070STMP	001429SMH	004137IN	168	1.5	16.63	11.45	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
4	006074STMP	004137IN	001329SMH	142	1.5	16.63	11.75	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
4	006075STMP	001329SMH	000535ND	22	1.5	28.6	20.66	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
4	006082STMP	004138IN	001335SMH	177	3	111.17	21.44	0	0.2	-	1.3	-	-	0.0	0.0	0	0	Sufficient Capacity
4	006083STMP	001333SMH	004138IN	40	3.5	95.79	12.36	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
4	006085STMP	004139IN	001333SMH	56	3.5	-95.74	9.62	0	0	0.6	-	-	-	0.0	0.0	0	0	Surcharged
4	006086STMP	004140IN	004139IN	54	3	71.76	14.28	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
4	006087STMP	004143IN	004140IN	97	2.5	61.04	17.26	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
4	006088STMP	004141IN	004140IN	44	1.25	10.56	8.99	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
4	006089STMP	004142IN	004141IN	205	1.25	10.57	11.91	0	0	-	-	1.7	-	0.0	0.0	0	0	Sufficient Capacity
4	006090STMP	004144IN	004143IN	68	2	60.85	19.22	0.1	0	2.8	-	-	-	0.0	0.0	0	0	Surcharged
4	006091STMP	001334SMH	004144IN	267	2	36.24	11.43	0.1	0.1	3.1	1.0	0.9	-	0.0	0.0	0	0	Insufficient Freeboard

TABLE 1

Backlick Run Detailed Hydraulic Model Results

		Junction FaciltiyID						Duration of Surcharge (hrs)		Surcharge/ Depth Above Crown (ft)		Insufficient Freeboard/ Depth Below Rim (ft)		Duration of Flooding (hrs)		Flooded Volume (ft3)		
Subshed	DGravityMain FacilityID	US	DS	Length (ft)	Diameter/ Height x Width (ft)	Maximum Flow (ft3/s)	Maximum Velocity (fps)	US	DS	US	DS	US	DS	US	DS	US	DS	Summary Pipe Condition
4	006092STMP	001335SMH	000605IO	26	3	111.13	15.88	0.2	0	1.3	0.3	-	-	0.0	0.0	0	0	Surcharged
4	006097STMP	004172IN	000077CB	348	1.5	8.13	13.87	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
4	006098STMP	000077CB	001336SMH	105	1.5	8.14	5.68	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
4	006099STMP	001336SMH	001337SMH	98	1.5	8.14	11.97	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
4	006100STMP	004174IN	001337SMH	26	1.5	18.25	9.97	0	0	0.3	-	-	-	0.0	0.0	0	0	Surcharged
4	006101STMP	000540ND	004174IN	25	1.5	18.23	10.13	0.2	0	0.3	-	-	-	0.0	0.0	0	0	Surcharged
4	006112STMP	001337SMH	001338SMH	131	2.5	67.4	15.17	0	0.1	4.9	4.9	-	-	0.0	0.0	0	0	Surcharged
4	006150STMP	004276IN	000282IO	130	1.5	15.22	9.2	0.1	0	2.9	-	0.8	-	0.0	0.0	0	0	Insufficient Freeboard
4	006158STMP	001362SMH	001363SMH	129	1.5	20.09	11.15	0.5	0	5.1	1.1	-	-	0.0	0.0	0	0	Surcharged
4	006160STMP	001363SMH	001364SMH	119	5	331.96	31.39	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
4	006252STMP	001368SMH	001364SMH	147	2	28.05	16.57	0	0	-	0.7	-	-	0.0	0.0	0	0	Sufficient Capacity
4	006253STMP	001369SMH	001368SMH	104	1.5	28.05	15.76	0.1	0	1.9	-	-	-	0.0	0.0	0	0	Surcharged
4	006258STMP	001370SMH	001369SMH	218	1.5	28.51	18.45	0	0.1	-	1.4	-	-	0.0	0.0	0	0	Sufficient Capacity
4	006309STMP	004324IN	004325IN	177	1.25	16.42	13.13	0.5	0	Flooded	-	Flooded	-	0.2	0.0	650	0	Flooded
4	006314STMP	000555ND	000068CP	418	4	98.99	13.56	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
4	006443STMP	004659IN	004660IN	90	1.25	13.19	10.44	1.1	1	Flooded	Flooded	Flooded	Flooded	1.0	0.9	9143	9764	Flooded
4	006445STMP	004660IN	004688IN	71	1.25	15.88	12.5	1	1.3	Flooded	Flooded	Flooded	Flooded	0.9	0.2	9764	848	Flooded
4	006571STMP	001395SMH	004341IN	27	2	30.08	12.95	0.2	0.2	2.8	3.1	-	-	0.0	0.0	0	0	Surcharged
4	006573STMP	004341IN	004123IN	141	2	44.85	14.06	0.2	0.6	5.0	5.0	-	-	0.0	0.0	0	0	Surcharged
4	006575STMP	004123IN	000296IO	34	2	44.77	14.07	0.6	0	5.1	4.5	-	-	0.0	0.0	0	0	Surcharged
4	006578A	004124IN	000343ND	14	1.25	7.68	7.39	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
4	006578B	000343ND	001393SMH	106	1.25	7.34	8.68	0	0	-	1.7	-	-	0.0	0.0	0	0	Sufficient Capacity
4	006579STMP	001425SMH	004127IN	35	1.75	16.91	7.07	0	0	0.0	-	-	-	0.0	0.0	0	0	Surcharged
4	006580STMP	004126IN	001425SMH	114	1.75	16.89	8.11	0	0	-	0.0	-	-	0.0	0.0	0	0	Sufficient Capacity
4	006581STMP	004127IN	001426SMH	28	2	25.59	8.07	0	0	0.1	-	-	-	0.0	0.0	0	0	Surcharged
4	006619STMP	004353IN	003555SMH	16	2.5	24.52	5.4	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
4	006620STMP	001451SMH	001450SMH	142	1.5	14.69	17.19	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
4	006621STMP	001450SMH	002063ND	150	2	14.64	8.08	0	0.4	-	5.4	-	-	0.0	0.0	0	0	Sufficient Capacity
4	006622STMP	004914SMH	001451SMH	282	1.5	14.69	12.48	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
4	006627STMP	004346IN	004350IN	193	1.5	19.91	16.48	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
4	006628STMP	004350IN	004351IN	37	1.5	19.93	19.44	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
4	006718STMP	004688IN	004690IN	277	1.5	27.42	14.65	1.3	0	Flooded	0.0	Flooded	-	0.2	0.0	848	0	Flooded
4	006719STMP	004689IN	004688IN	307	4	45.96	4.53	1.1	1.3	11.0	Flooded	1.3	Flooded	0.0	0.2	0	848	Insufficient Freeboard
4	006722STMP	004325IN	004690IN	36	3	16.42	12.65	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
4	006723STMP	004690IN	001500SMH	120	3	43.56	12.31	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
4	006727STMP	001500SMH	001505SMH	133	3	43.56	12.32	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
4	006734STMP	001505SMH	001507SMH	186	4	43.56	13.5	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
4	006738STMP	001507SMH	000588ND	213	4	62.12	17.22	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
4	007534STMP	005074IN	005073IN	53	3	87.83	18.38	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
4	007535STMP	000675ND	001767SMH	176	3	96.76	21.33	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
4	007537STMP	002921ND	001768SMH	49	3	113.22	22.17	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
4	007539STMP	001764SMH	005082IN	51	3	141.42	19.97	0	0	1.1	-	-	-	0.0	0.0	0	0	Surcharged
4	007540STMP	005082IN	005083IN	67	3	141.52	19.89	0	0	2.0	0.2	-	-	0.0	0.0	0	0	Surcharged
4	007549STMP	001770SMH	005084IN	83	2.5	33.15	16.1	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
4	007551STMP	005084IN	000348IO	13	2.5	-33.17	9.65	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
4	007553STMP	001771SMH	001449SMH	139	2	24.57	16.81	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
4	007555STMP	005087IN	001771SMH	135	2	24.55	19.59	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
4	007558STMP	004344IN	005093IN	69	2	34.01	15.99	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
4	007563STMP	005092IN	005093IN	185	2.5	13.84	8.79	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity

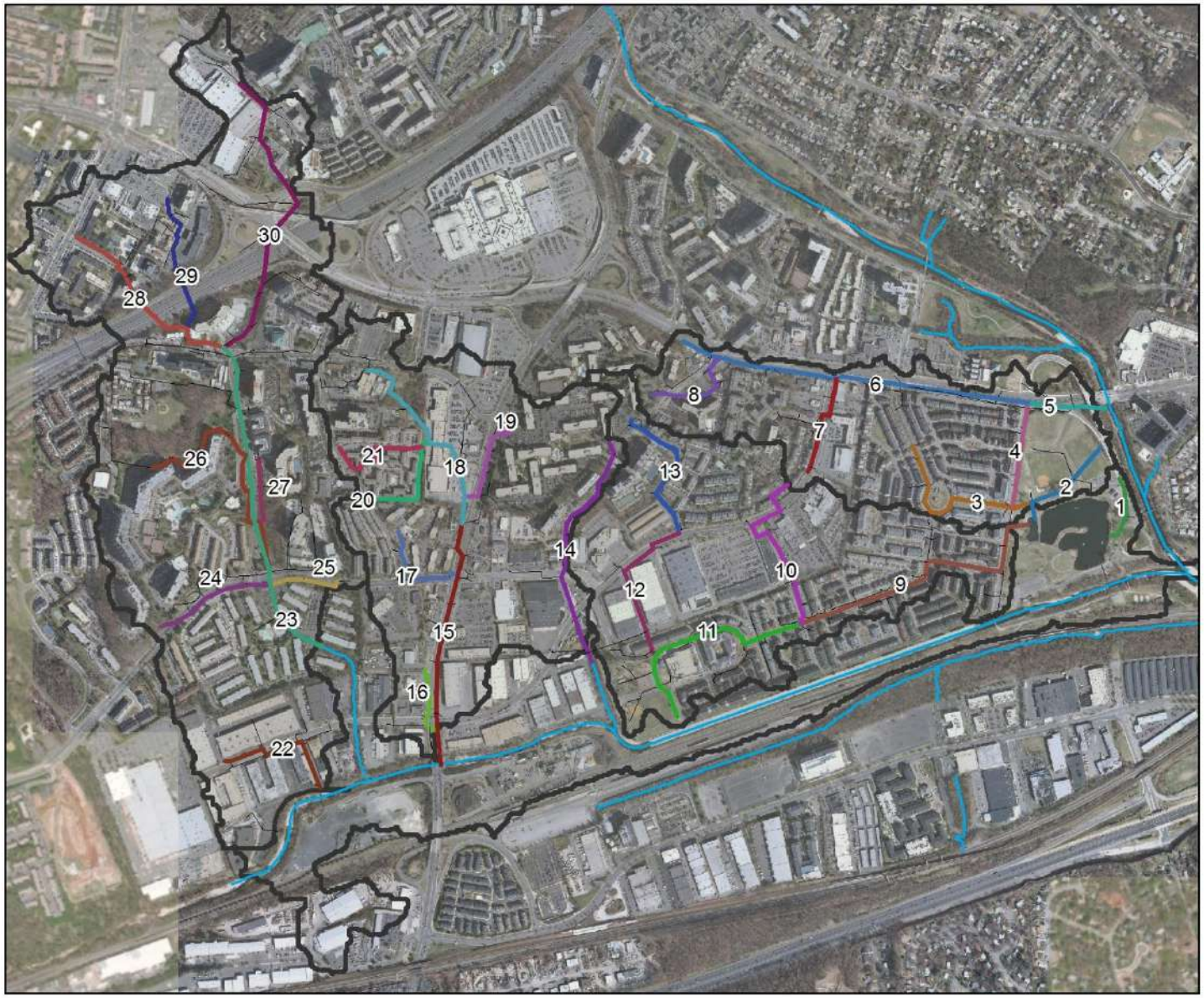
TABLE 1

Backlick Run Detailed Hydraulic Model Results

Subshed	DGravityMain FacilityID	Junction FaciltiyID		Length (ft)	Diameter/ Height x Width (ft)	Maximum Flow (ft3/s)	Maximum Velocity (fps)	Duration of Surcharge (hrs)		Surcharge/ Depth Above Crown (ft)		Insufficient Freeboard/ Depth Below Rim (ft)		Duration of Flooding (hrs)		Flooded Volume (ft3)		Summary Pipe Condition
		US	DS					US	DS	US	DS	US	DS	US	DS	US	DS	
4	007564STMP	002064ND	005092IN	79	2.5	13.87	10.46	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
4	007565STMP	005093IN	001773SMH	191	2	47.68	22.66	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
4	007567STMP	001773SMH	001774SMH	204	2	54.72	20.62	0	0.2	-	2.1	-	-	0.0	0.0	0	0	Sufficient Capacity
4	007569STMP	001774SMH	002063ND	177	2.5	54.63	11.06	0.2	0.4	2.3	4.9	-	-	0.0	0.0	0	0	Surcharged
4	007570STMP	001768SMH	001764SMH	276	3	112.01	22.06	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
4	007571STMP	005083IN	003555SMH	444	4	174.09	16.58	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
4	007584STMP	005106IN	005107IN	226	2.5	67.35	13.54	0.1	0.2	5.3	3.7	-	-	0.0	0.0	0	0	Surcharged
4	007585STMP	001338SMH	005106IN	147	2.5	67.32	15.12	0.1	0.1	4.9	5.3	-	-	0.0	0.0	0	0	Surcharged
4	007586STMP	005107IN	001778SMH	123	2.5	87.16	17.6	0.2	0	3.7	1.4	-	-	0.0	0.0	0	0	Surcharged
4	007588STMP	001778SMH	001779SMH	125	2.5	87.25	18	0	0	1.4	-	-	-	0.0	0.0	0	0	Surcharged
4	007590STMP	001779SMH	005074IN	150	3	87.45	17.87	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
4	007594A	001364SMH	004305IN	116	8	383.68	25.14	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
4	007594B	004305IN	003549SMH	186	8	391.03	25.15	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
4	007597A	001452SMH	002063ND	44	5 x 7	-723	10.3	0	0.4	2.8	2.4	-	-	0.0	0.0	0	0	Surcharged
4	007597B	002063ND	001783SMH	278	5 x 7	-791.03	11.36	0.4	0	2.4	-	-	-	0.0	0.0	0	0	Surcharged
4	007598STMP	001783SMH	003554SMH	231	6 x 7	833.15	27.49	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
4	013339STMP	003561SMH	003560SMH	9	1.5	25.96	14.59	0.2	0	1.8	-	-	-	0.0	0.0	0	0	Surcharged
4	013340STMP	003562SMH	003561SMH	245	2	25.95	9.75	0	0.2	-	1.2	-	-	0.0	0.0	0	0	Sufficient Capacity
4	013342STMP	000645CB	003562SMH	87	3	26.25	9.43	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
4	013353STMP	003549SMH	003560SMH	465	8	425.73	25.81	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
4	013354STMP	003560SMH	003552SMH	391	8	455.09	25.51	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
4	013355STMP	003552SMH	003551SMH	221	8	455.44	21.1	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
4	013356STMP	003551SMH	003555SMH	508	5 x 7	454.93	19.55	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
4	014663STMP	003554SMH	000609IO	231	6 x 7	853.5	12.02	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
4	014669STMP	003555SMH	001452SMH	72	5 x 7	722.19	20.7	0	0	-	2.8	-	-	0.0	0.0	0	0	Sufficient Capacity
4	014670STMP	000229CP	000228CP	340	3	100.28	15.82	0	0	1.3	-	-	-	0.0	0.0	0	0	Surcharged
4	014681STMP	005073IN	000675ND	87	3	88.05	20.77	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
4	014682STMP	002296ND	004351IN	642	2.5	43.74	18.52	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
4	014689STMP	002297ND	001783SMH	236	2	29.15	9.82	0	0	-	-	0.6	-	0.0	0.0	0	0	Sufficient Capacity
4	014690STMP	001772SMH	002064ND	81	2	13.85	10.43	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
4	014694STMP	002058ND	001361SMH	38	2.5	9.73	7.05	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
4	014993A	000535ND	002919ND	375	1.75	28.59	23.04	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
4	014993B	002919ND	003549SMH	33	1.75	35.97	19.17	0	0	-	1.1	-	-	0.0	0.0	0	0	Sufficient Capacity
4	014995STMP	009930IN	002919ND	115	1	7.41	10.2	0	0	-	0.2	0.6	-	0.0	0.0	0	0	Sufficient Capacity
4	014996STMP	000294CP	000296CP	333	2	36.05	12.33	0	0	5.8	-	-	-	0.0	0.0	0	0	Surcharged
4	014998STMP	000588ND	000555ND	380	4	82.43	15.43	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity
4	014999STMP	009933IN	009932IN	166	1.25	17.06	15.21	1.1	1.1	Flooded	1.6	Flooded	-	1.1	0.0	17652	0	Flooded
4	015000STMP	009932IN	000555ND	132	1.25	17.06	15.06	1.1	0	1.6	1.2	-	-	0.0	0.0	0	0	Surcharged
4	015002STMP	002920ND	005083IN	39	2.5	32.98	24.67	0	0	-	0.7	-	-	0.0	0.0	0	0	Sufficient Capacity
4	015003STMP	001767SMH	002921ND	57	3	97.13	20.98	0	0	-	-	-	-	0.0	0.0	0	0	Sufficient Capacity

TABLE 2
Backlick Run Outfall Boundary Conditions

Node ID	Location	Boundary Condition
000378ND	Backlick Run	Type2, Fixed Backwater
000162IO	Holmes Run	Type 1, Free Outfall
000215IO	Backlick Run	Type 1, Free Outfall
000216IO	Backlick Run	Type 1, Free Outfall
000609IO	Backlick Run	Type 1, Free Outfall
000580IO	Backlick Run	Type 1, Free Outfall
000044CP	Backlick Run	Type 1, Free Outfall



LEGEND

Profile

N/A	11	22
1	12	23
2	13	24
3	14	25
4	15	26
5	16	27
6	17	28
7	18	29
8	19	30
9	20	
10	21	

City of Alexandria Streams

Subwatersheds

Note: Subwatershed number provided in upper corner of each subwatershed

N

0 500 1,000 2,000

Feet

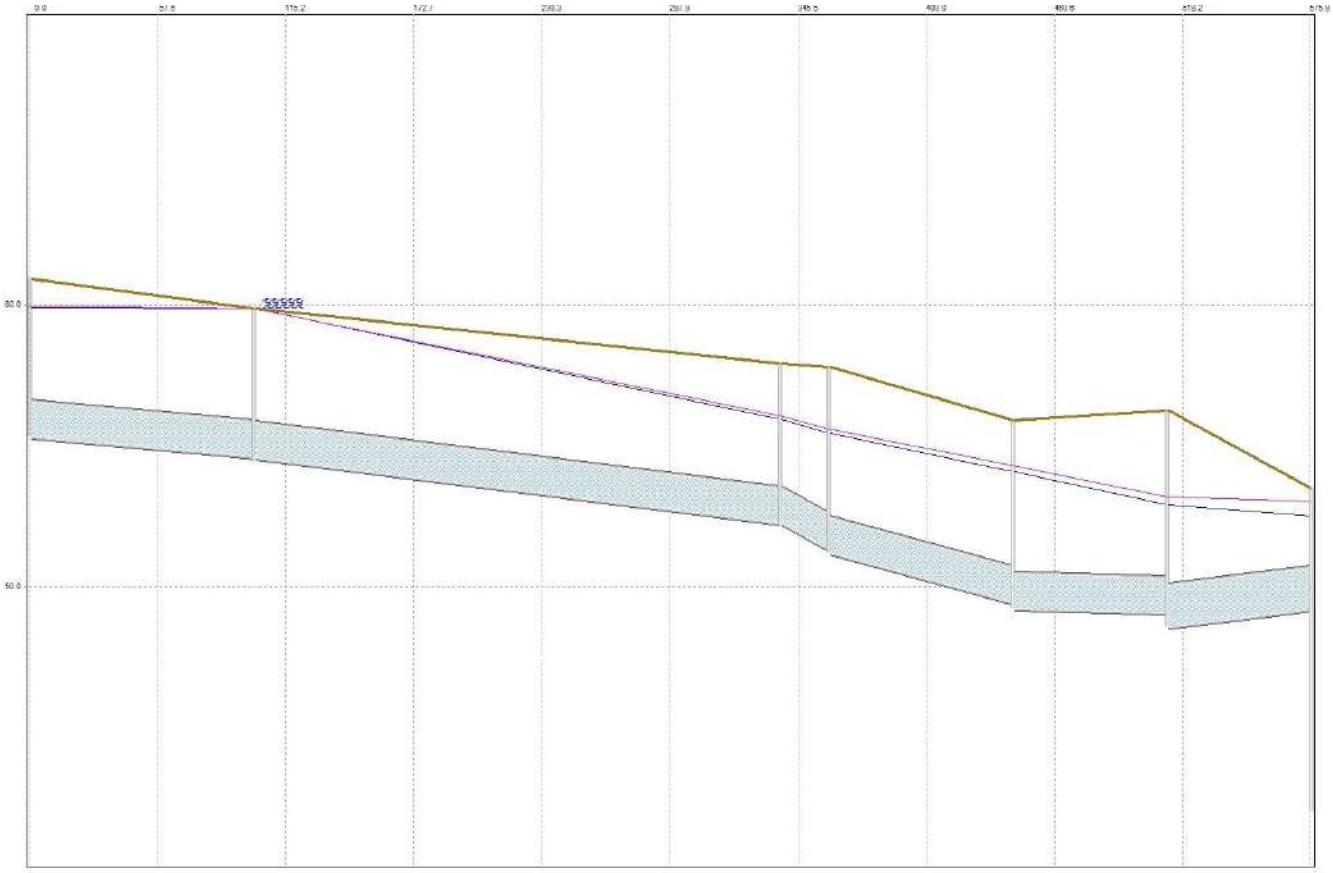
Backlick Run Profile Locations

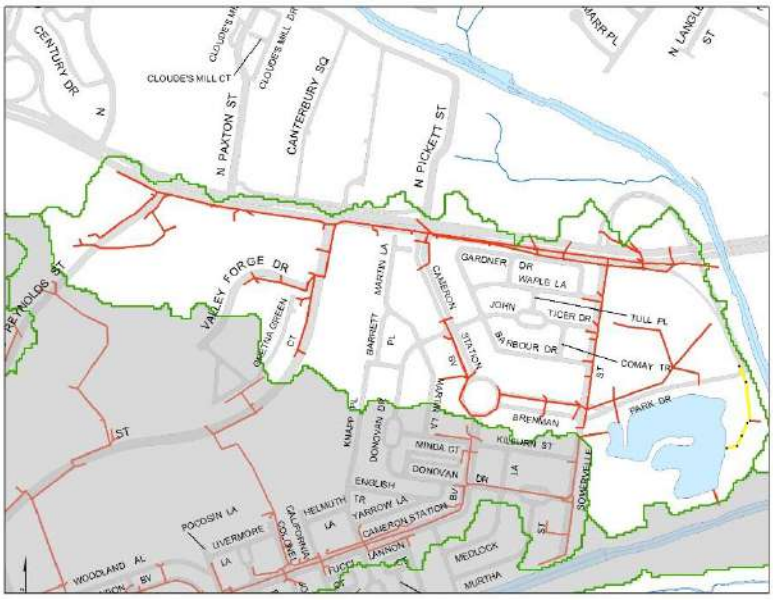
Stormwater Capacity Analysis for Backlick Run Watershed, Alexandria, Virginia

CH2MHILL

FIGURE 1

Backlick Run Profile 1 from 002128IN to 000154IO





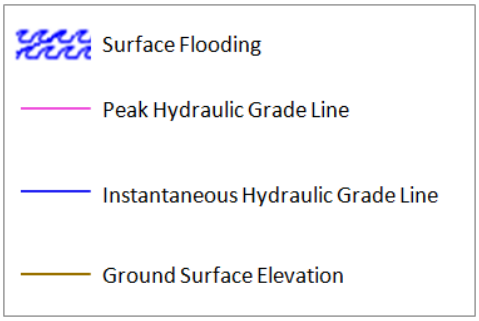
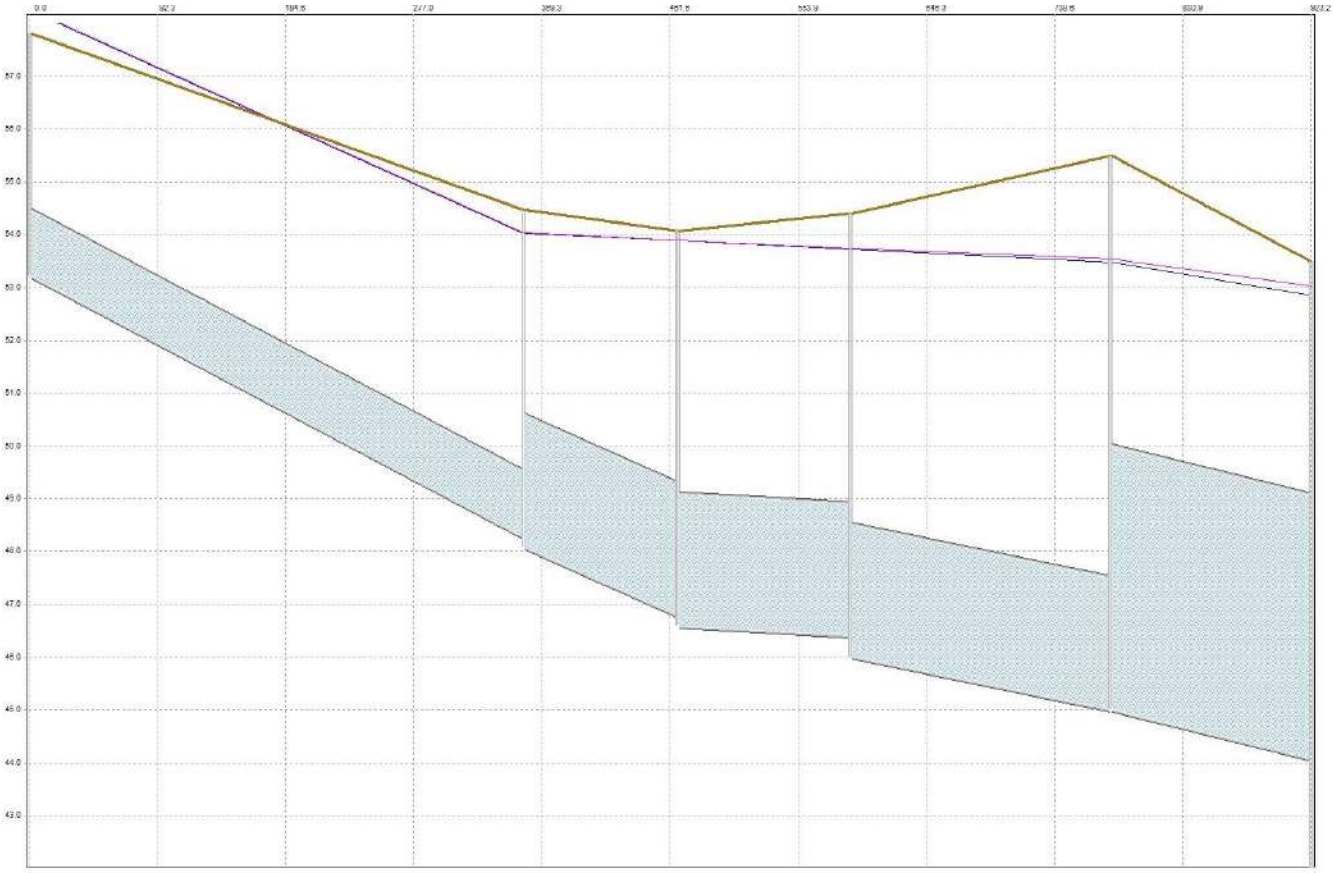
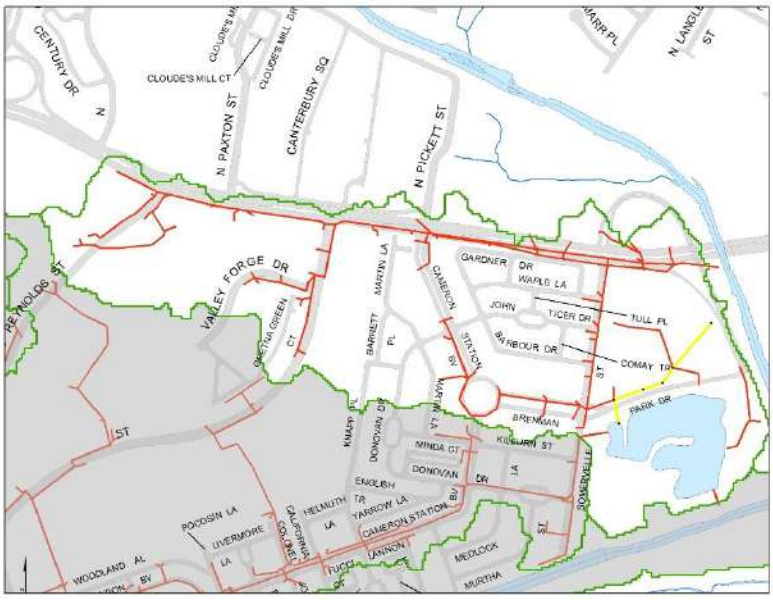


FIGURE 2

Backlick Run Profile 2 from 002188IN to 000158IO





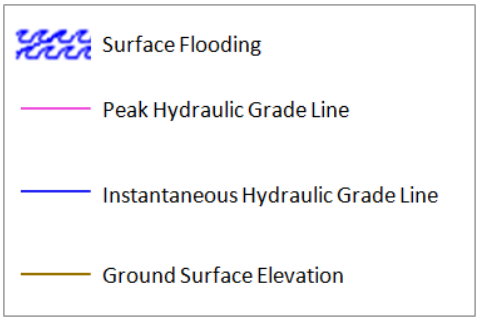
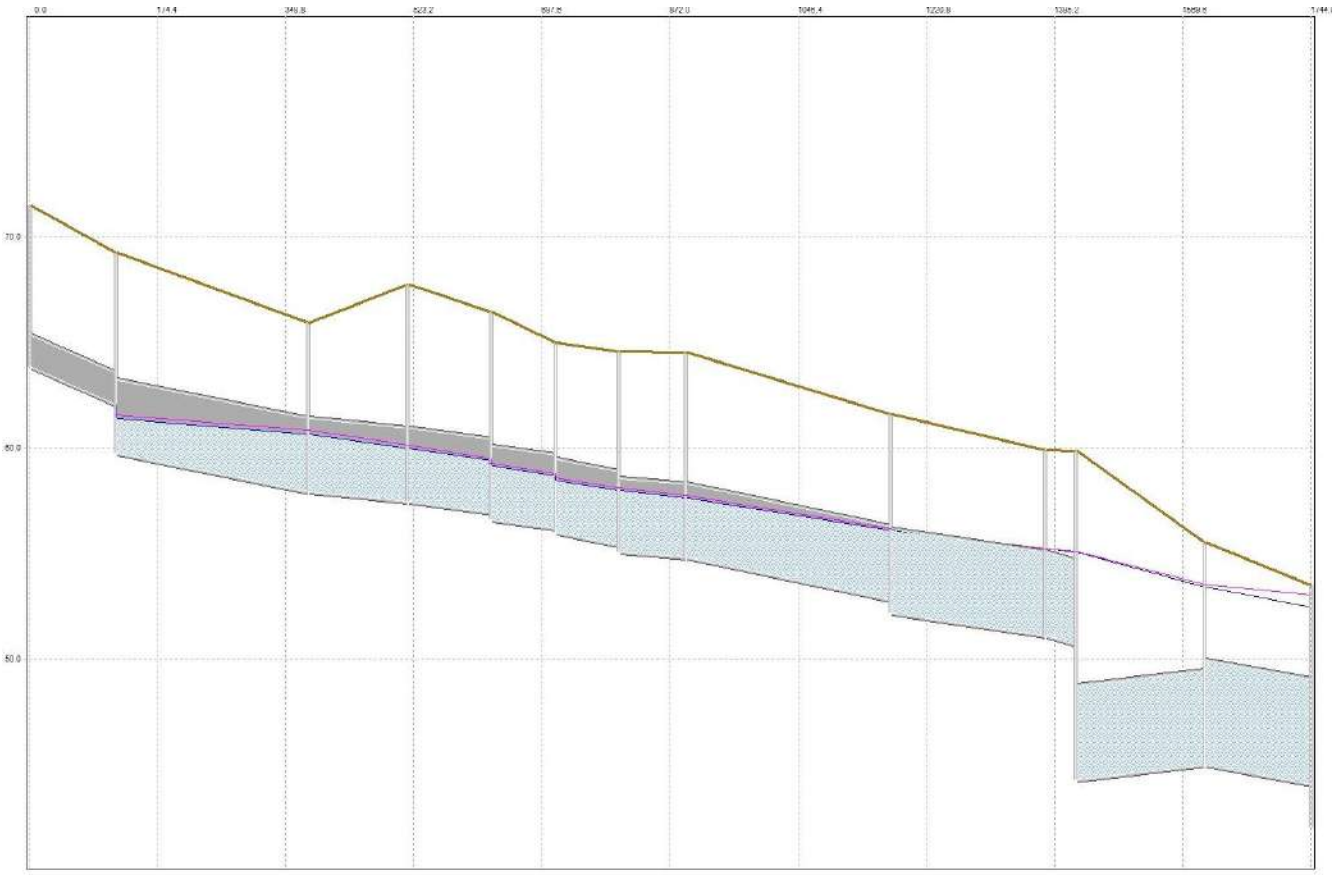
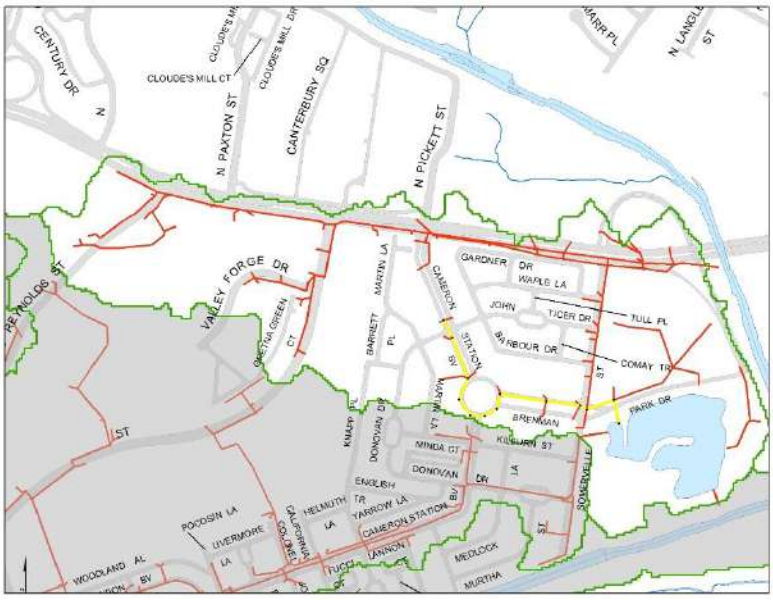


FIGURE 3

Backlick Run Profile 3 from 001284SMH to 000158IO





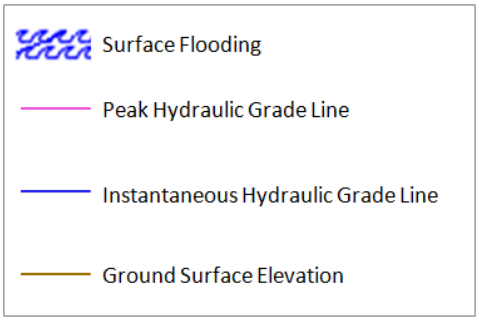
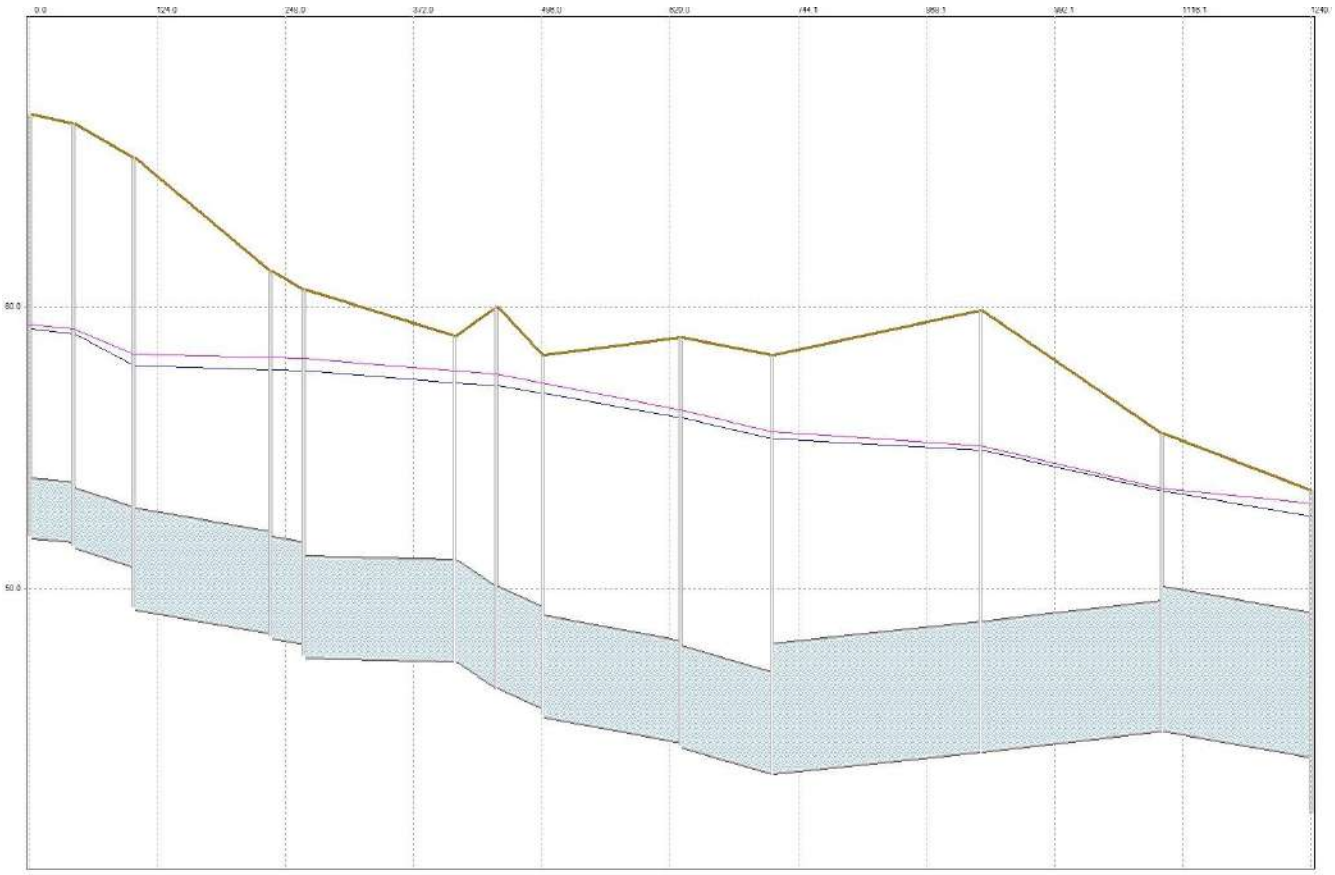
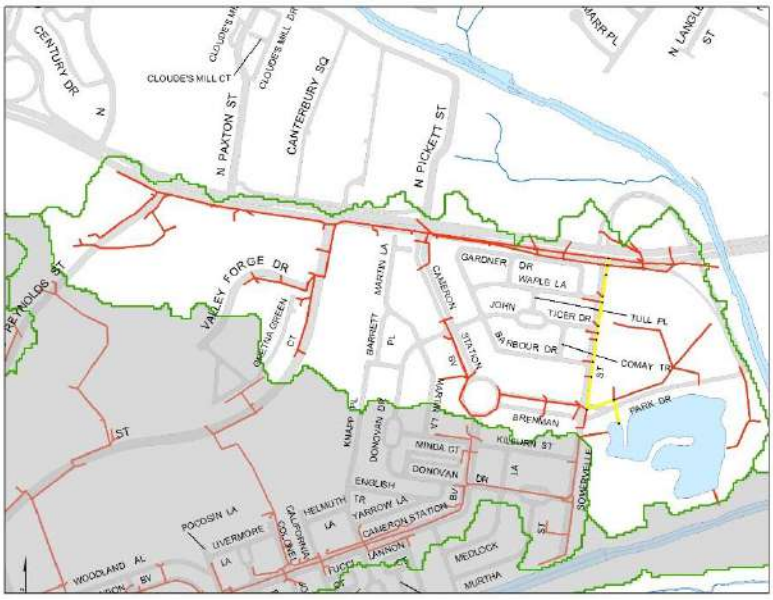


FIGURE 4

Backlick Run Profile 4 from 000683SMHto 000158IO





Surface Flooding

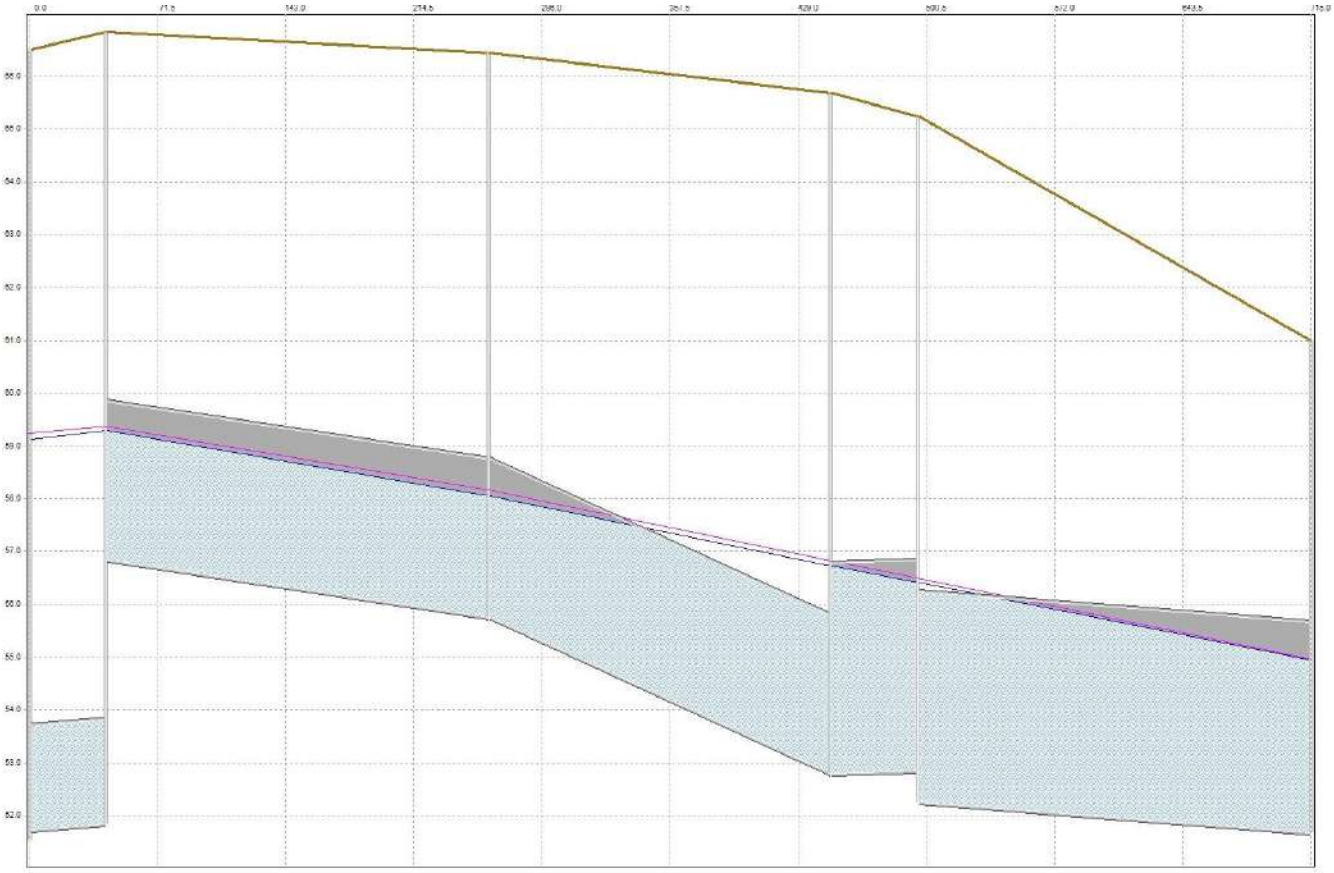
Peak Hydraulic Grade Line

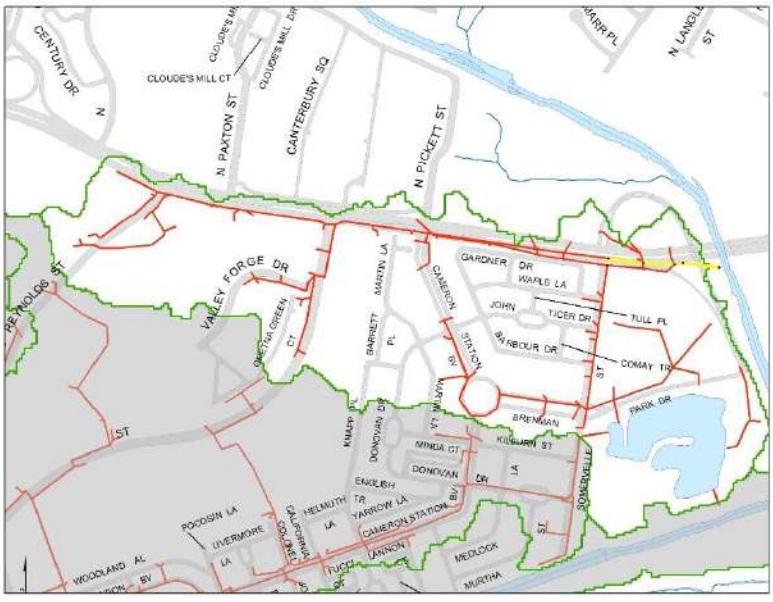
Instantaneous Hydraulic Grade Line

Ground Surface Elevation

FIGURE 5

Backlick Run Profile 5 from 000162IO to 000743SMH





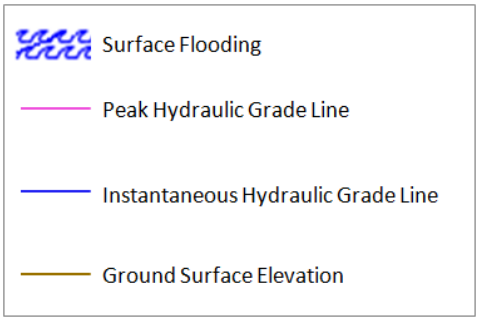
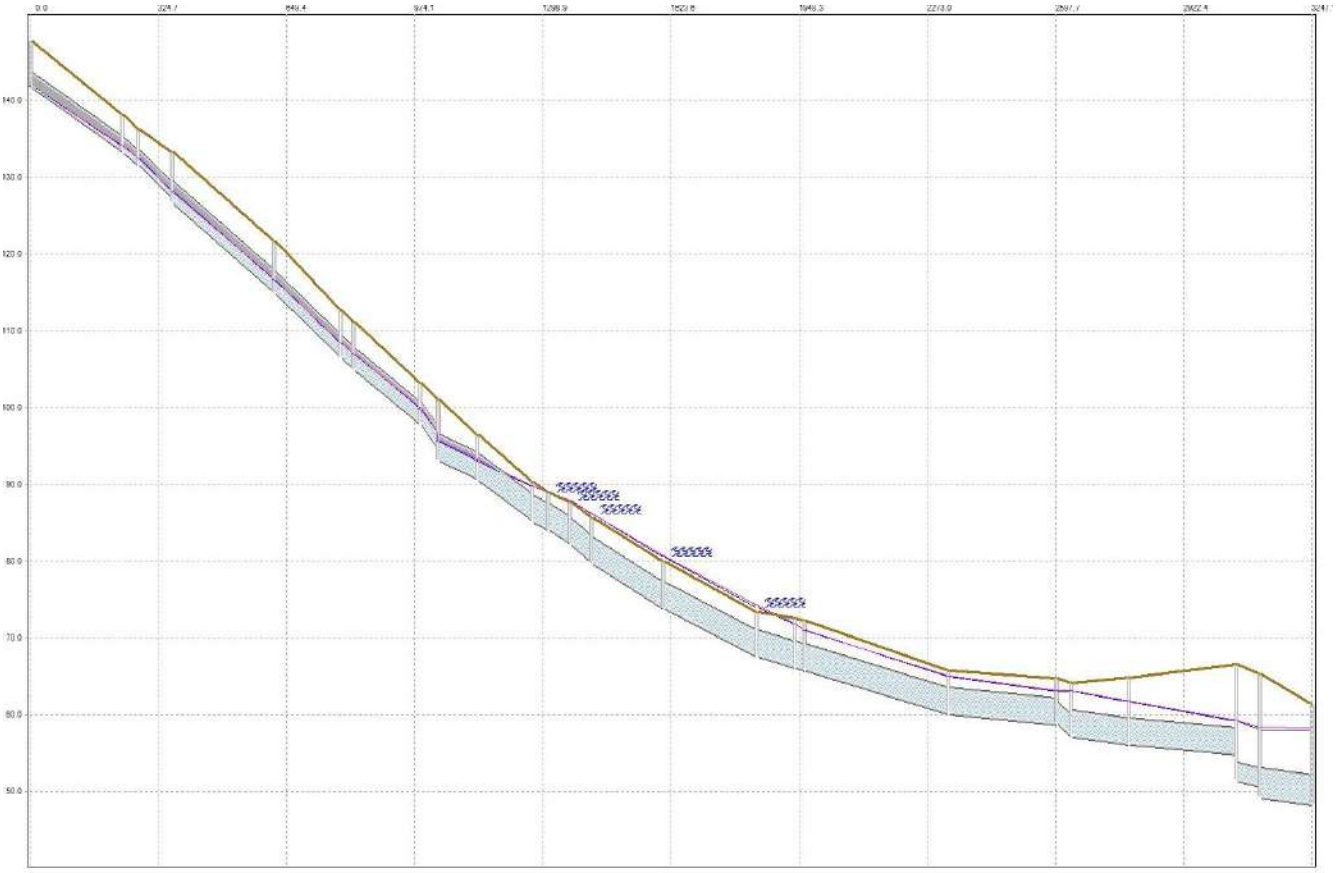
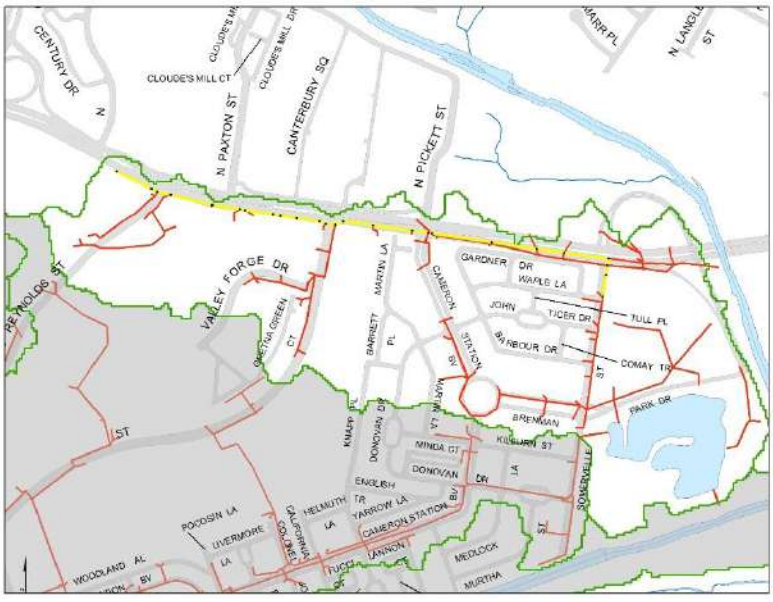


FIGURE 6

Backlick Run Profile 6 from 003847IN to 002175IN





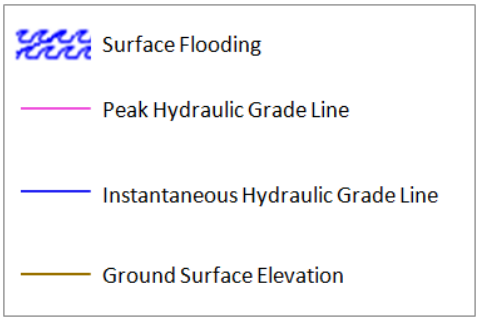
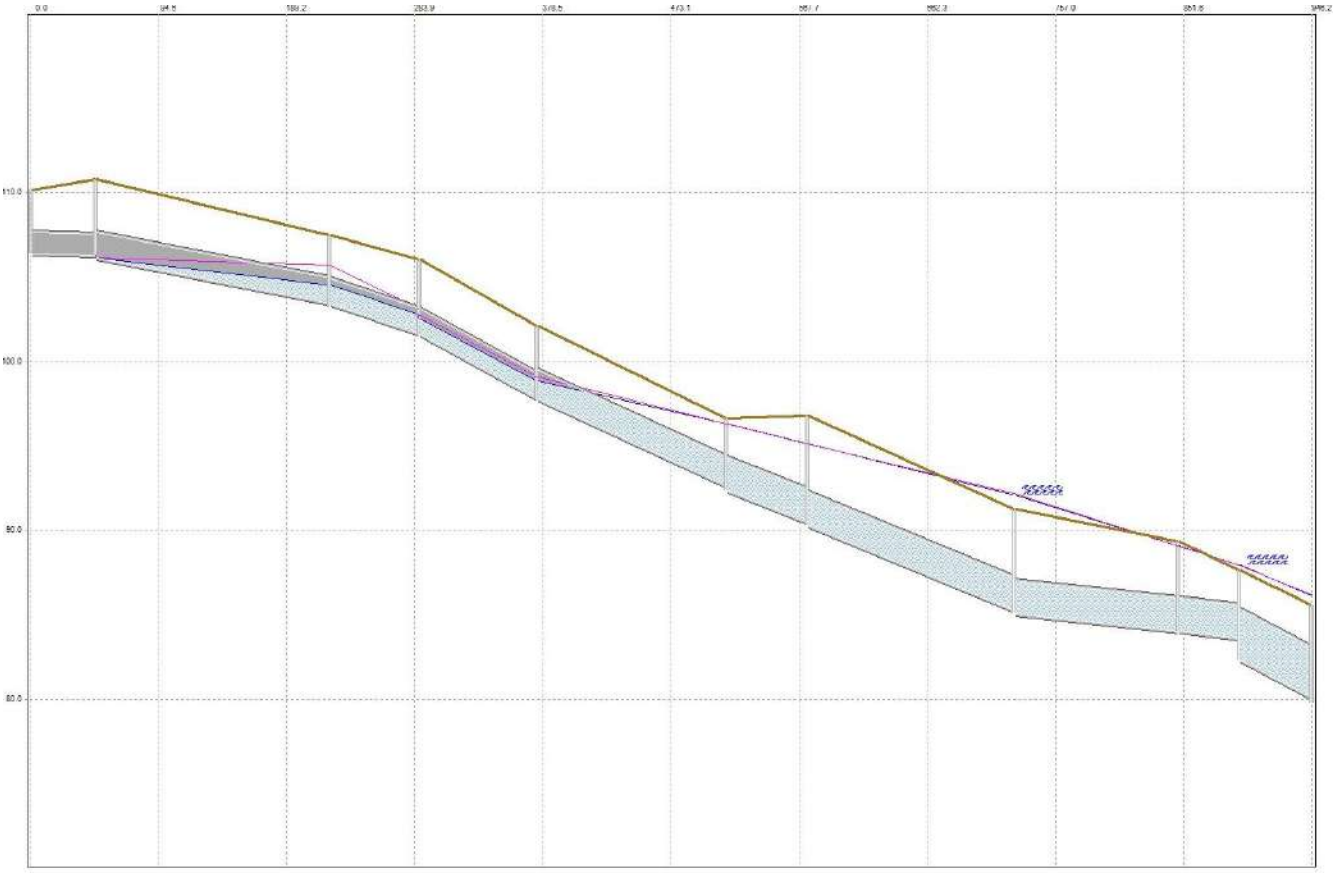
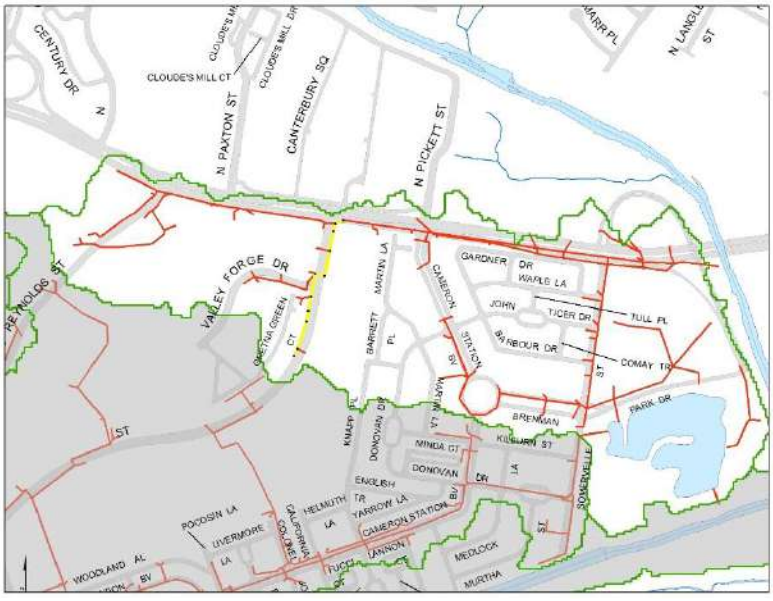


FIGURE 7

Backlick Run Profile 7 from 001309SMH to 001268SMH





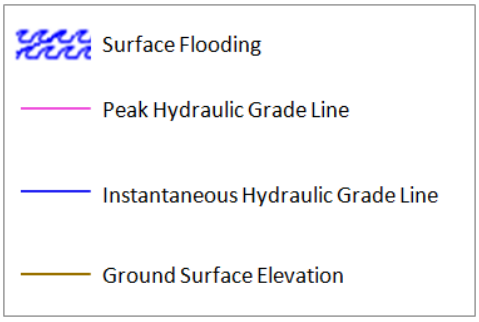
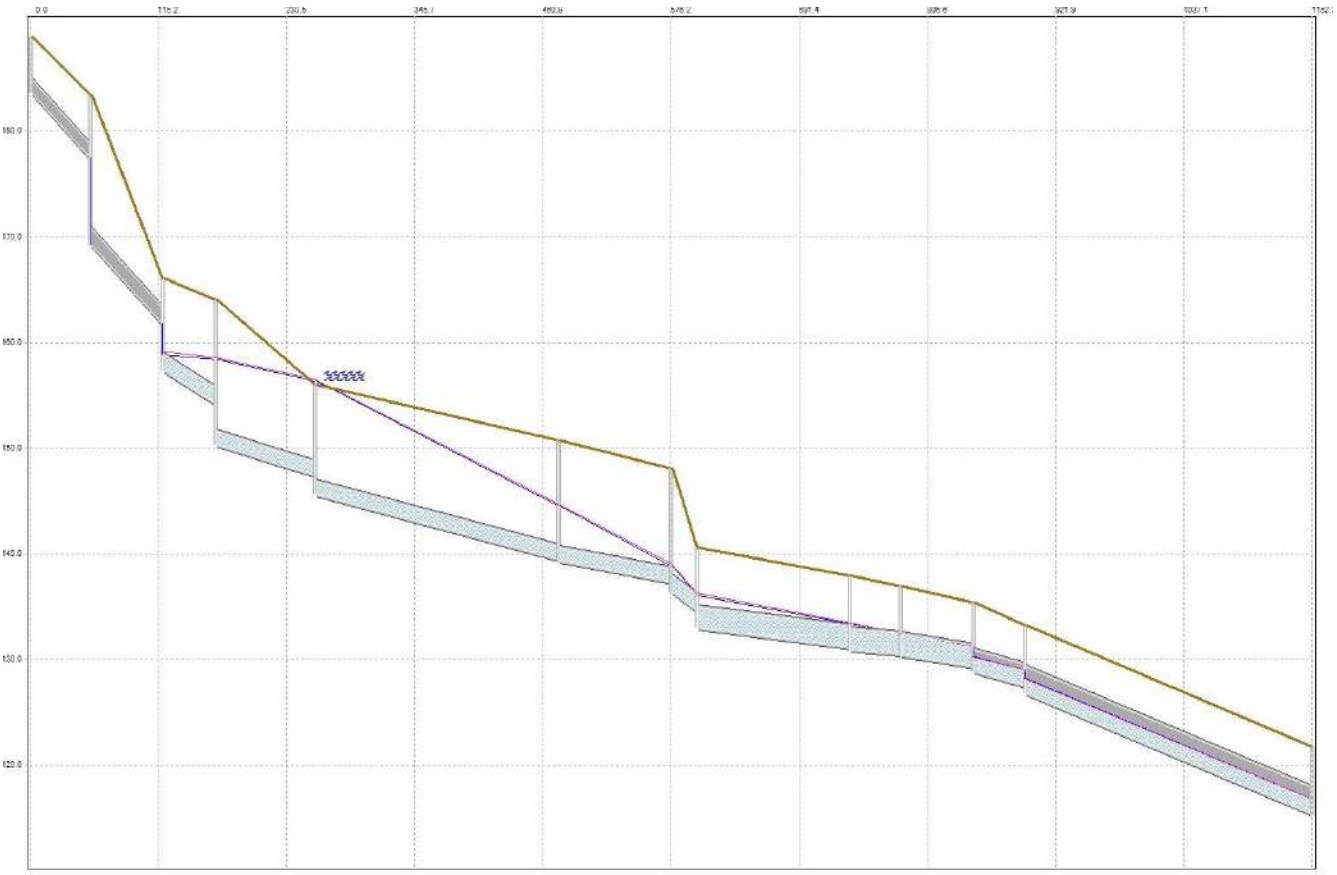
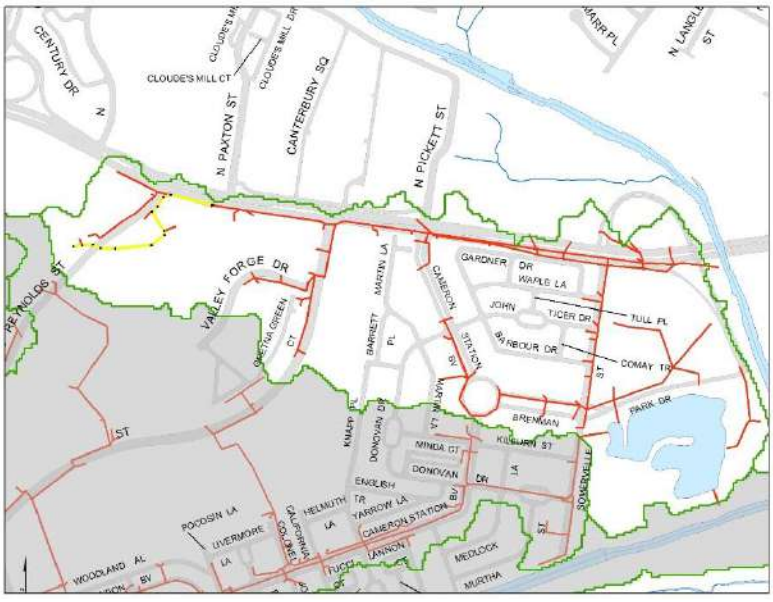


FIGURE 8

Backlick Run Profile 8 from 000518ND to 001274SMH





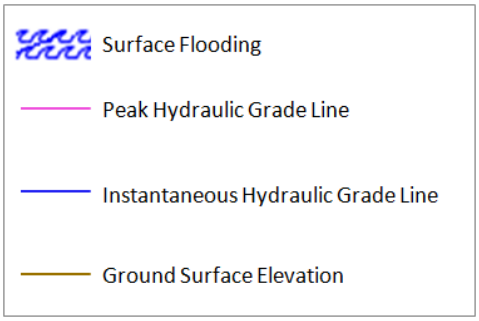
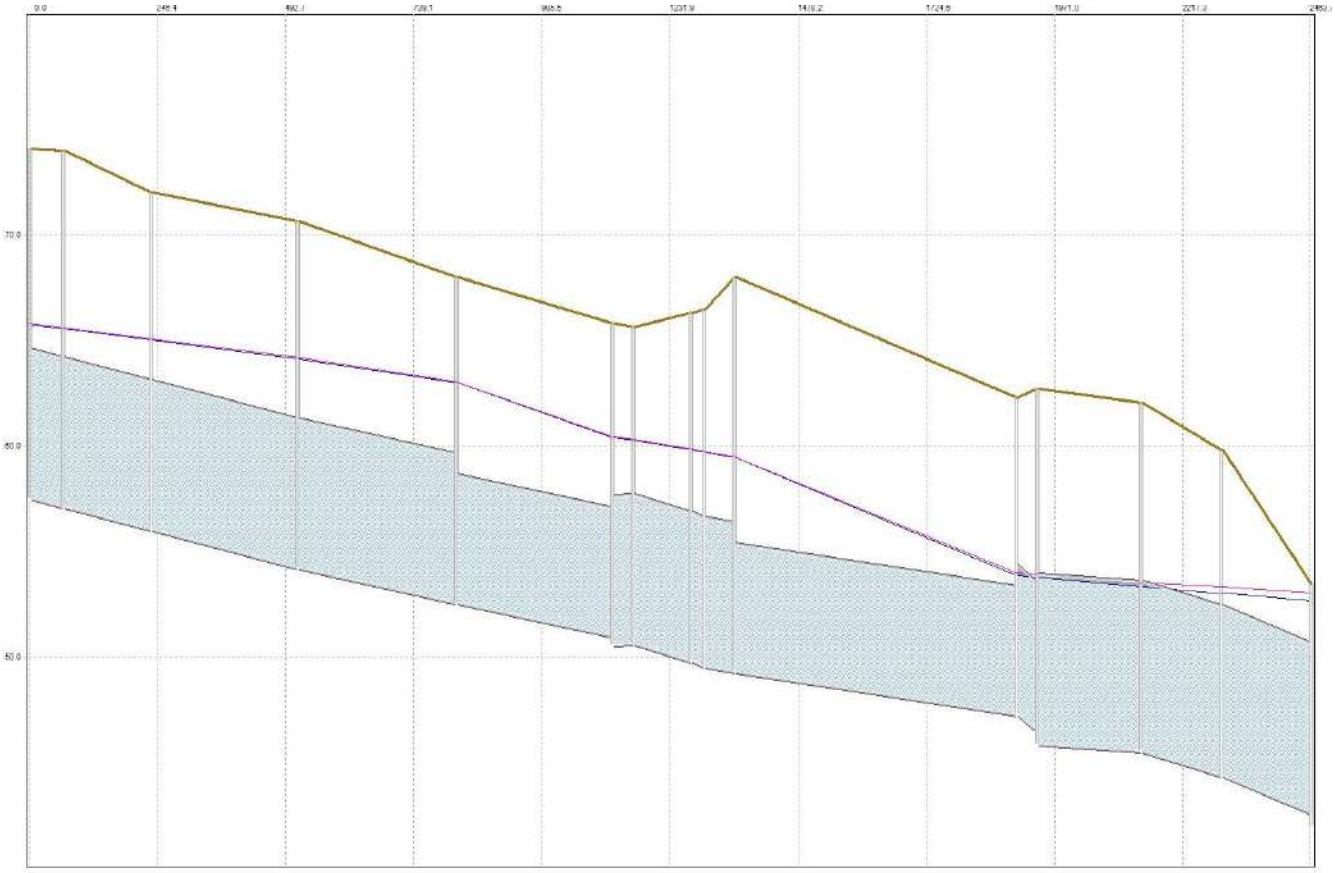
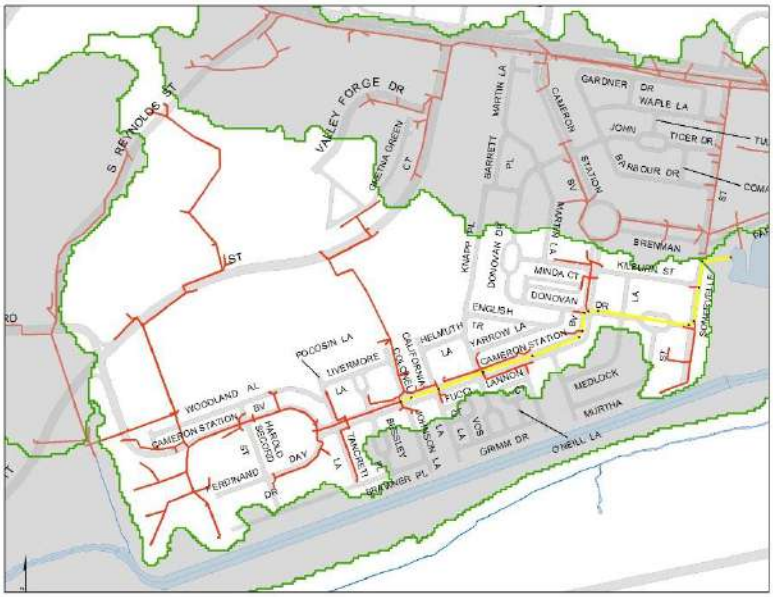


FIGURE 9

Backlick Run Profile 9 from 001299SMH to 000156IO

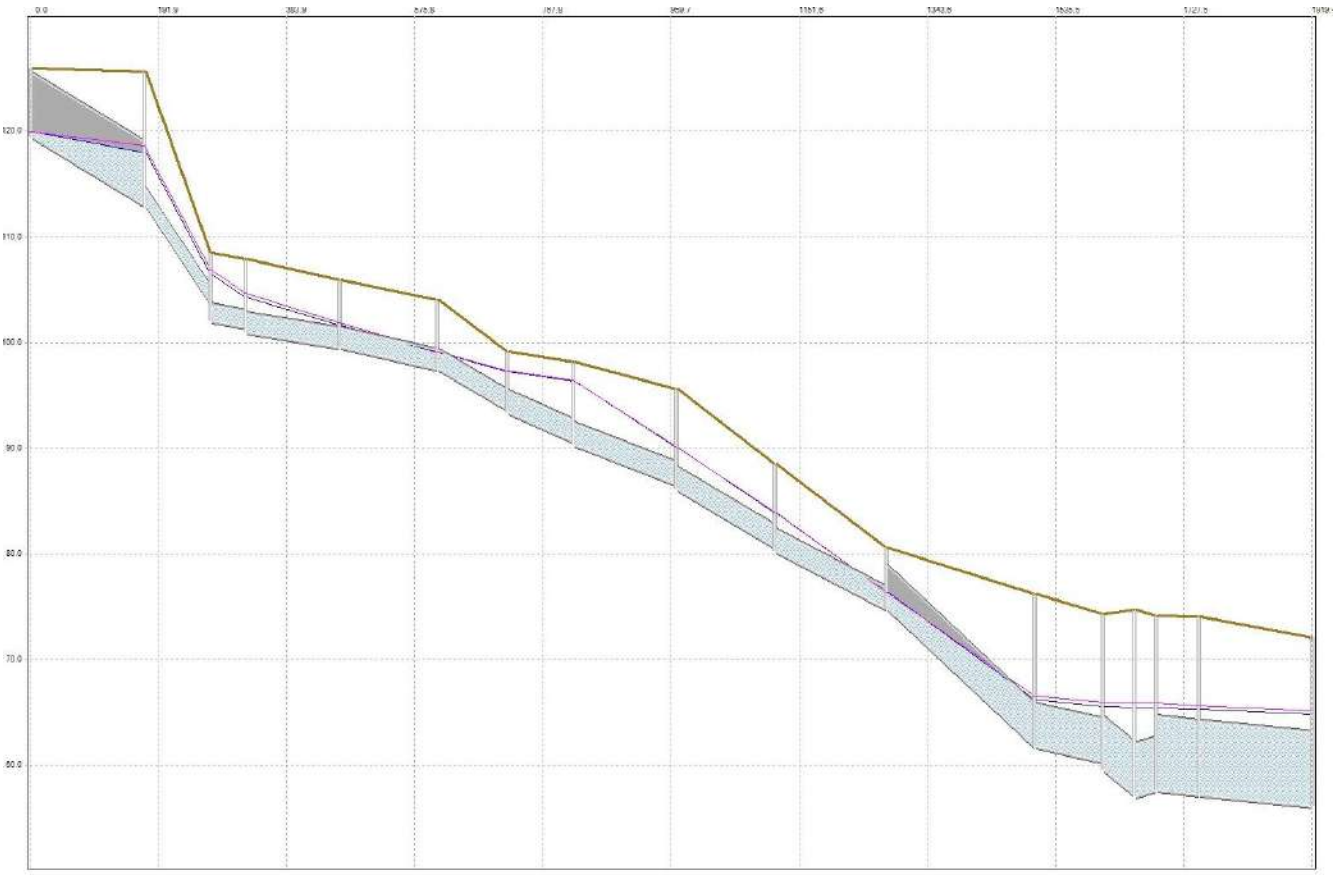


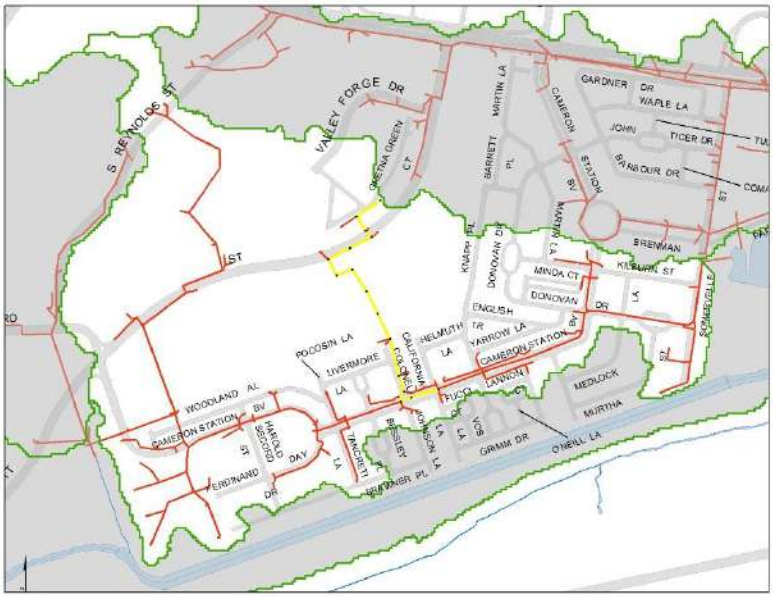


- Surface Flooding
- Peak Hydraulic Grade Line
- Instantaneous Hydraulic Grade Line
- Ground Surface Elevation

FIGURE 10

Backlick Run Profile 10 from 000506ND to 002301ND





Surface Flooding

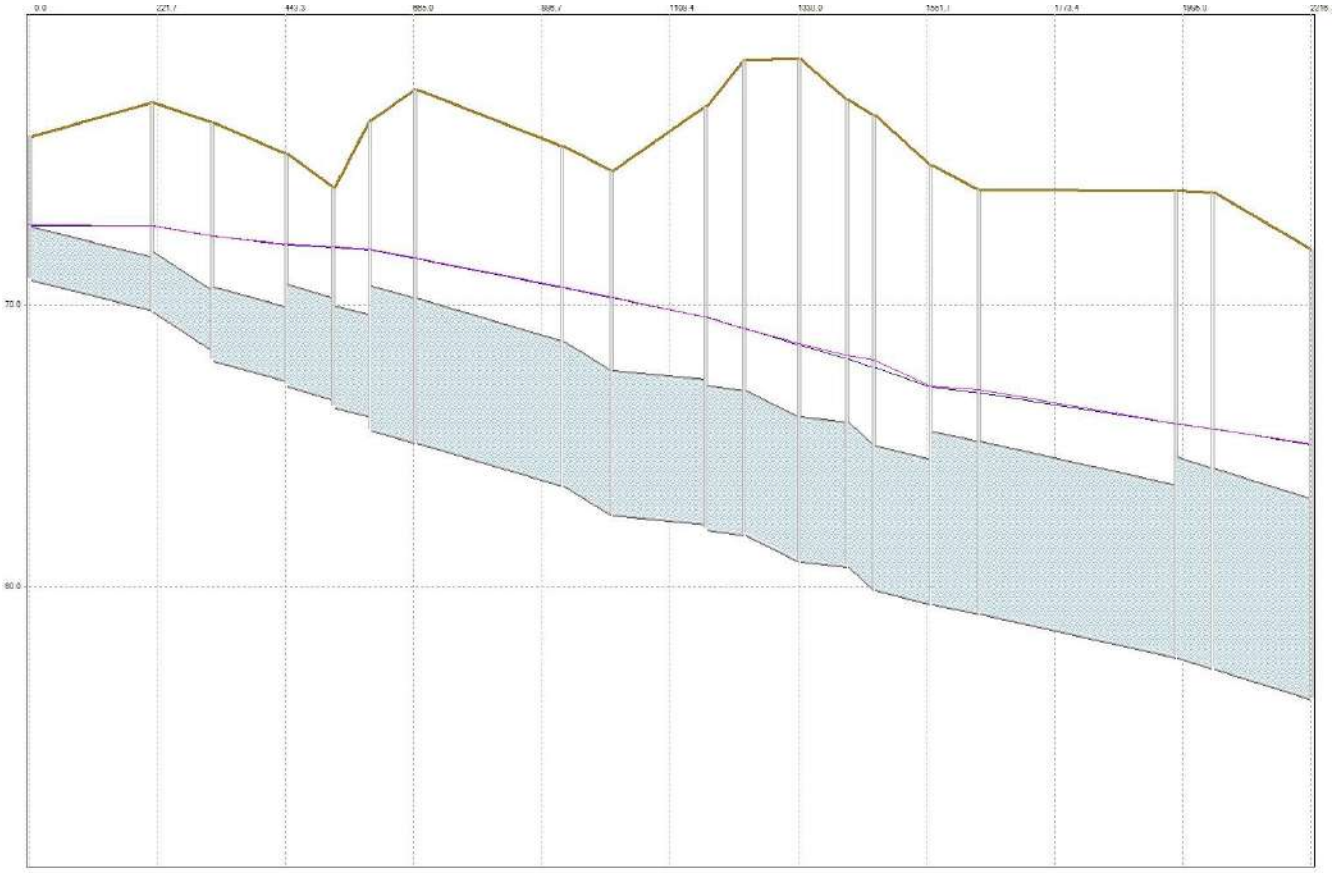
Peak Hydraulic Grade Line

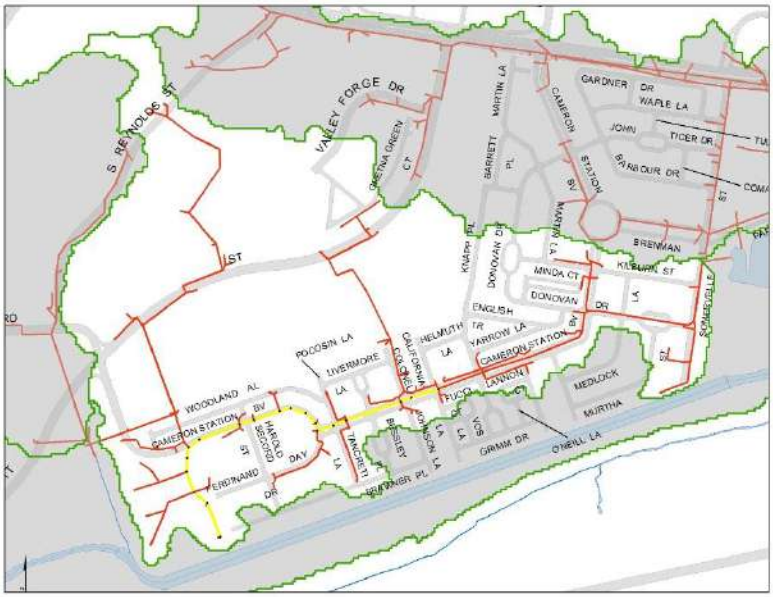
Instantaneous Hydraulic Grade Line

Ground Surface Elevation

FIGURE 11

Backlick Run Profile 11 from 003416IN to 002301ND





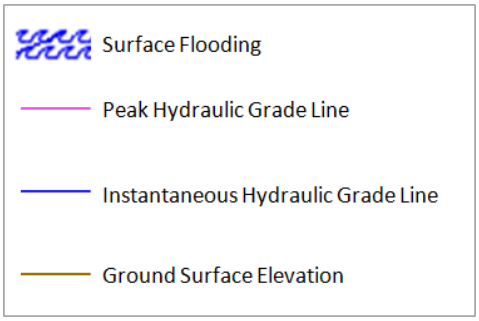
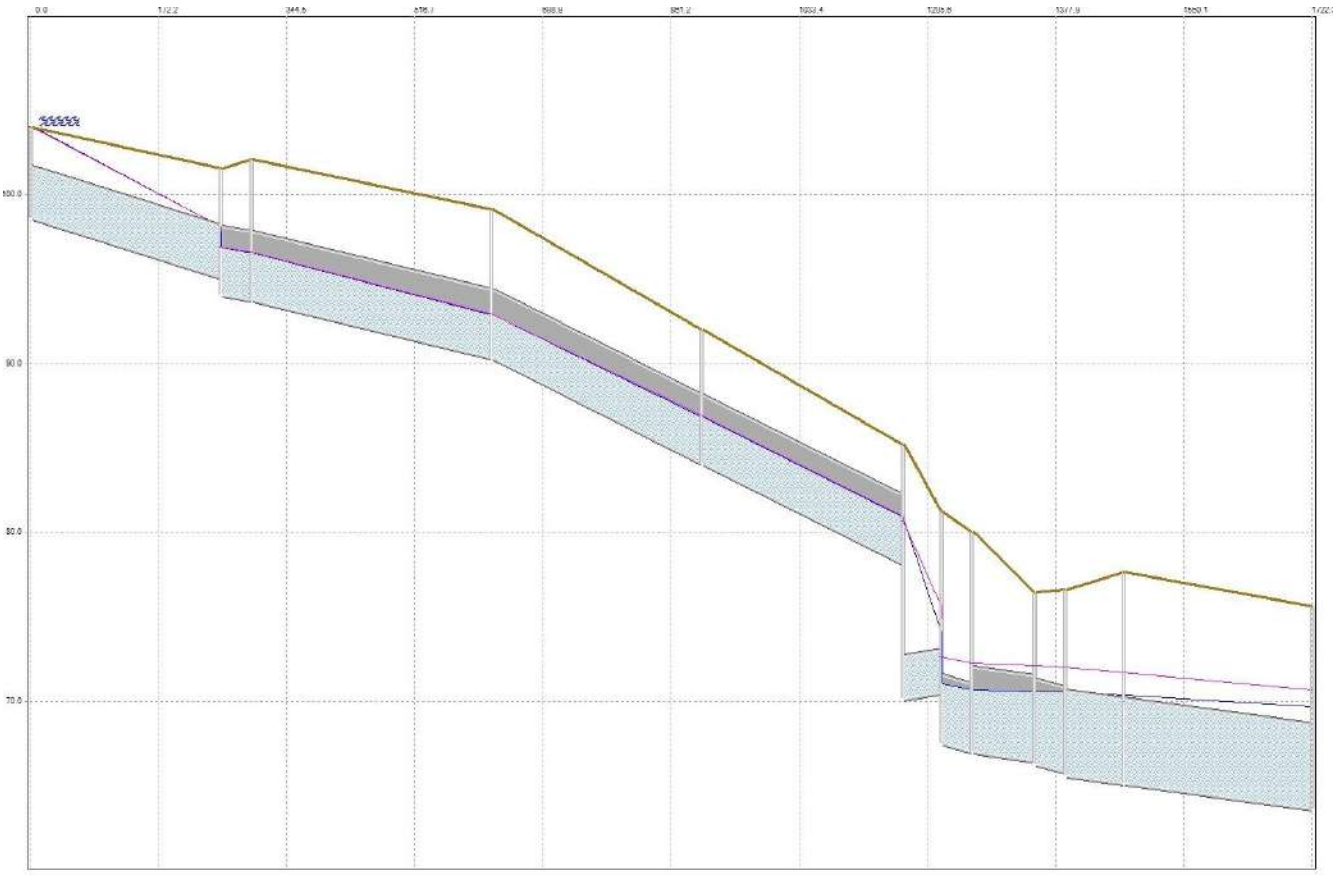
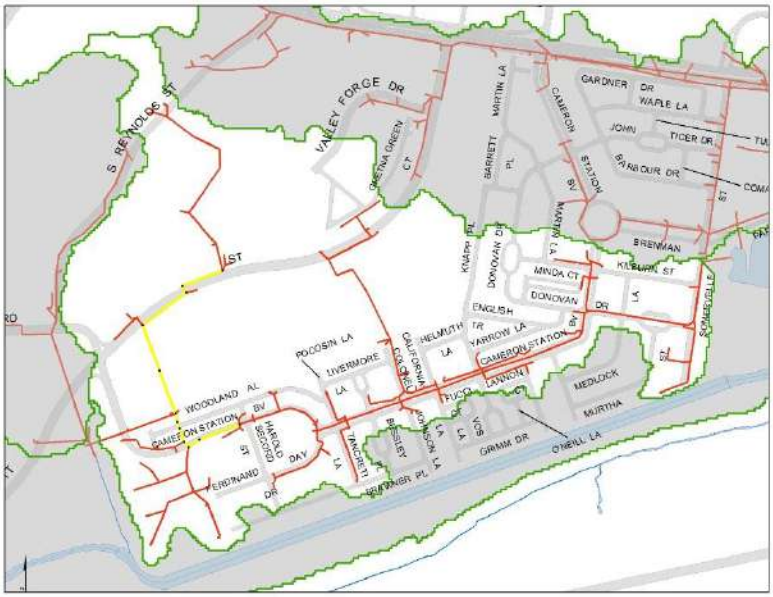


FIGURE 12

Backlick Run Profile 12 from 004049IN to 001128SMH





Surface Flooding

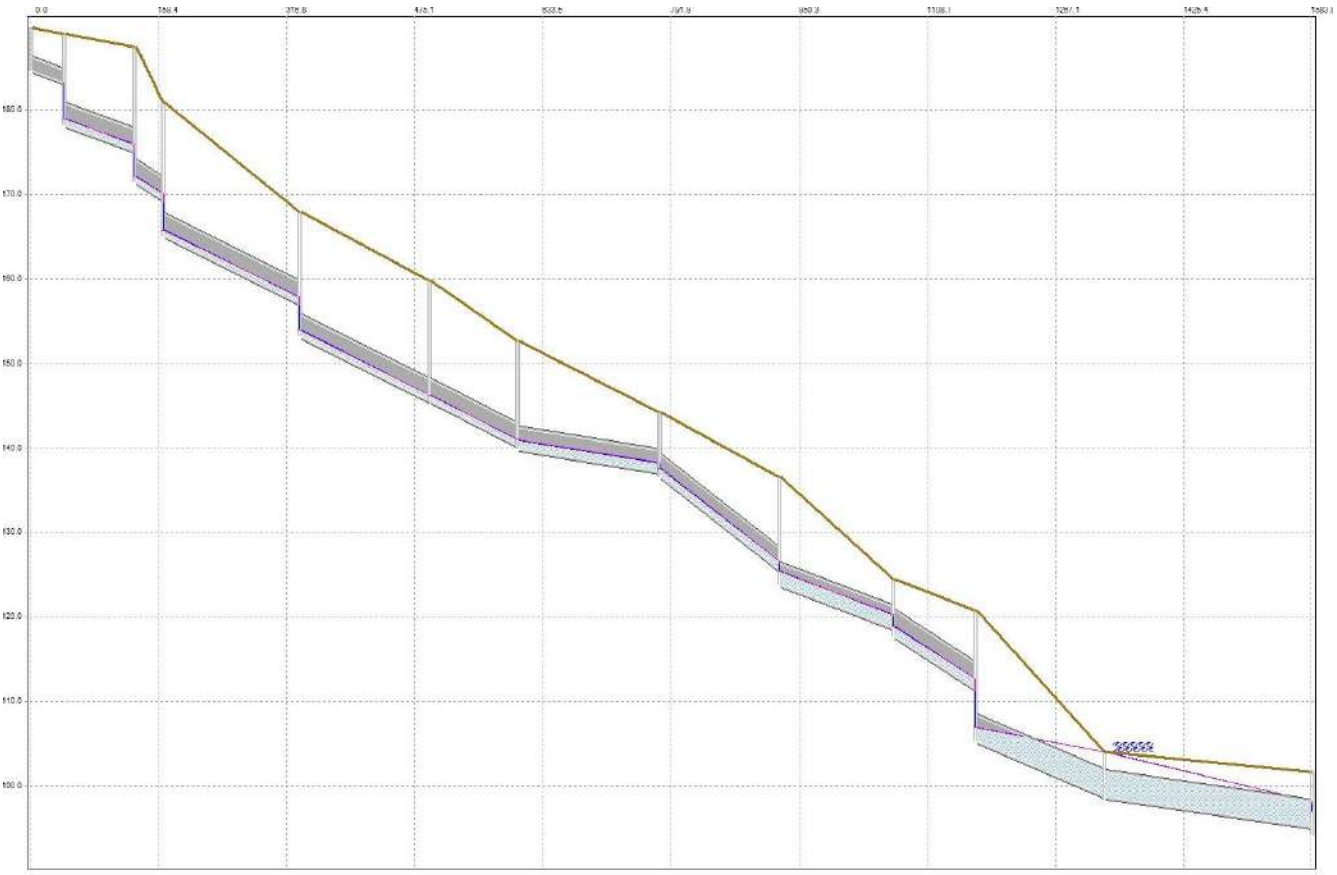
Peak Hydraulic Grade Line

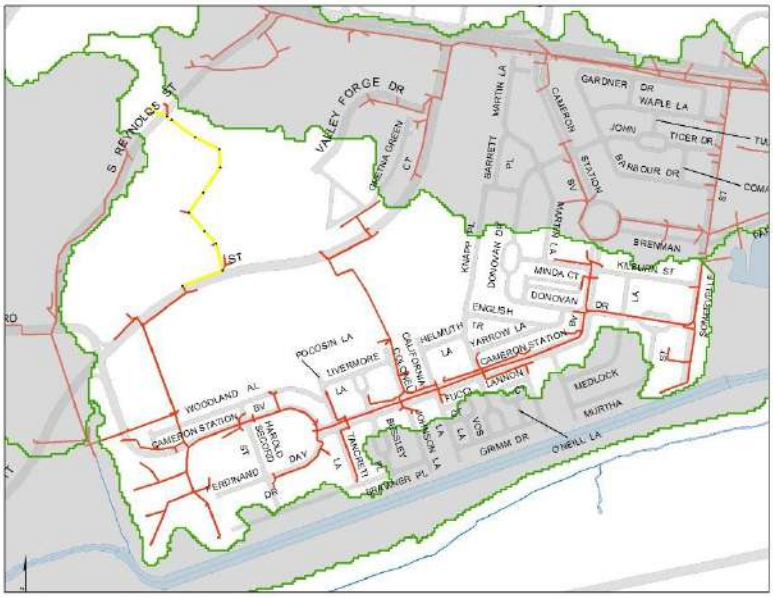
Instantaneous Hydraulic Grade Line

Ground Surface Elevation

FIGURE 13

Backlick Run Profile 13 from 000515ND to 004035IN





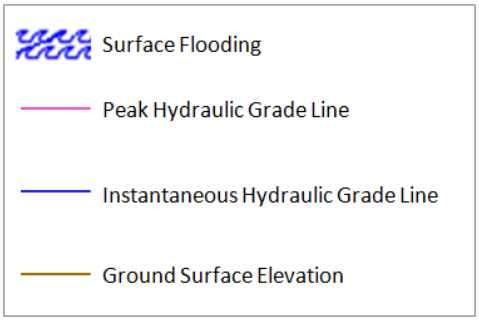
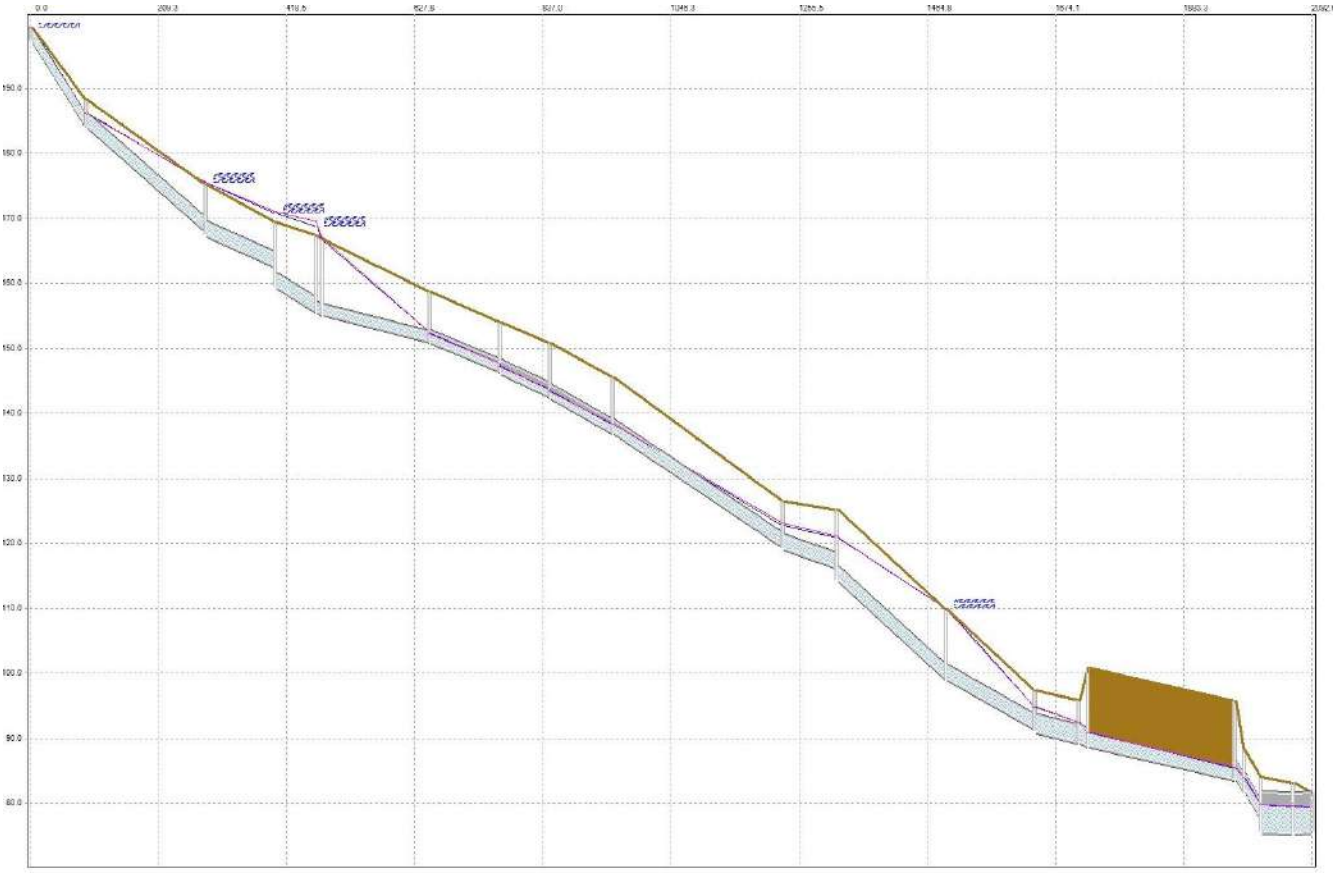
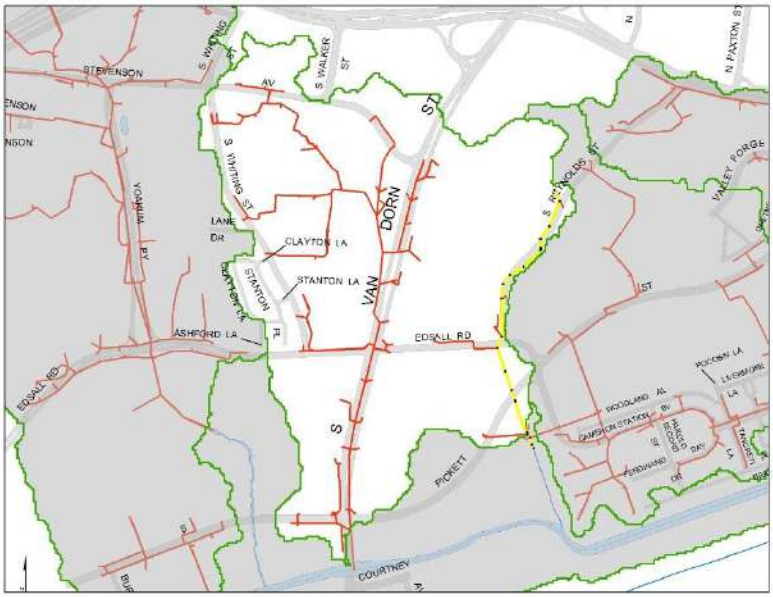


FIGURE 14

Backlick Run Profile 14 from 004103IN to 000215IO





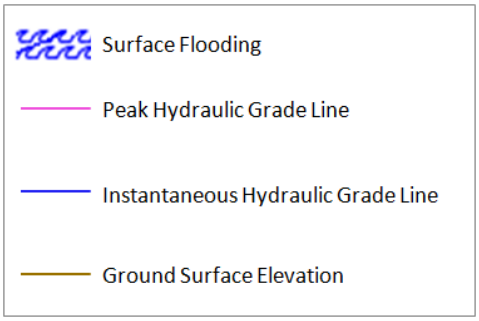
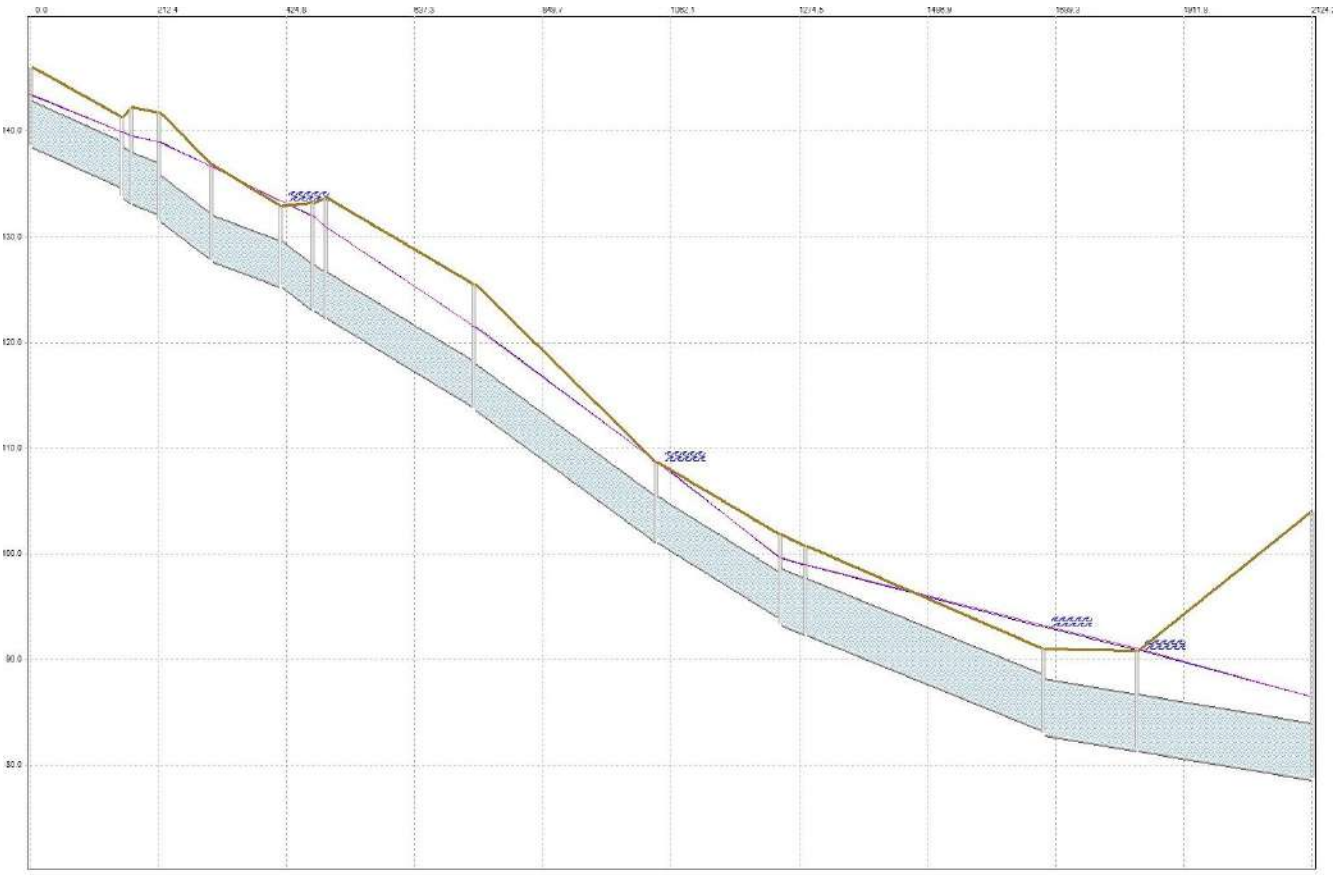
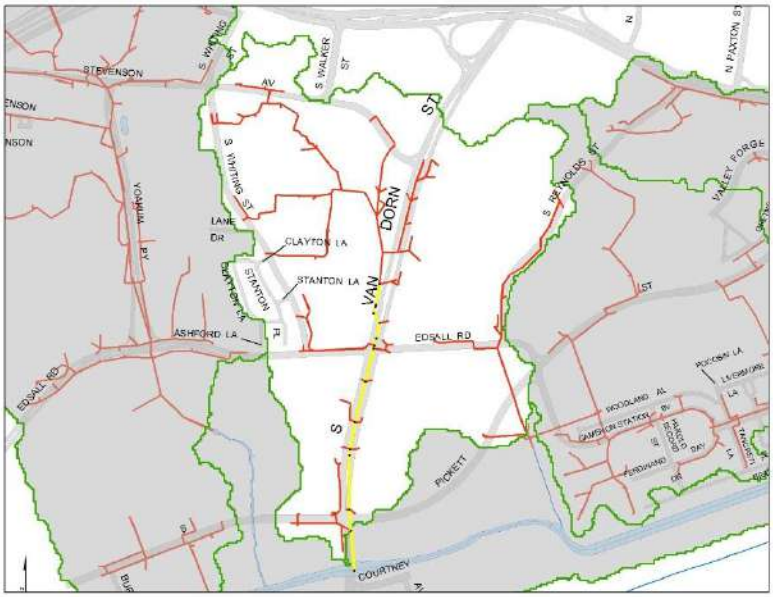


FIGURE 15

Backlick Run Profile 15 from 004396IN to 000378ND





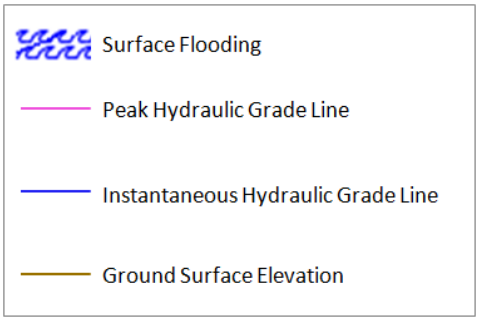
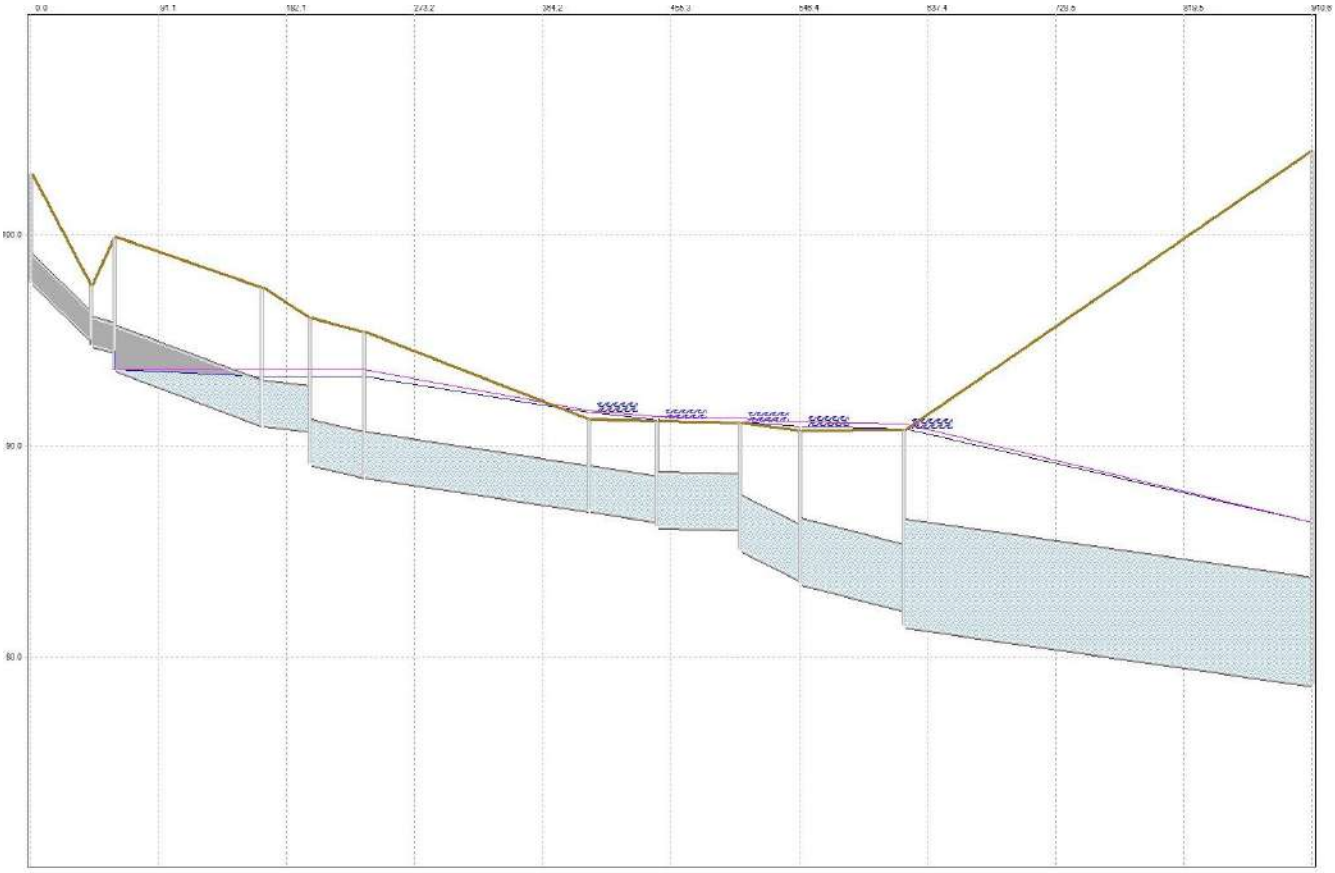
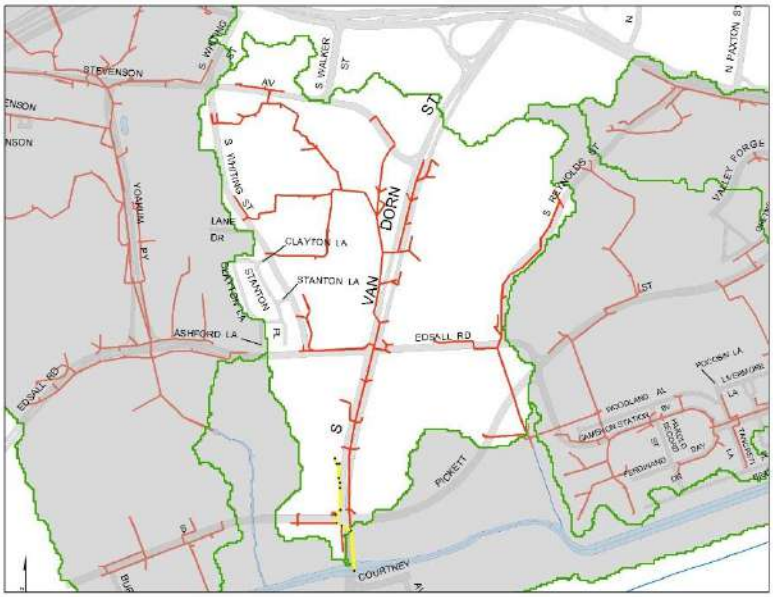


FIGURE 16

Backlick Run Profile 16 from 003088IN to 000378ND





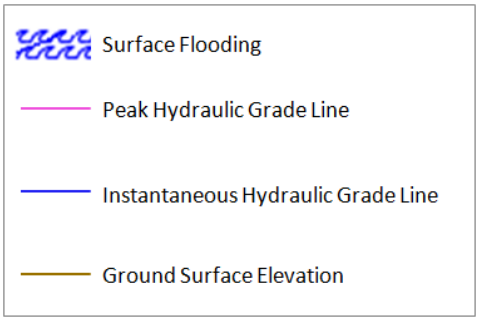
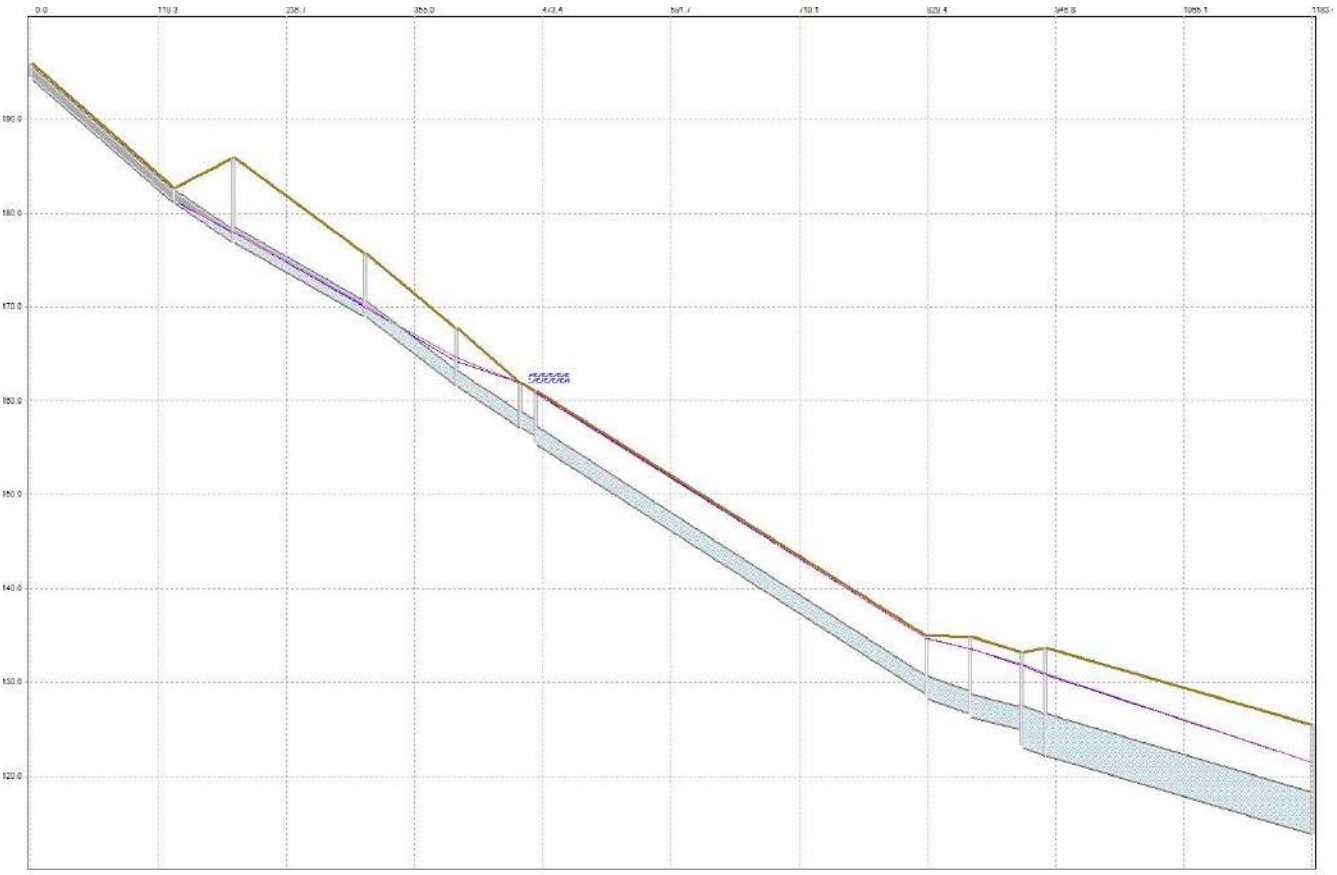
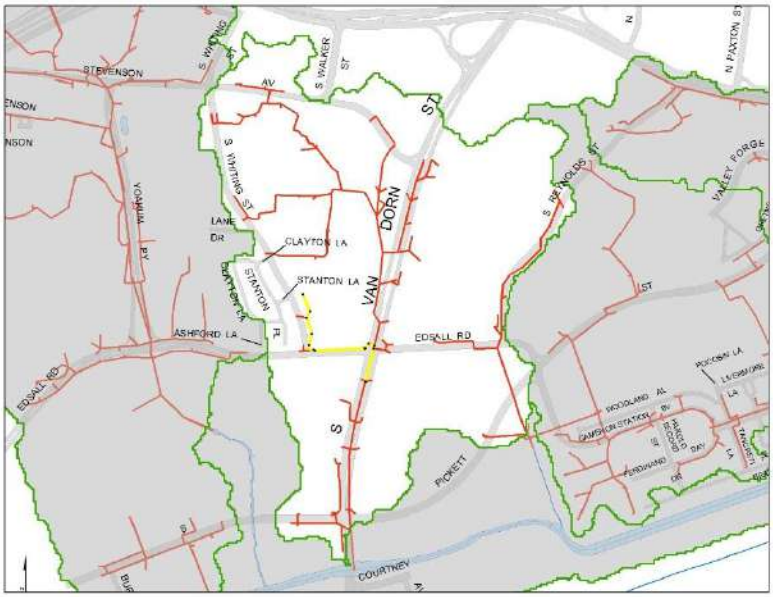


FIGURE 17

Backlick Run Profile 17 from 009935IN to 001431SMH





Surface Flooding

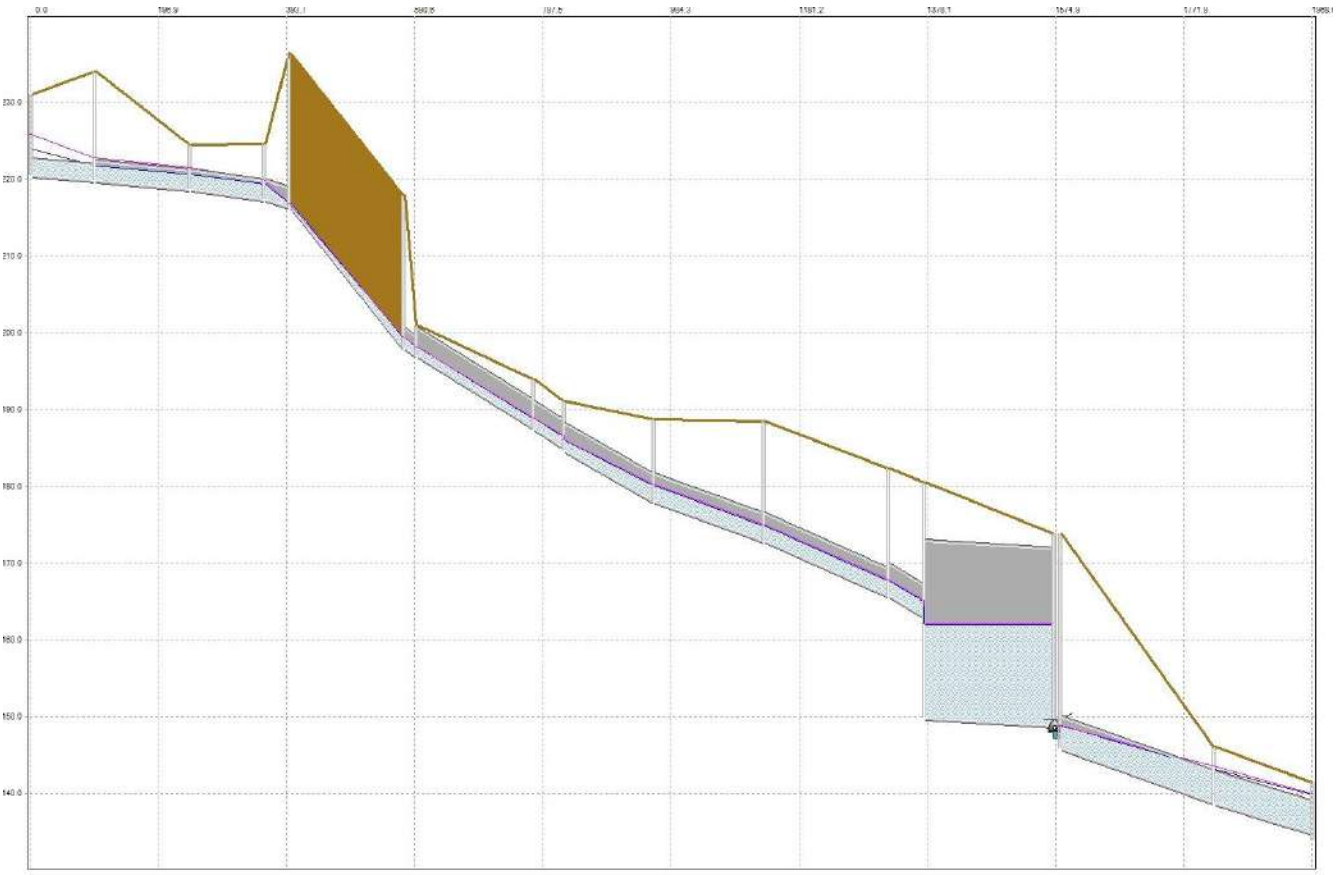
Peak Hydraulic Grade Line

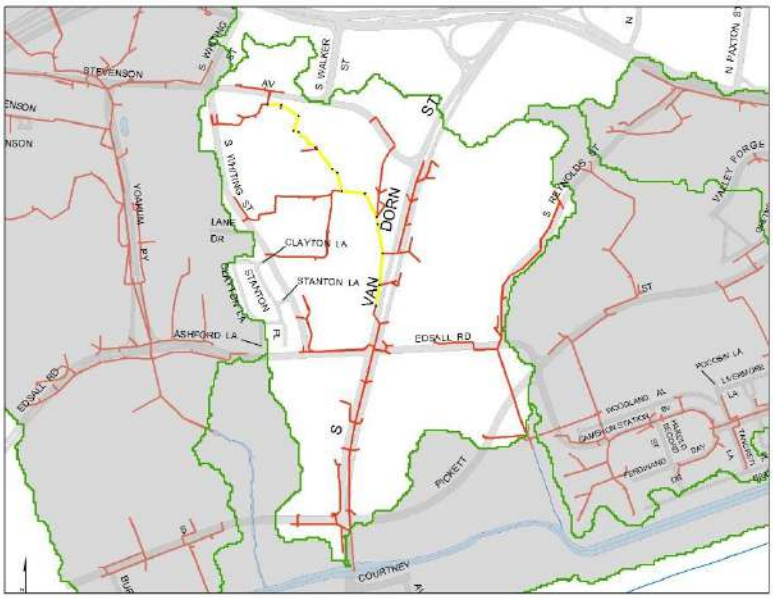
Instantaneous Hydraulic Grade Line

Ground Surface Elevation

FIGURE 18

Backlick Run Profile 18 from 001350SMH to 004397IN





Surface Flooding

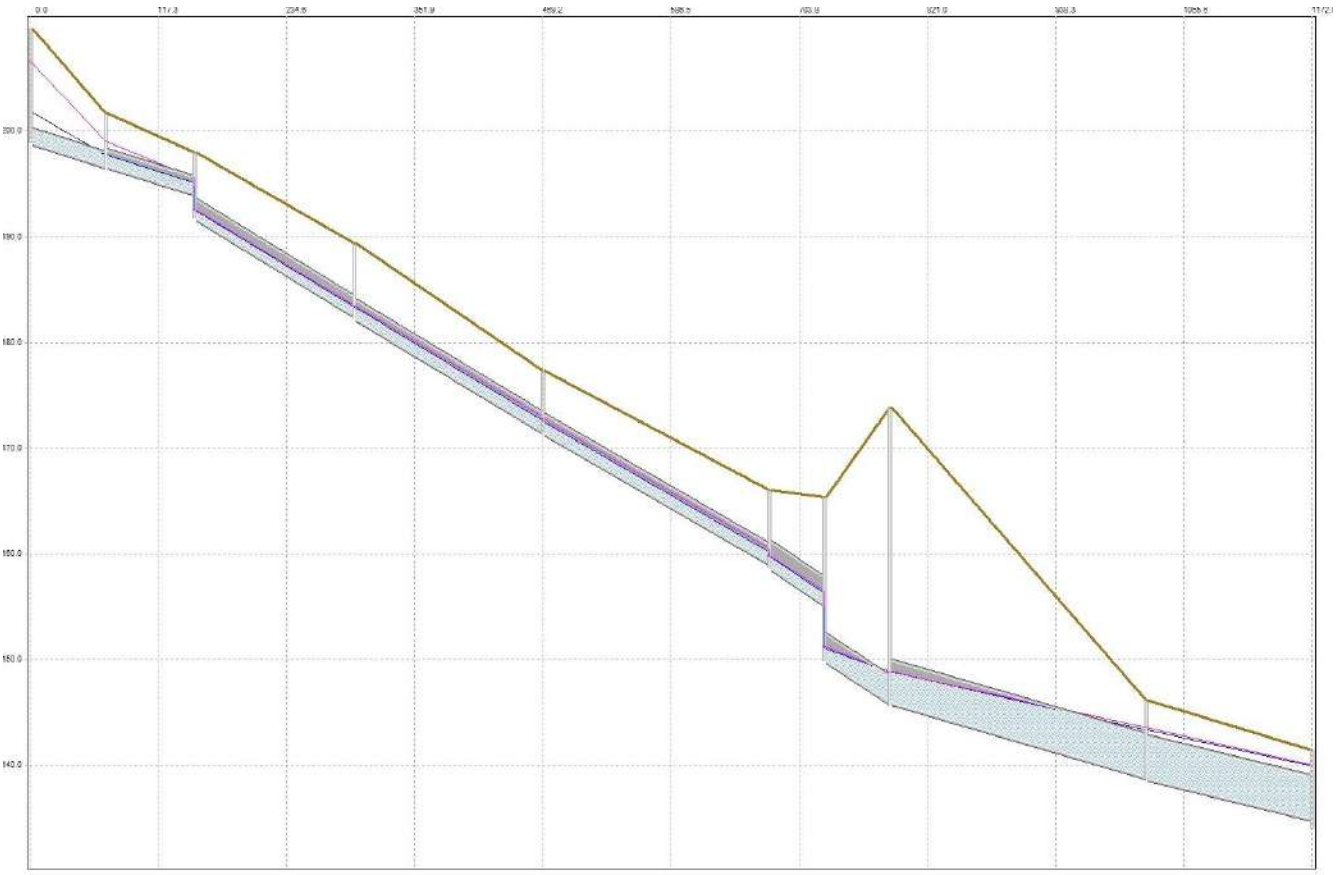
Peak Hydraulic Grade Line

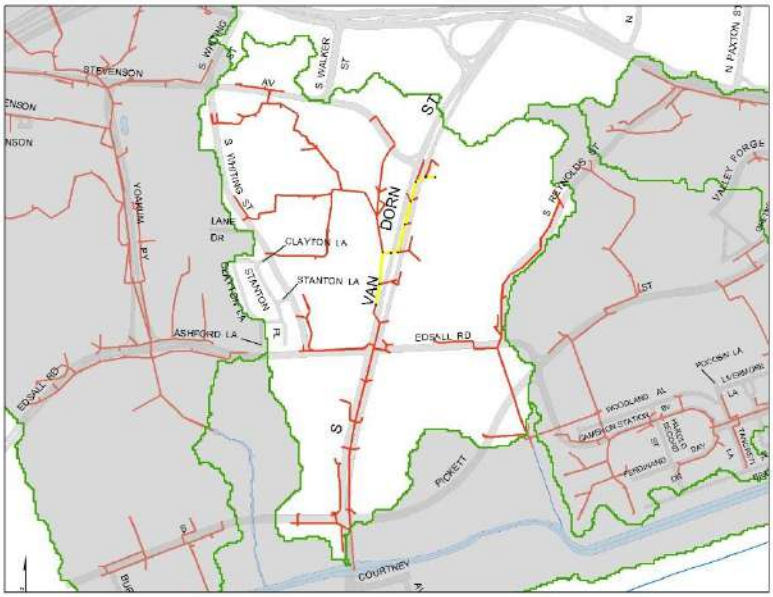
Instantaneous Hydraulic Grade Line

Ground Surface Elevation

FIGURE 19

Backlick Run Profile 19 from 000565ND to 004397IN





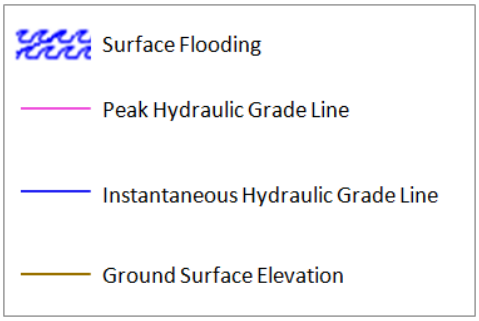
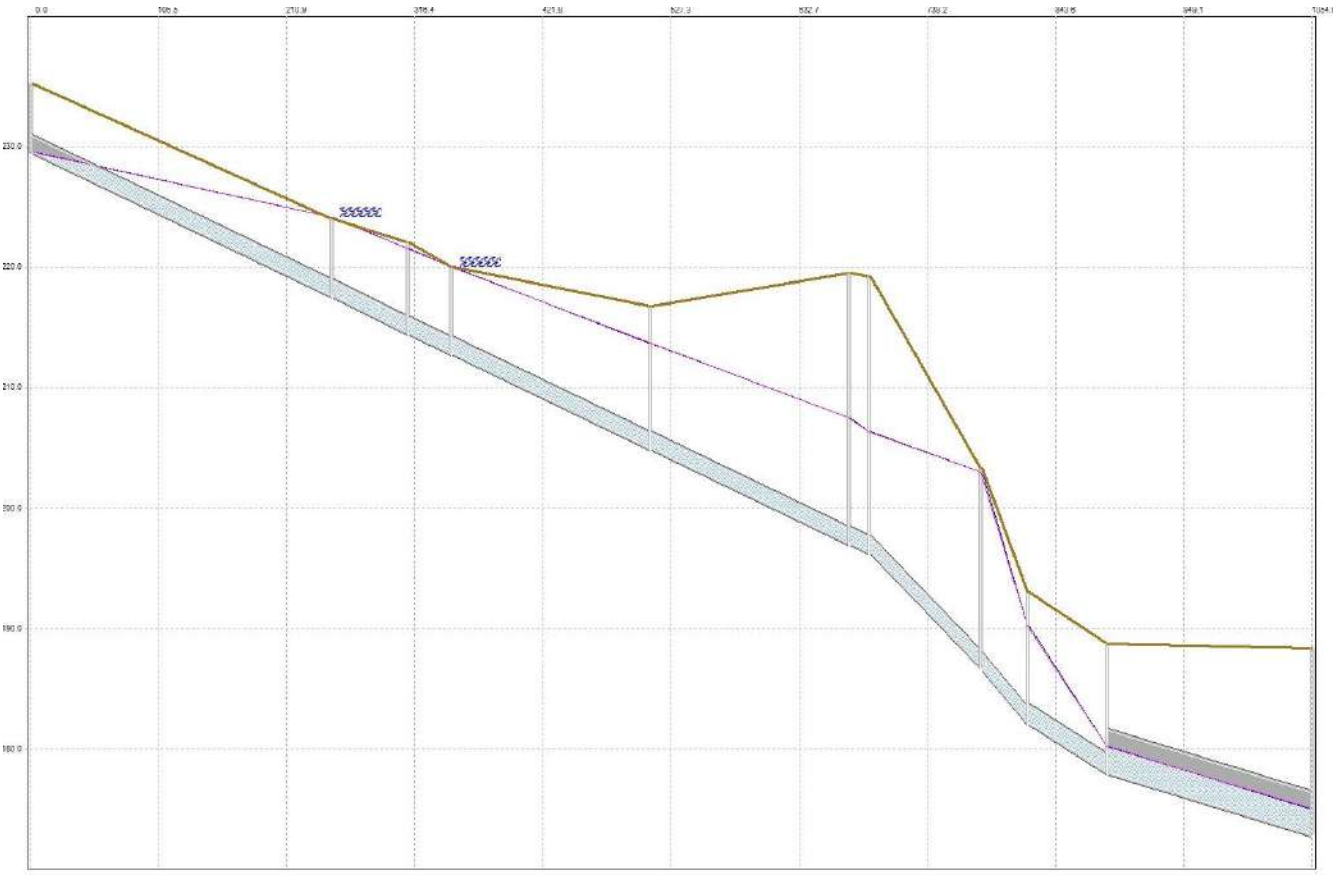
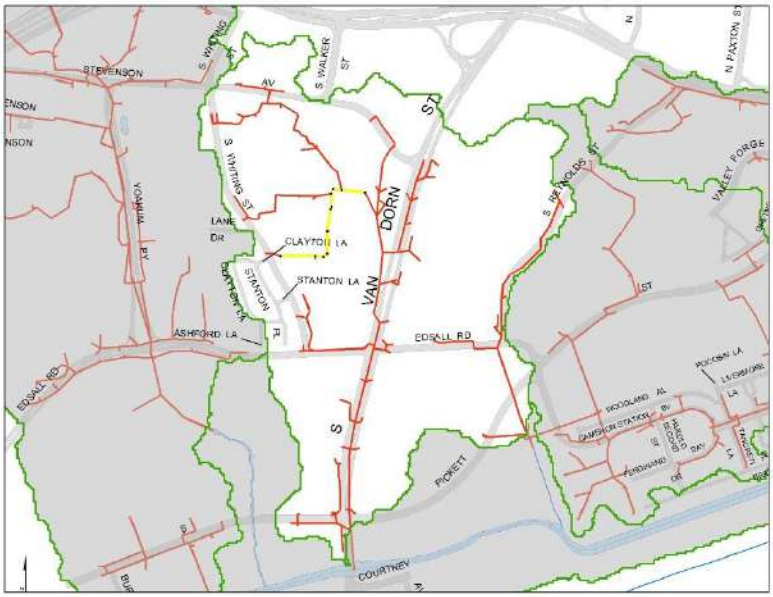


FIGURE 20

Backlick Run Profile 20 from 001766SMH to 004921SMH





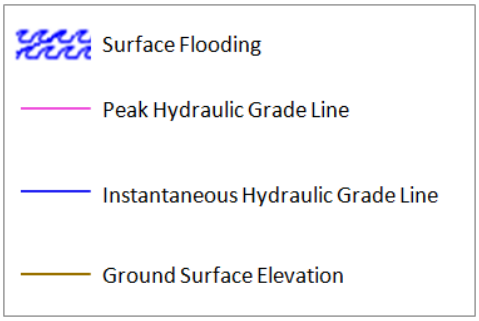
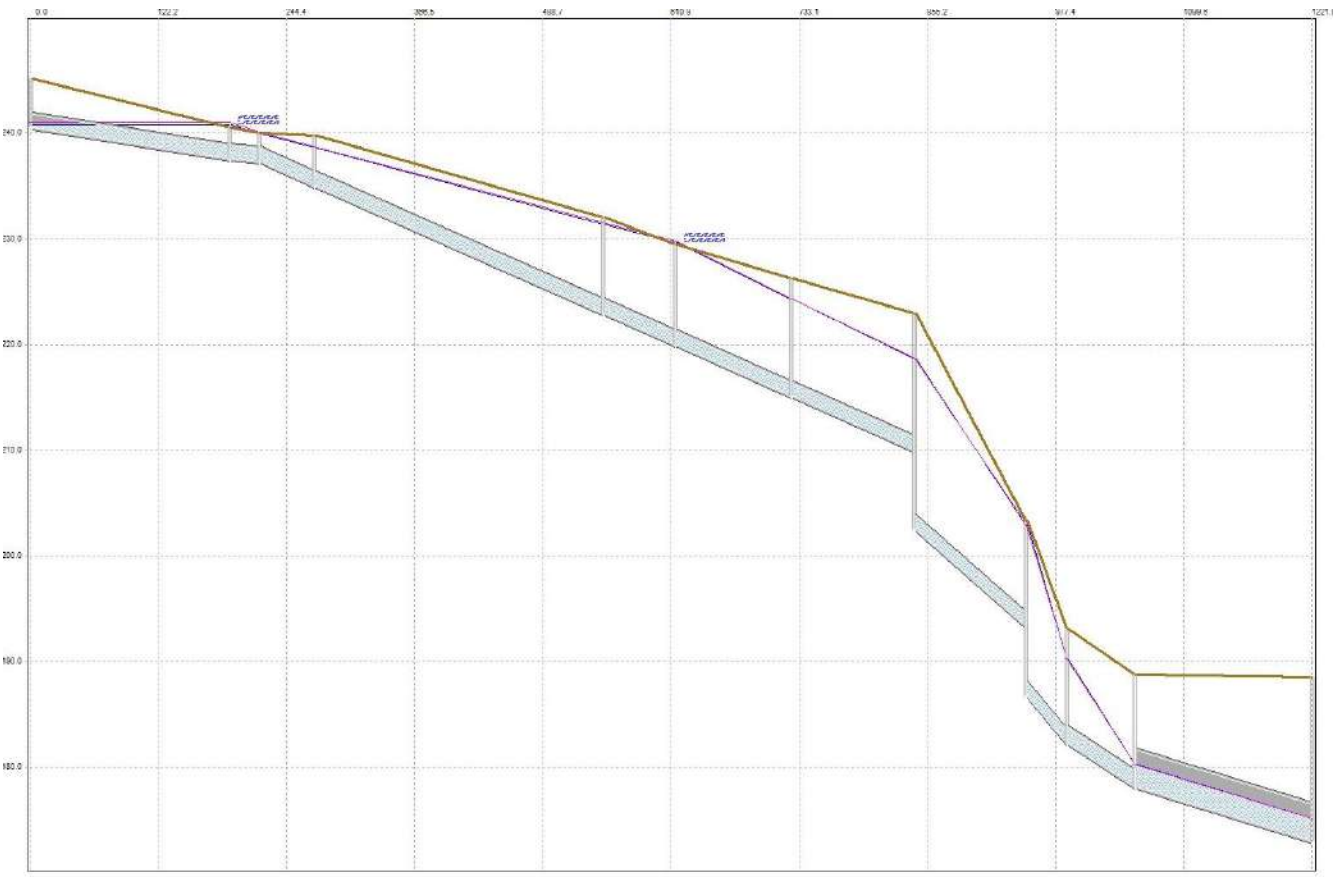
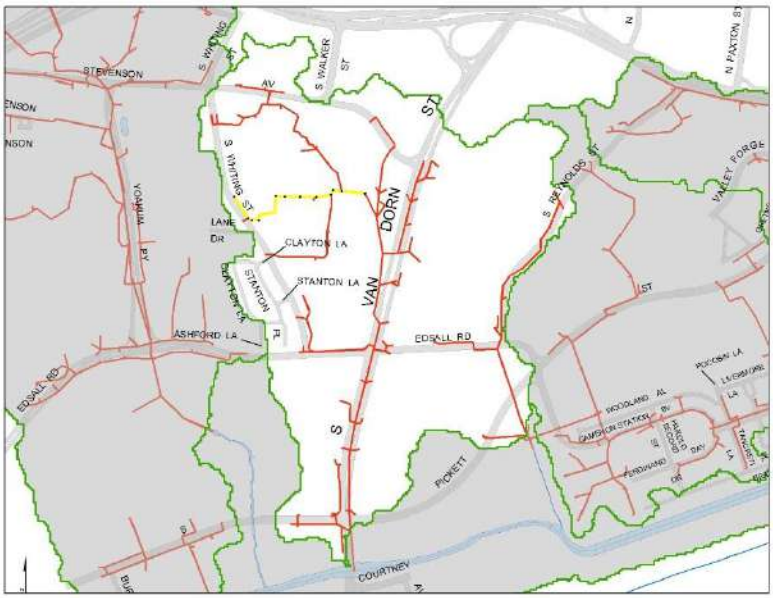


FIGURE 21

Backlick Run Profile 21 from 005069IN to 004921SMH





Surface Flooding

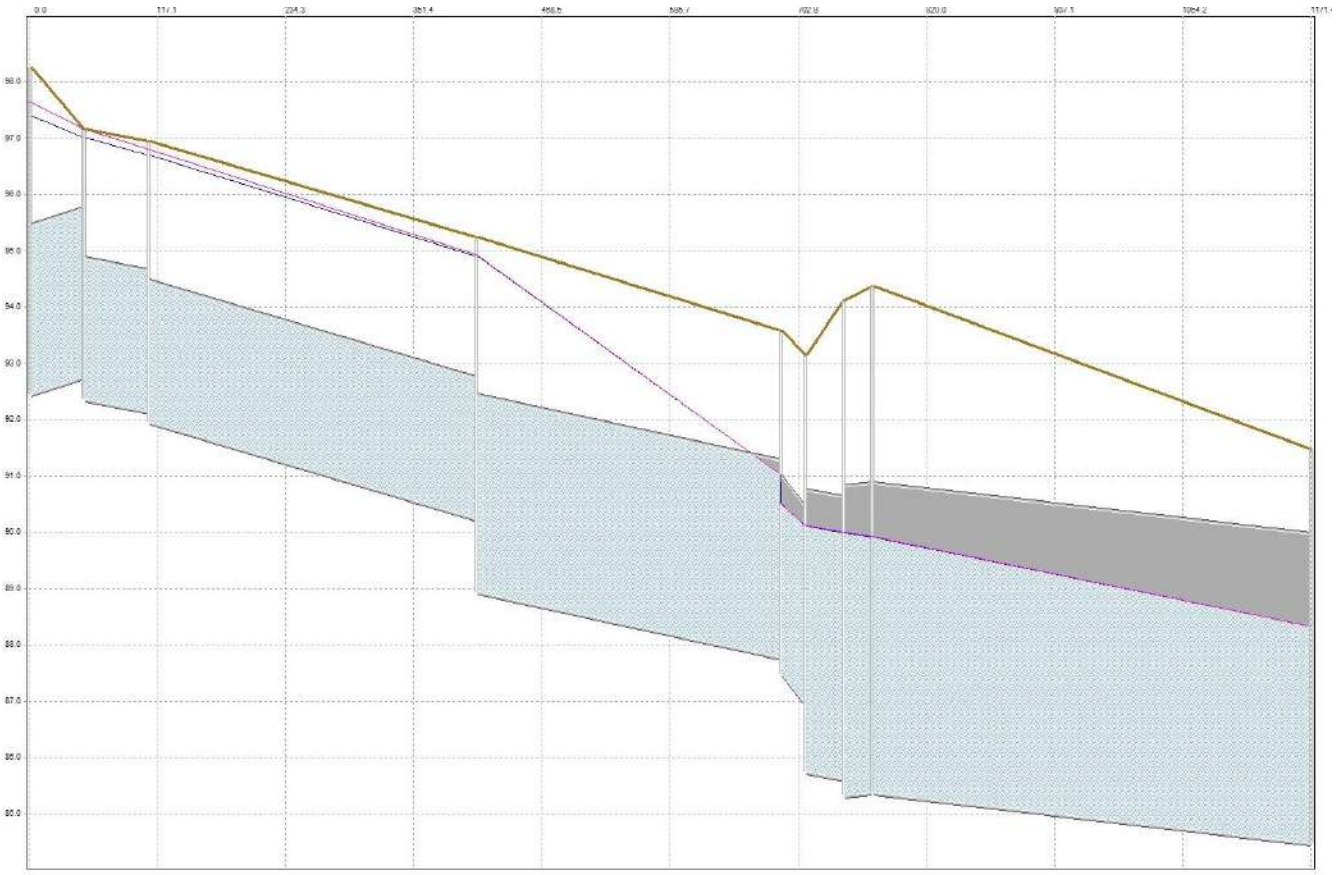
Peak Hydraulic Grade Line

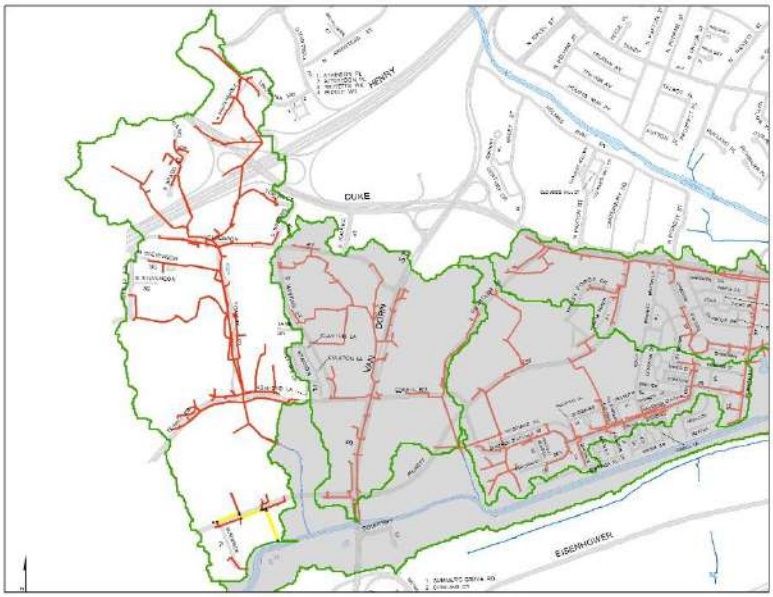
Instantaneous Hydraulic Grade Line

Ground Surface Elevation

FIGURE 22

Backlick Run Profile 22 from 003058IN to 000216IO





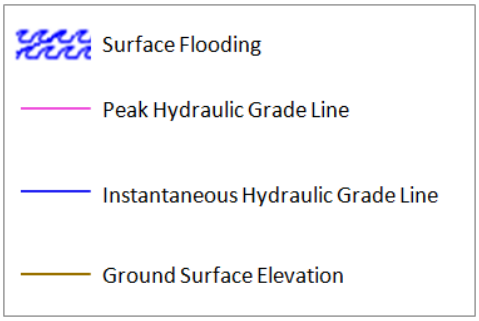
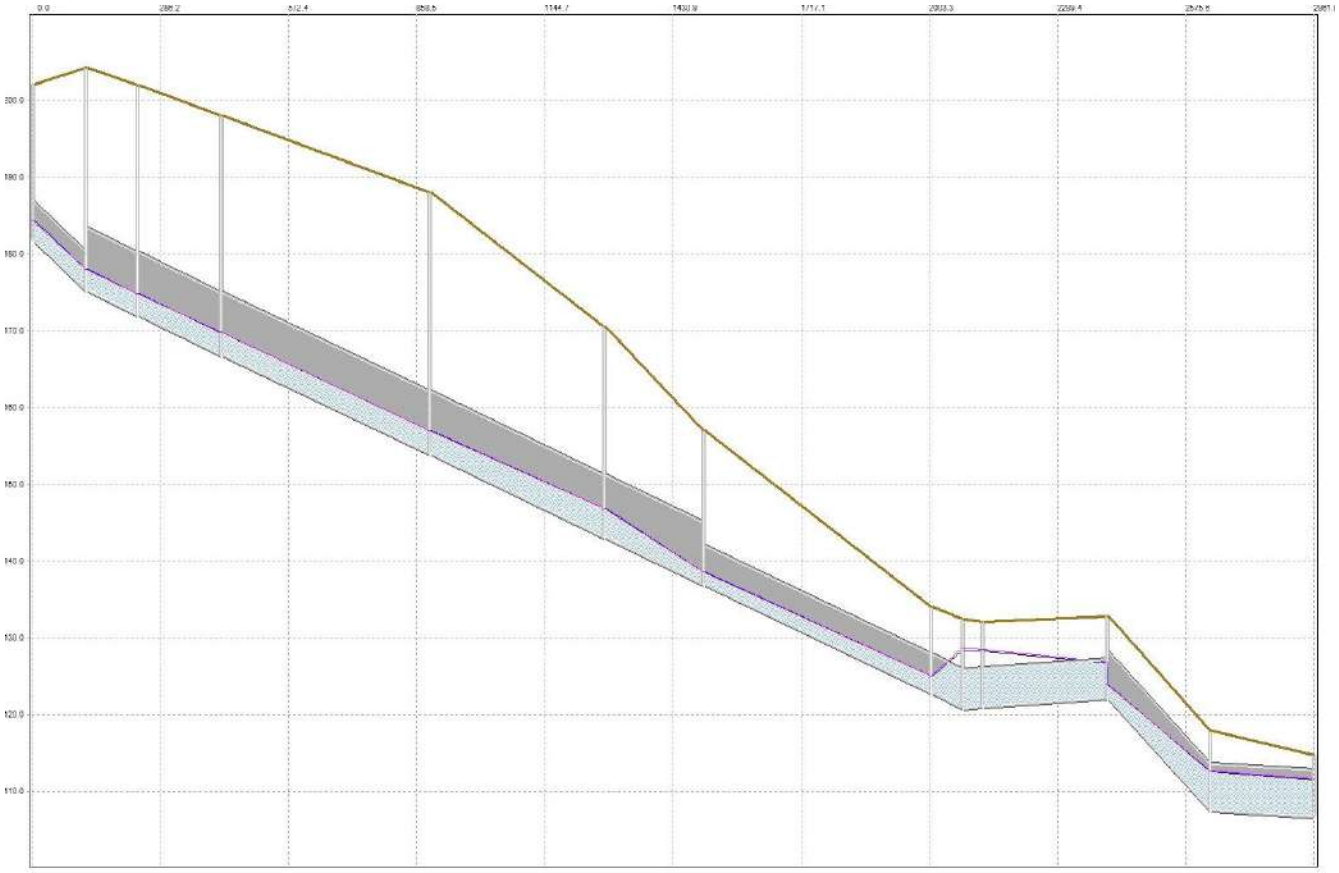
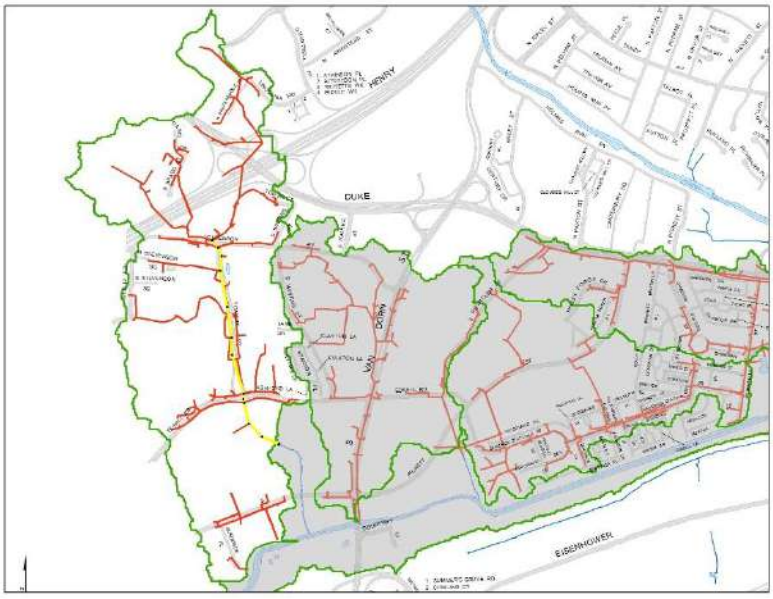


FIGURE 23

Backlick Run Profile 23 from 001363SMH to 000609IO





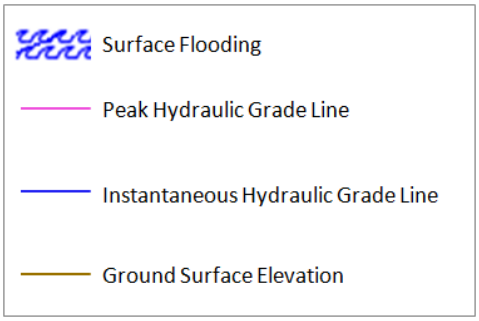
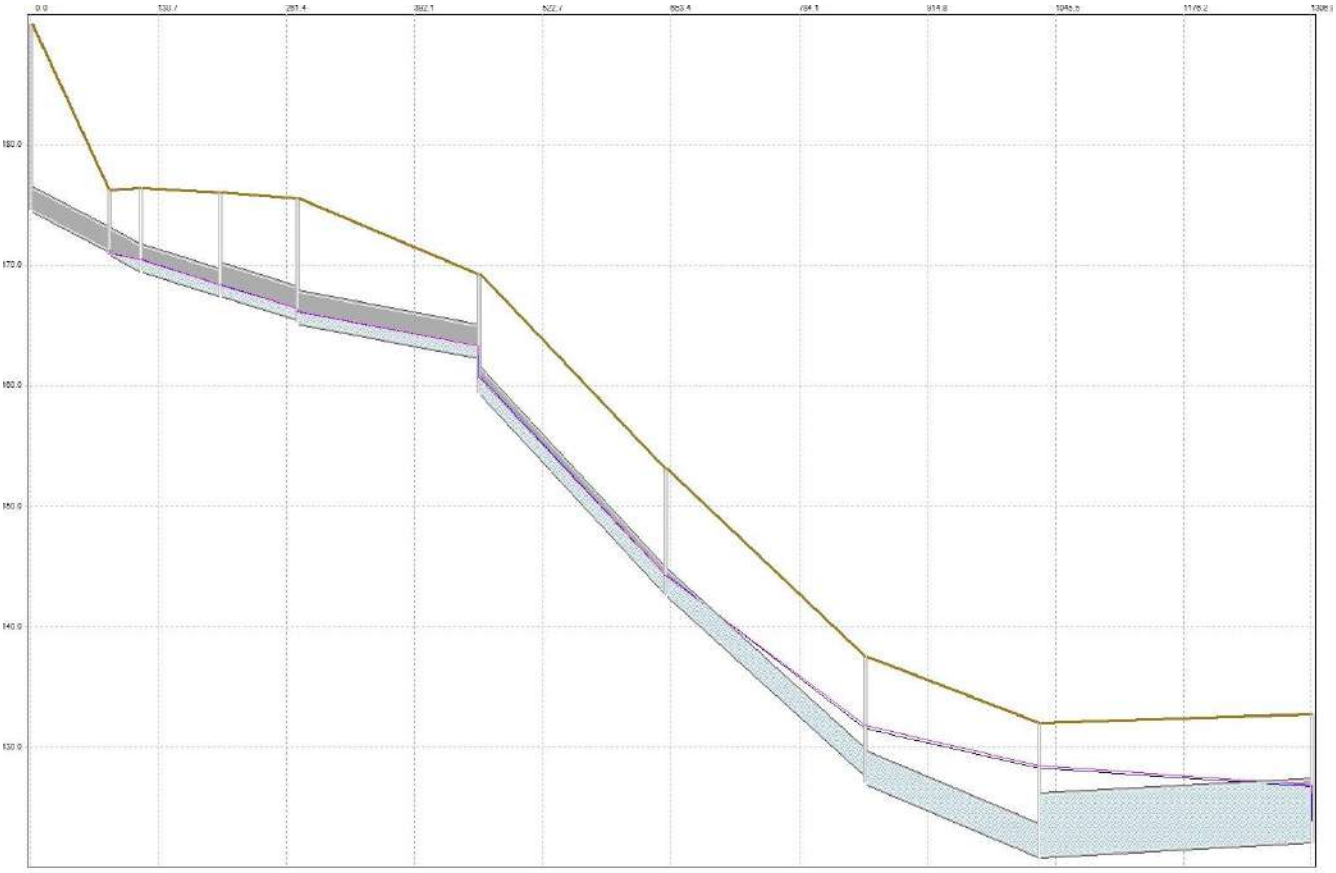
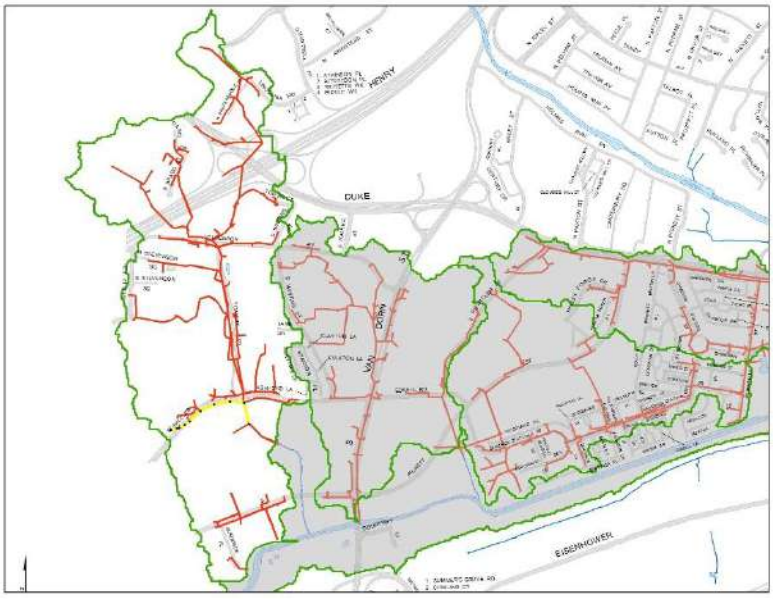


FIGURE 24

Backlick Run Profile 24 from 002294ND to 001783SMH





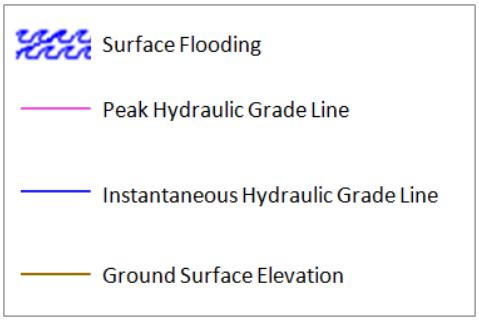
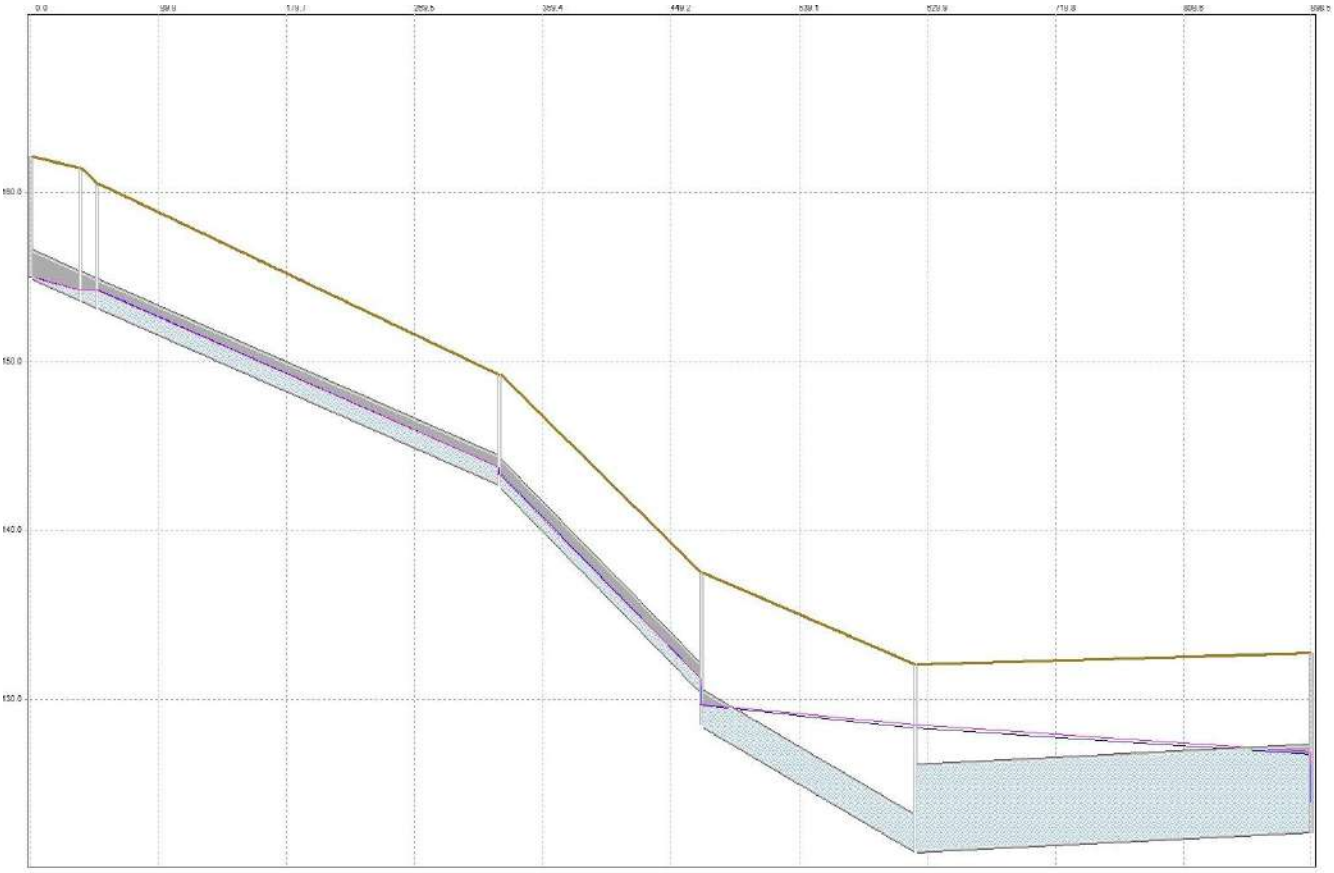
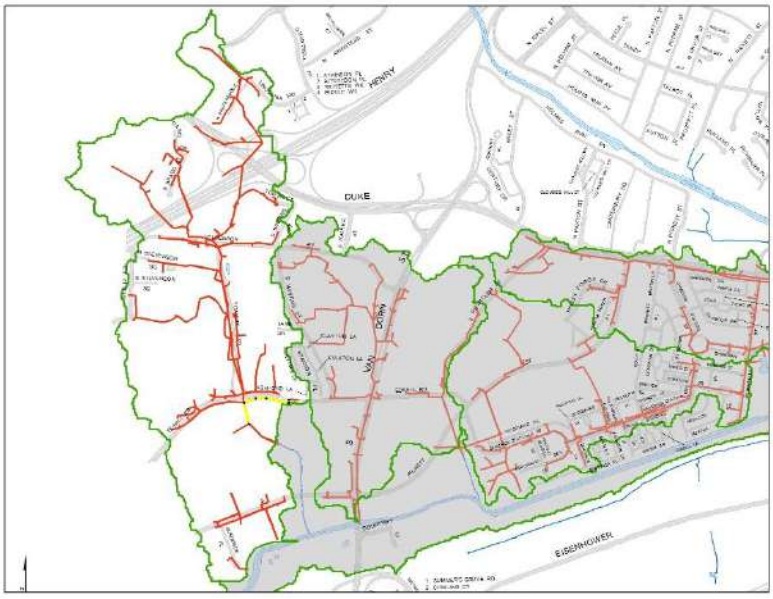


FIGURE 25

Backlick Run Profile 25 from 001444SMH to 001783SMH





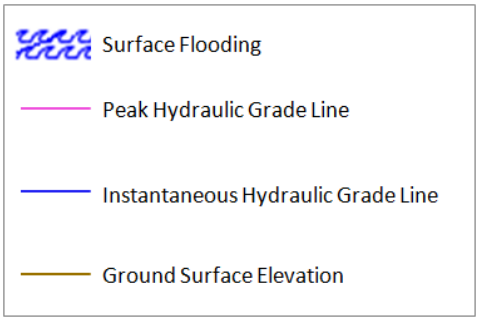
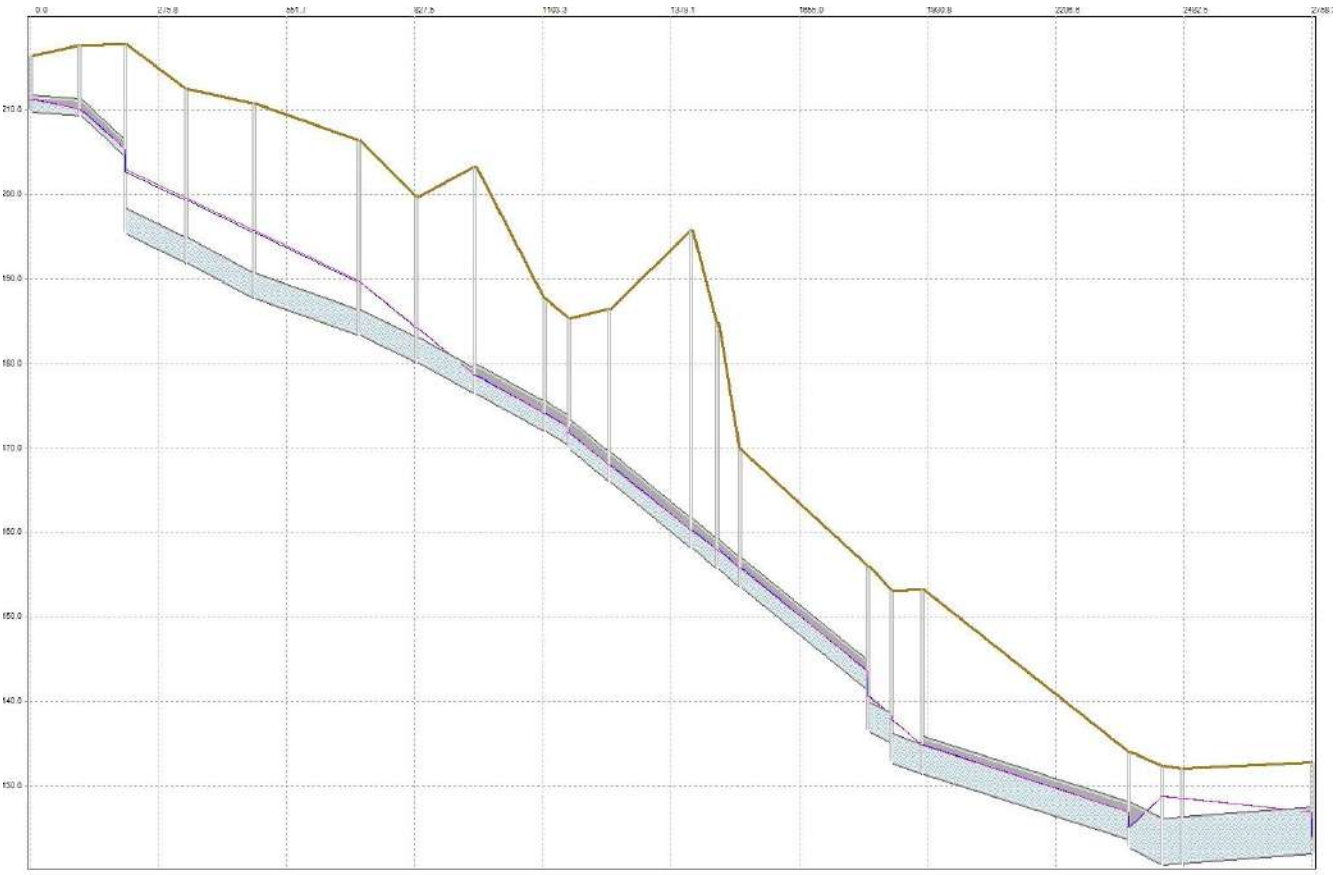
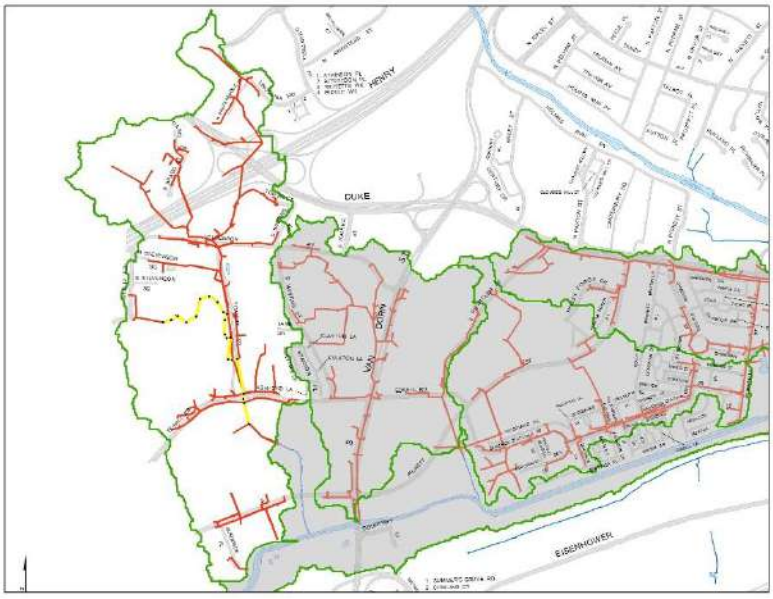


FIGURE 26

Backlick Run Profile 26 from 000077CB to 001783SMH





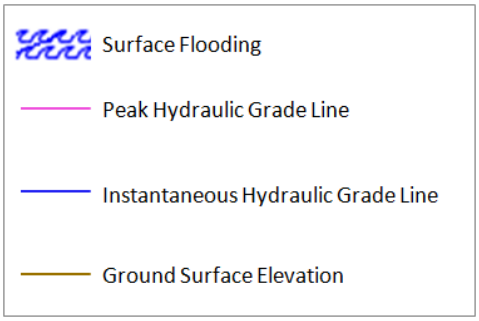
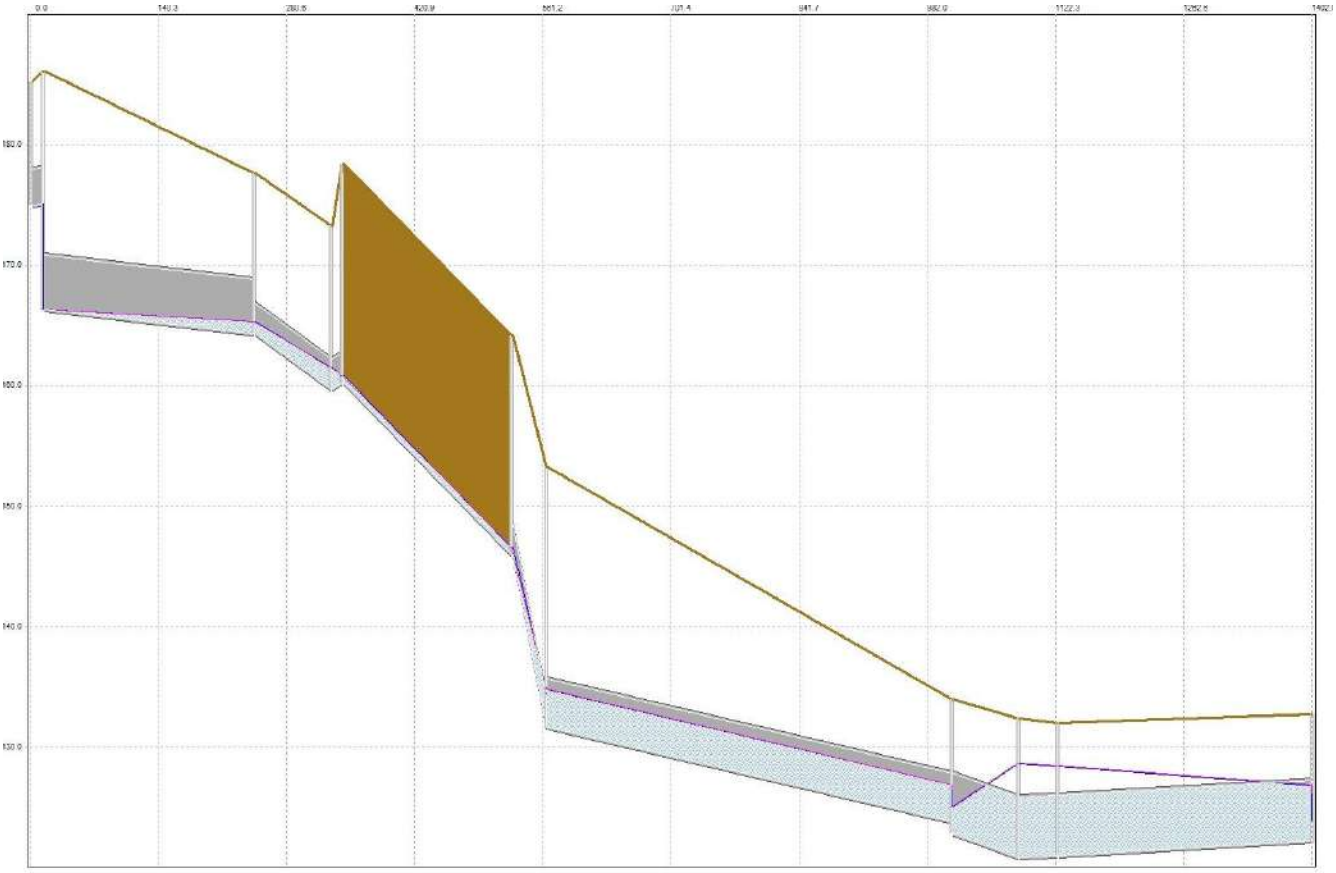
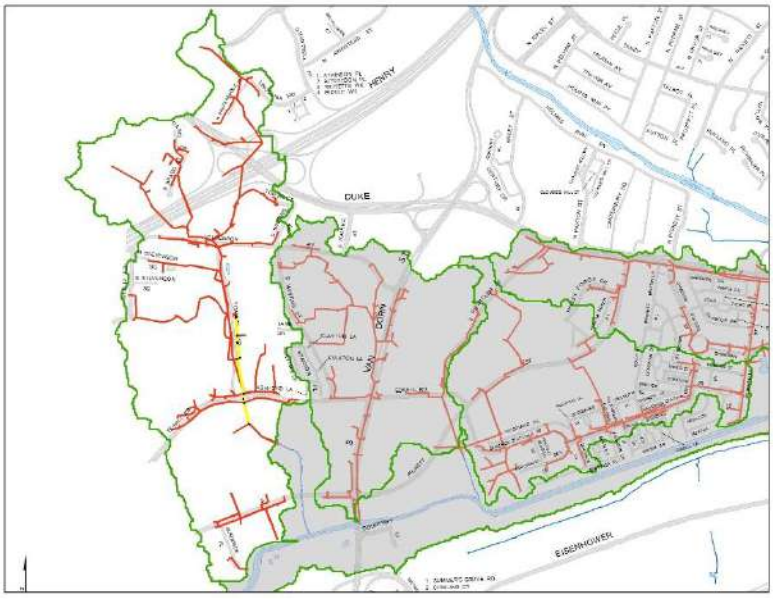


FIGURE 27

Backlick Run Profile 27 from 004104SMH to 001783SMH





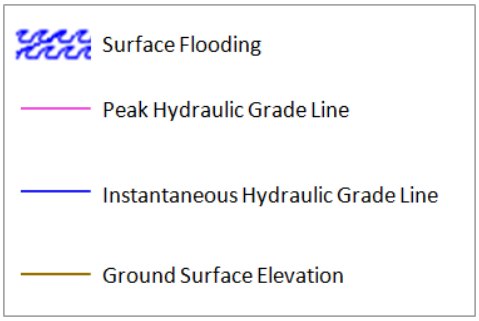
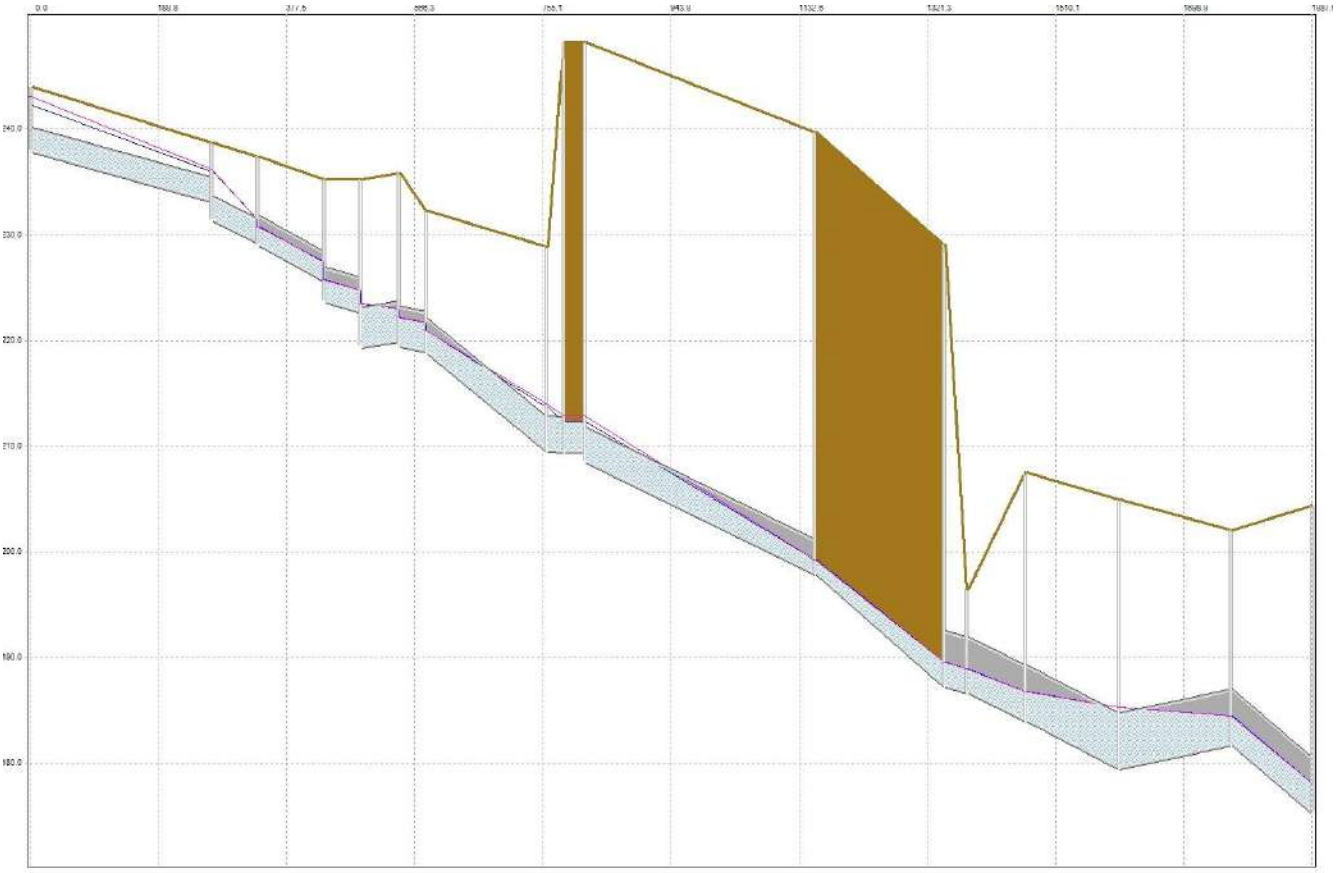
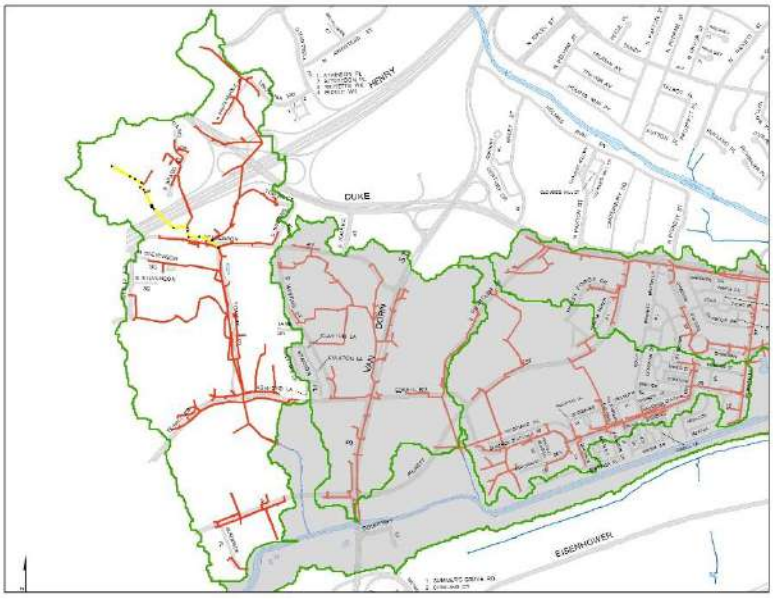


FIGURE 28

Backlick Run Profile 28 from 001334SMH to 001364SMH





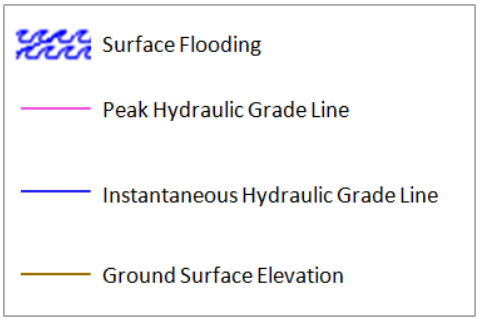
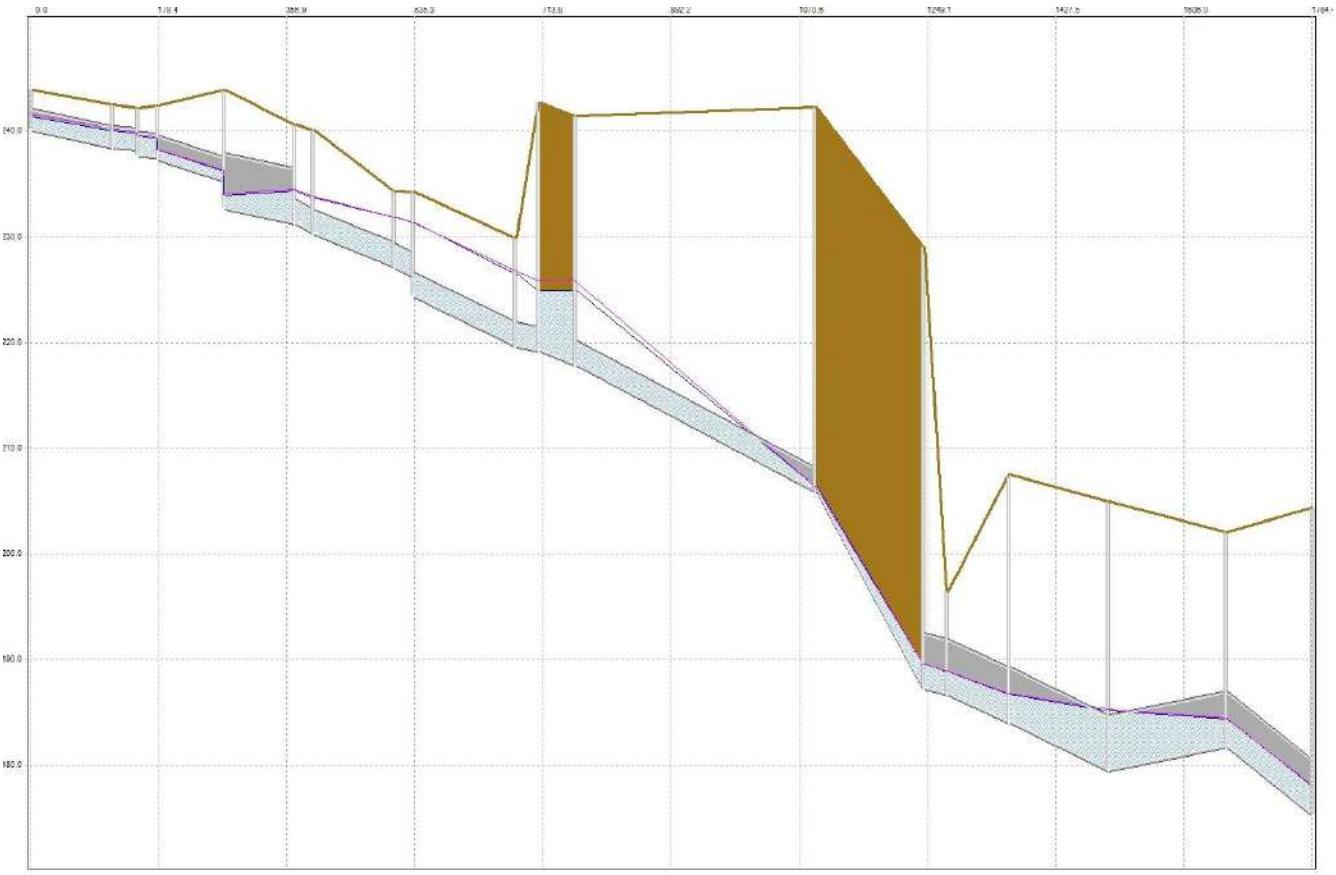
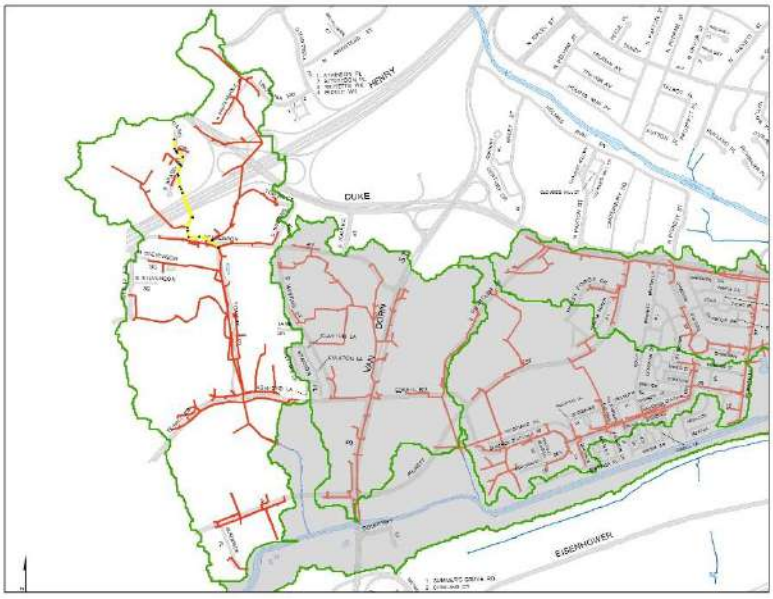


FIGURE 29

Backlick Run Profile 29 from 004126IN to 001364SMH





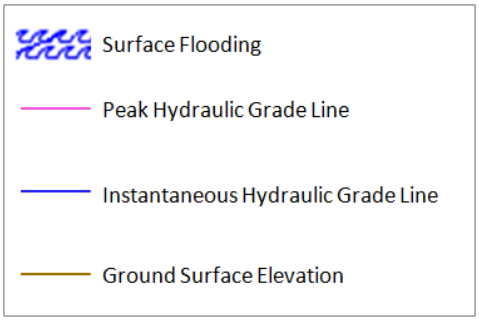
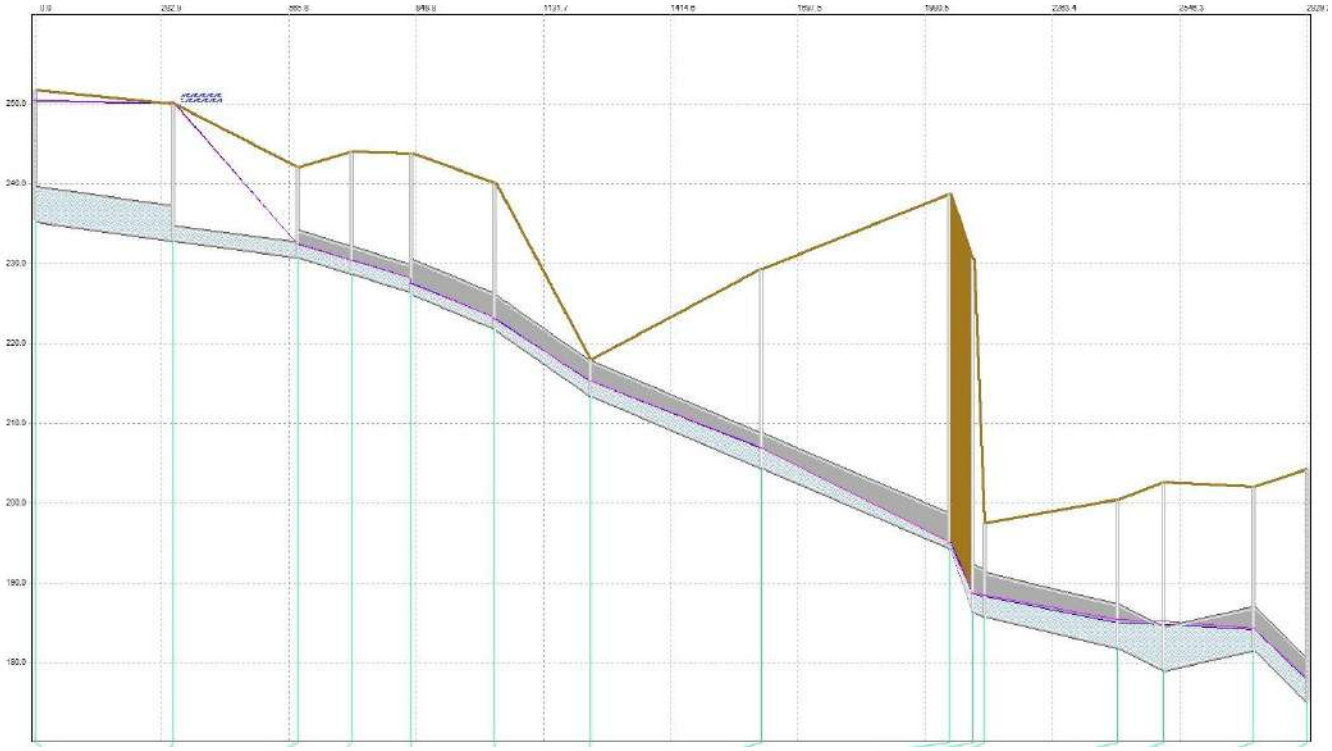
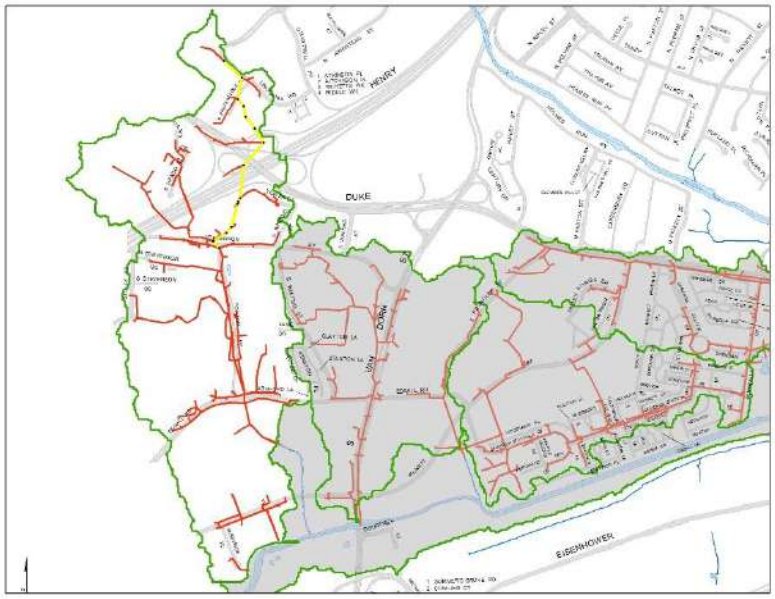


FIGURE 30

Backlick Run Profile 30 from 004689IN to 001364SMH





Surface Flooding

Peak Hydraulic Grade Line

Instantaneous Hydraulic Grade Line

Ground Surface Elevation