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List of Acronyms

CEASER	Center for Applied Sciences and Engineering Research
FEMA	Federal Emergency Management Agency
FIS	Flood Insurance Study
GIS	Geographic Information System
H&H	Hydrologic and Hydraulic
HGL	Hydraulic Grade Line
Hr.	Hour
MS4	Municipal Separate Stormwater Sewer Systems
NLCD	National Land Cover Database
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Resources Conservation Service
Rd.	Road
SWMM	City of Memphis/Shelby County Storm Water Management Manual
TN	Tennessee
UMRF	University of Memphis Research Foundation

RIDGEWAY STUDY AREA – VOLUME I

USDA
USGS

United States Department of Agriculture
United States Geological Survey

Executive Summary

To effectively address stormwater issues and efficiently utilize its resources throughout the City of Memphis (City), the Division of Engineering has established a systematic process to inventory its drainage system, model system performance, identify and quantify problems, and analyze potential solutions. Seven major drainage areas, generally corresponding to City Council Districts have been identified. These districts were subdivided into 37 study areas deemed appropriate for “big picture” drainage studies. In 2018, the City selected HDR Engineering to study the characteristics of one of the study areas, Ridgeway, and to evaluate possible solutions to its drainage and flooding issues.

HDR’s project team (project team) consisted of subconsultant firms THY, Inc., Allwood and West Surveying. The scope of services for this study consisted of the following activities:

- Data Collection
- Field Survey
- Public Outreach
- Model Development
- Analysis
- Report Preparation
- File Delivery

The Ridgeway Basin drainage area is located in the east side of Memphis. The Ridgeway Basin drainage area is bounded to the south by the Nonconnah Creek and extends northwards to Park Avenue, which also changes to Poplar Pike. The western boundary is just west of White Station Rd and the eastern boundary is just east of South Germantown Road. Figure 1 shows the extents of the subbasins and model.

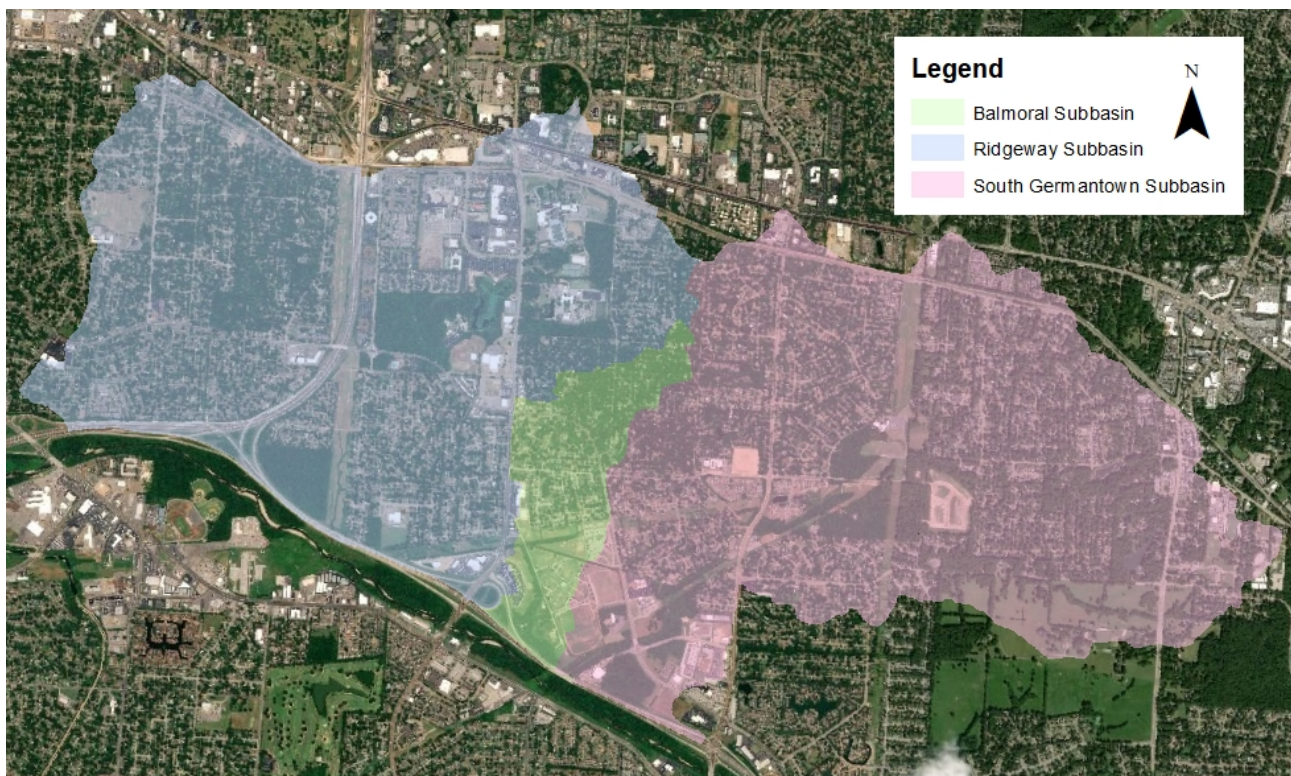


Figure 1: Modeling Basin Extents

As required by the City, a model of the Ridgeway Basin drainage system was developed using Innovyze’s InfoSWMM Version 14.6 hydraulic modeling software. The model was constructed using measured field survey data, information furnished by the City of Memphis, and readily available physical characteristic data, such as LiDAR. A calibration process was performed to ensure the model depicted “real-world” conditions as determined from stream and precipitation gage monitoring, public identified issues, and issues observed by the project team. Once calibrated, the model was run to identify drainage issues throughout the basin based on 2-, 5-, 10-, 25-, 50-, and 100-year, 24-hour design storm events in accordance with the Memphis and Shelby County Stormwater Management Manual (SWMM).

The existing conditions model confirmed observations that the team gathered from public surveys; the majority of the drainage and flooding issues in the Ridgeway Basin study area occur in the downstream portion of three streams in the eastern half of the basin. Based on these findings, the focus of the team’s solution development and analysis concentrated on the following three geographic areas:

- Area between Quince Road to Sea Isle Road
- Around Ridgeway Middle School along Quince Road
- Open channel along Kirby Parkway between Sulgrave Drive and Messick Road

Figure 2 shows the areas of the flooded areas in the model.

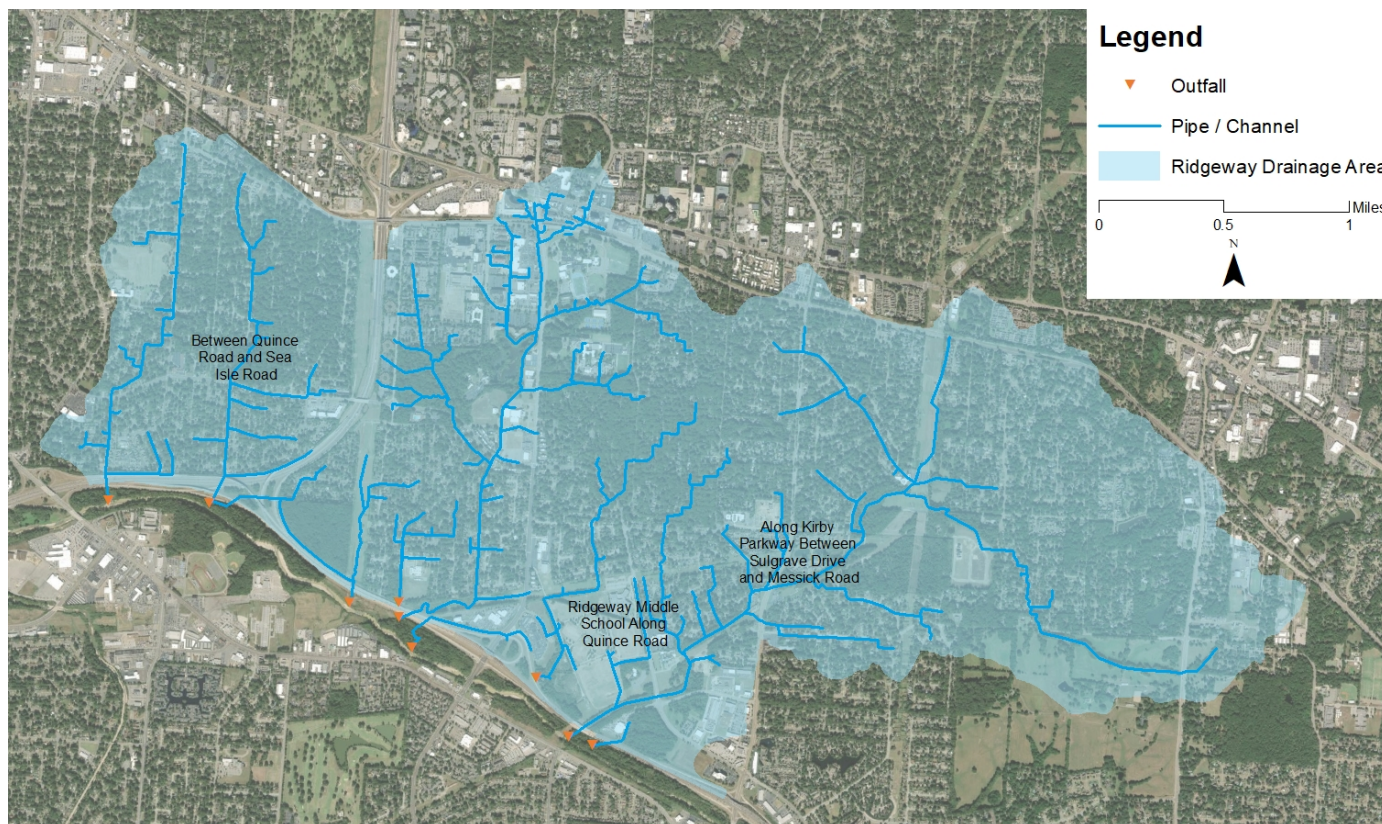


Figure 2: Areas of Flooding Concerns

The project team presented the results of the modeling analysis for these areas along with possible solutions to the City for further investigation. Three scenarios were provided to the City for further review and analysis. The City determined that these areas were a lower priority and further modeling to identify system improvements was not deemed to be necessary at this time.

The model results for each of these design storms are a part of the final InfoSWMMM electronic deliverable of this study. This report volume focuses on the results of the 10- and 100-year, 24-hour design storms, and discusses each scenario individually. Because no improvement scenarios were identified, a summary of costs was not prepared.

Recommendations

After the completion of this project, should any area in the Ridgeway basin become an issue due to flooding, the following actions to reduce flooding in these areas are recommended:

- Increase channel areas or box culverts as necessary
- Addition of underground storage/detention area
- Clean channels or create new ones as necessary
- Add inlets to the existing stormwater collection system

It should be noted that should other areas become identified as flooding areas, additional modeling may be required. The current model has been developed to evaluate system performance at a basin planning level. For site-specific neighborhood flooding issues, it is recommended that additional modeling be performed on a local level. Modeling done on a local level could help identify issues that result in localized flooding at houses as opposed to the larger basin flooding issues identified by the current model.

Section 1 - Background

1.1 Introduction

Located in the southwestern corner of Shelby County in far southwestern Tennessee, the city of Memphis was founded in 1819 and incorporated as a city in 1826. As early as the 1880's, Memphis began construction of a revolutionary sewer system in an effort to help diminish disease outbreak. Since that time, other improvements include a series of levees, floodwalls, and pumping stations implemented to protect the City from the seasonal flooding of the Mississippi River and associated tributaries. As each generation worked to maintain and extend the stormwater infrastructure, the system was subject to the design criteria, construction materials, and techniques of that time.

Today, the City is a permitted Phase I Municipal Separate Stormwater Sewer System (MS4) operating a large urban system of varied age, material, and capacity. As such, the City has the authority to discharge stormwater runoff in accordance with its established Stormwater Management Program. The duties and responsibilities of the MS4 include the proper operation and maintenance of the City's stormwater system. In exercising these responsibilities, the City has documented numerous reports of excessive flooding, erosion, and general drainage issues throughout the City.

To effectively address these stormwater issues and efficiently utilize its resources City-wide, the Division of Engineering has established a systematic process to inventory its drainage system, model system performance, identify and quantify problems, and analyze potential solutions. Seven major drainage areas, generally corresponding to City Council Districts have been identified, see Figure 3. These districts were then subdivided into 37 study areas deemed appropriate for "big picture" drainage studies.

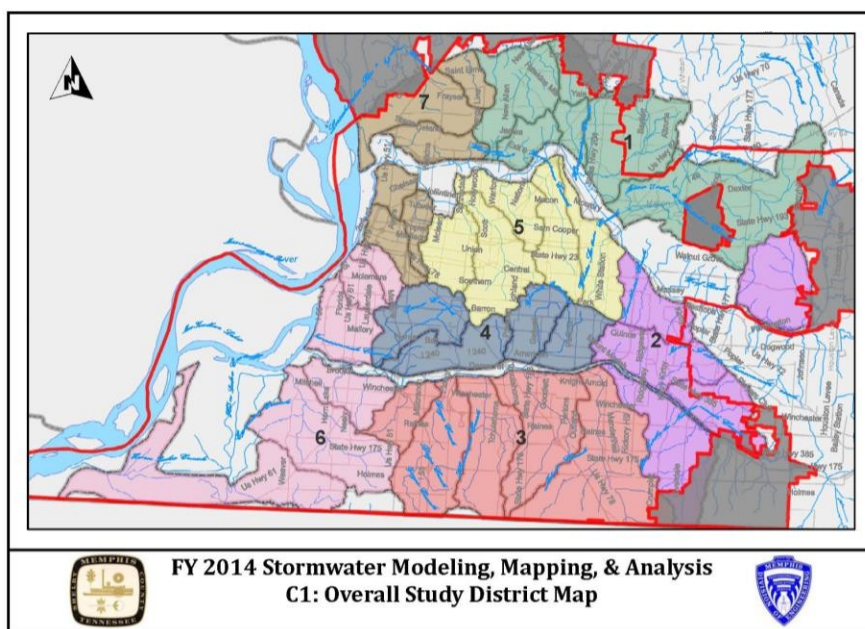


Figure 3: City of Memphis Overall Study District Map

Commencing in 2014 the City of Memphis began to hire qualified firms (study consultants) to analyze the hydrologic and hydraulic (H&H) characteristics of select drainage areas and to develop recommendations to improve drainage conditions throughout the assigned study area. The recommended improvements are and will be reviewed, prioritized, and implemented under a series of capital improvement projects in subsequent years.

The tools selected by the City to inventory its drainage system, model system performance, identify and quantify

problems, and analyze potential solutions, namely Geographic Information System (GIS) mapping and InfoSWMM drainage model will allow the City to make informed decisions for its Capital Improvement Program (CIP); be leveraged for future asset management use; and assist in National Pollutant Discharge Elimination System (NPDES) permit compliance. Documentation of each study will be done in the following formats: reports, electronic version of the InfoSWMM model, and supporting GIS data files.

1.1.1 Purpose

In 2018, the City selected HDR, Inc. to study the characteristics of the Ridgeway drainage basin and to evaluate possible solutions to drainage and flooding issues in the area. The Ridgeway drainage basin, which discharges to the Nonconnah Creek, lies within Study District 2 and is part of the second program year. It has been assigned the numeric code 0302 (study district 3 / study year 2) for the City's record keeping.

HDR's (project team) consisted of subconsultant firms THY, Inc., Allwood, and West Engineering.

1.1.2 Scope

The scope of services for this study consisted of the following activities:

- Data Collection: Collect available data from the City including GIS based topographic files, record drawings, and previously identified issues; accepted technical resources; field survey; and public input.
- Field Survey: Field survey drainage structures and stormwater conveyance facilities to include open channels; pipes 24" diameter and larger in the network; pipes downstream of known flooding concerns; and structures, headwalls, inlets, etc. for drainage features greater than 24" in diameter in open channels or with known flooding concerns. The survey included a photographic inventory of road crossings and outfalls. The project team also used the photographs to identify maintenance issues for the City of Memphis.
- The field survey served two purposes:
 - To provide the appropriate data to generate a model of the Ridgeway Basin Drainage Area
 - To provide feature data to the City for record purposes.
- Final quantities for Ridgeway field surveys were: 449 Inlets, 353 pipe segments, 337 cross sections, and 5880 total survey points
- Public Outreach: Identify known stormwater issues and gather concerns from the general public in the Ridgeway study area through public meetings and a project website.
 - The public meetings and website were also used to disseminate information to the public regarding the drainage study.
 - The website, <https://ridgewaybasinstudy.com>, included the capability for visitors to e-mail the project team and to complete a brief survey regarding drainage issues in the community, see Figure 4.
 - Initial public meetings were held on April 19, 2018 and April 24, 2018.
 - A final public meeting will disseminate project recommendations to the public.

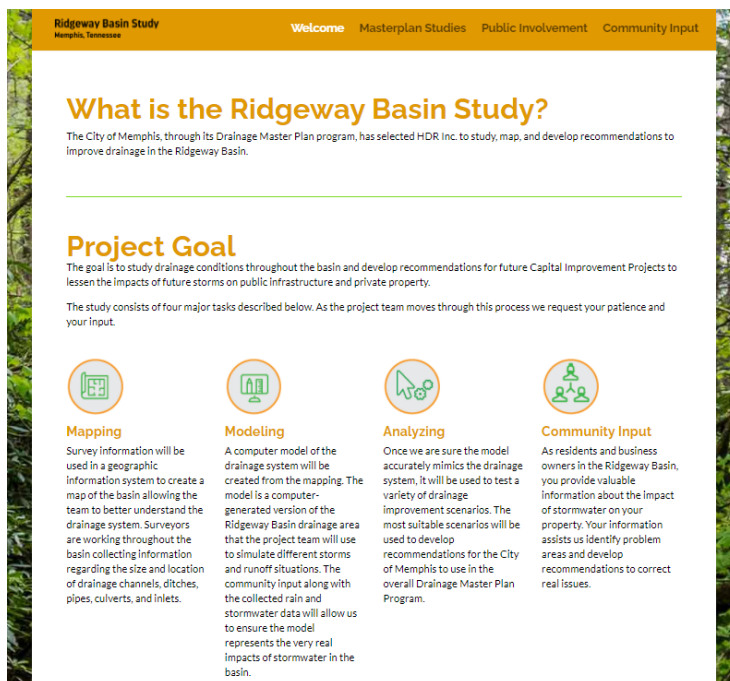


Figure 4: Ridgeway Basin Website

- Model:
 - Create an electronic model using InfoSWMM software that simulates the H&H characteristics of the Ridgeway drainage area.
 - Calibrate the model using City provided measured stream and precipitation data along with recorded and anecdotal data regarding actual flooding events.
 - Validate the model. The project team utilized measured precipitation obtained from the National Oceanic and Atmospheric Administration (NOAA) rain gage located at three different fire stations located near the study area.
- Analysis:
 - Identify “big picture” areas of flooding concern based on collected data and the calibrated model. In concert with City staff, identify possible solutions to address the identified drainage issues.
 - Evaluate possible solutions by simulating different storms and runoff situations in the model and document the recommended solutions. Develop an opinion of probable construction costs for recommended solutions.
- Report: Prepare a written report to document the analysis, findings and recommendations for the Ridgeway drainage area. The report consists of the following documents:
 - Volume 1 (this document) which describes the study area, documents drainage and flooding issues, discusses various improvement scenarios, and identifies solutions for these issues.
 - Volume 2 which details the technical process performed to document existing conditions and evaluate possible solutions through populated GIS files and the development and study of a drainage model using InfoSWMM software.

- Model Transfer: In addition to the report, an electronic version of the InfoSWMM drainage model along with developed GIS data will be installed on City of Memphis computer for record purposes as well as future analysis and update.

1.2 Overview of Project Area

The City of Memphis is the county seat for Shelby County and encompasses 324 square miles. Situated in the southwest corner of the State of Tennessee, the City lies within the Lower Mississippi Watershed. Three major watersheds drain the City. All of these watersheds eventually or directly discharge to the Mississippi River which defines City's western boundary. The watersheds are:

- The Nonconnah Creek Watershed which drains the southern portion of the City. The Nonconnah Creek discharges to McKellar Lake prior to joining the Mississippi River.
- The Wolf River Watershed, which drains central Memphis
- The Loosahatchie River Watershed, which drains the northern portion of Memphis

Multiple streams and rivers flow through the City providing area wide drainage. These discharge to one of these three primary rivers or their tributaries. The Ridgeway Basin is situated in the south-west portion of the City and discharges directly to the Nonconnah Creek.

The 4,530-acre Ridgeway drainage area is located in the City of Memphis with a small portion in the city of Germantown. The drainage area extends north from the Nonconnah Creek towards the US 72 and is bordered on the West by S White Station Rd and on the East by state route 177. The Ridgeway drainage area is divided into three subbasins, Ridgeway, Balmoral, and South Germantown (Figure 1). Ridgeway subbasin has an area of 2,060 acres and is bounded by Nonconnah Creek to the south, Park Avenue (which changes to Poplar Pike) to the north, just west of White Station Road to the west, and west of Kirby Road to the east. Balmoral subbasin has an area 290 acres and is bounded by Nonconnah Creek to the south, Robbins Ridge Lane to the north, Ridgeway Road to west, and just west of Kirby Road to the east. South Germantown subbasin has an area of 2,180 acres and is bounded by Noncannah Creek to the south, just north of Poplar Pike to the north, Quince Road to the west.

Approximately 90% of the study area is zoned residential. Residential areas to the west of I-240 are primarily single-family homes with a few green spaces, an elementary school, a church, and a few stores. Areas to the east of I-240 include single-family homes, several stores, a hospital, several schools, and several churches.

Section 2 – Existing Conditions

To understand how stormwater travels through and evaluate how stormwater affects the Ridgeway Basin drainage area, the project team determined the existing characteristics of the basin; surveyed stormwater conveyance infrastructure; and met with the City and the public to learn of drainage issues reported and/or experienced. This section of the report discusses the characteristics of the study area, describes the conveyance network, and summarizes known drainage issues in the study basin. The information gathered was utilized by the project team to create, calibrate, and validate the Ridgeway drainage area stormwater model. The incorporation of this data into the model is further described in Volume 2.

2.2 Study Area Characteristics

2.1.1 Topography

The Ridgeway basin study area has rolling topography and generally drains from north to south. There is about a 120-foot elevation difference between the uppermost reaches of Ridgeway and the lowest elevation discharge location at Nonconnah Creek. To the southwest of the basin, there are elevations ranging from 260 to 280. Moving south and east, the elevations range from 250 to 270. Continuing North and west, elevations rise to a range of 310 to 320.

2.1.2 Land Use and Land Cover

Most of the Ridgeway study area primarily consists of residential zoning classes with a small amount of industrial zoning in the far southeast and larger parcels of industrially zoned parcels in the north portion of the basin. The eastern edge of the basin is dominated by the University of Memphis Research Foundation (UMRF). Figure 5 depicts the land use distribution within the Ridgeway drainage area and **Error! Reference source not found.** summarizes the usage by acres.

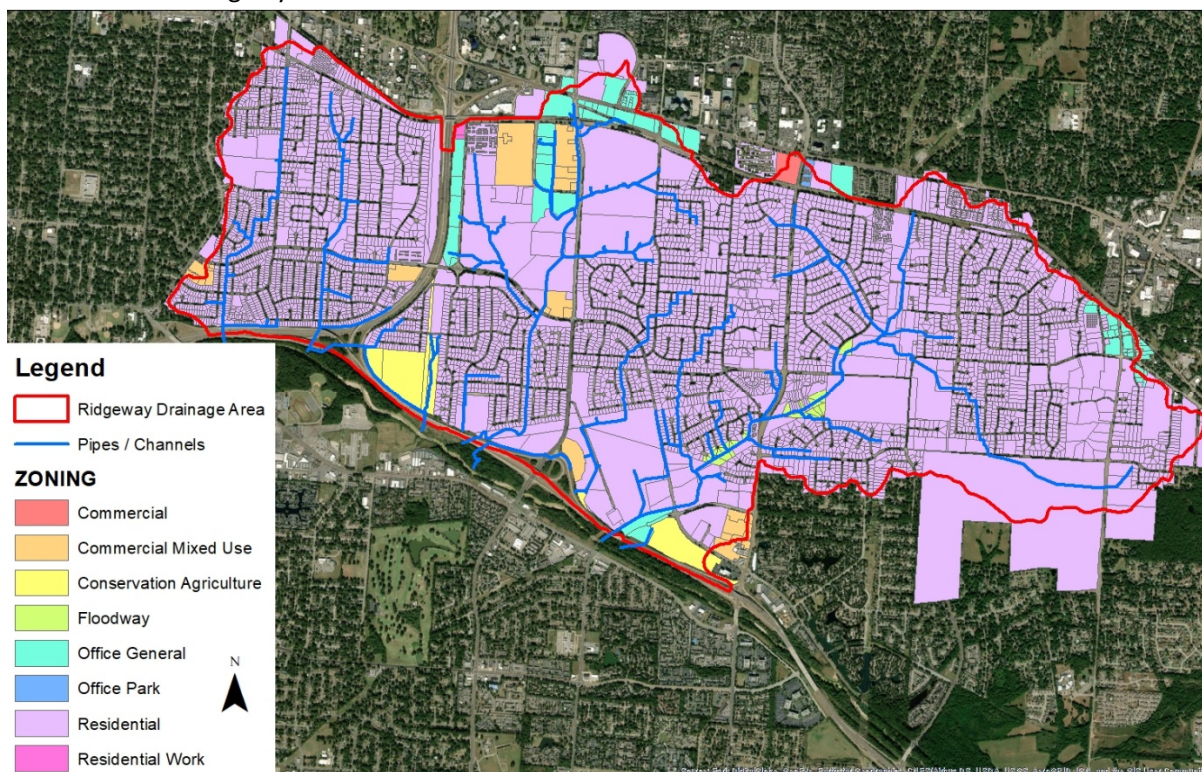


Figure 5: Land Use / Zoning Classification

Table 1: Land Use Distribution

Land Use Type	Area (acres)*
Residential	3780
Office	160
Conservation Agriculture	90
Commercial Mixed	30
Floodway	20
Commercial	10
TOTAL	4,090

*These values are actual land parcels from the county. These values do not include roads. As a result, these values are lower than the total number of acres modeled.

To help estimate impervious area in the basin, the 2011 United States Geological Survey (USGS) National Land Cover Database (NLCD) was referenced. The NLCD provides spatially explicit, 16-class land cover classifications at a spatial resolution of 30 meters, as well as estimates of percent imperviousness on a per pixel basis. The NLCD data was augmented by the use of aerial photography available through Google Maps/Earth.

In support of model construction, the Ridgeway drainage area was divided into 100 smaller drainage areas called subcatchments. The subcatchments range in size from approximately 2 acres to nearly 430 acres. Imperviousness within the individual subcatchments ranged from 10 percent to 84 percent. An average of imperviousness throughout the entire basin was calculated at 55 percent.

2.1.3 Soils

Soil data for the Ridgeway study area was obtained from the United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) Web Soil Survey, as well as published Soil Surveys. Based upon the NRCS soil data, the dominant soil association in the Ridgeway subbasin is filled land, silty which features somewhat poorly drained, strongly acid, mainly level silty soil on bottom lands. The dominant soil association for the Balmoral subbasin is Henry silt loam which features poorly drained silty soil on broad flats. Lastly, the dominant soil association in the South Germantown subbasin was Grenada silt loam which features moderately well drained silty soil that has a fragipan.

Figure 6, Figure 7, and Figure 8 depict the soil distribution in the study area and Table 2, Table 3, and Table 4 summarize the soil distribution and characteristics.

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Ridgeway Soils:

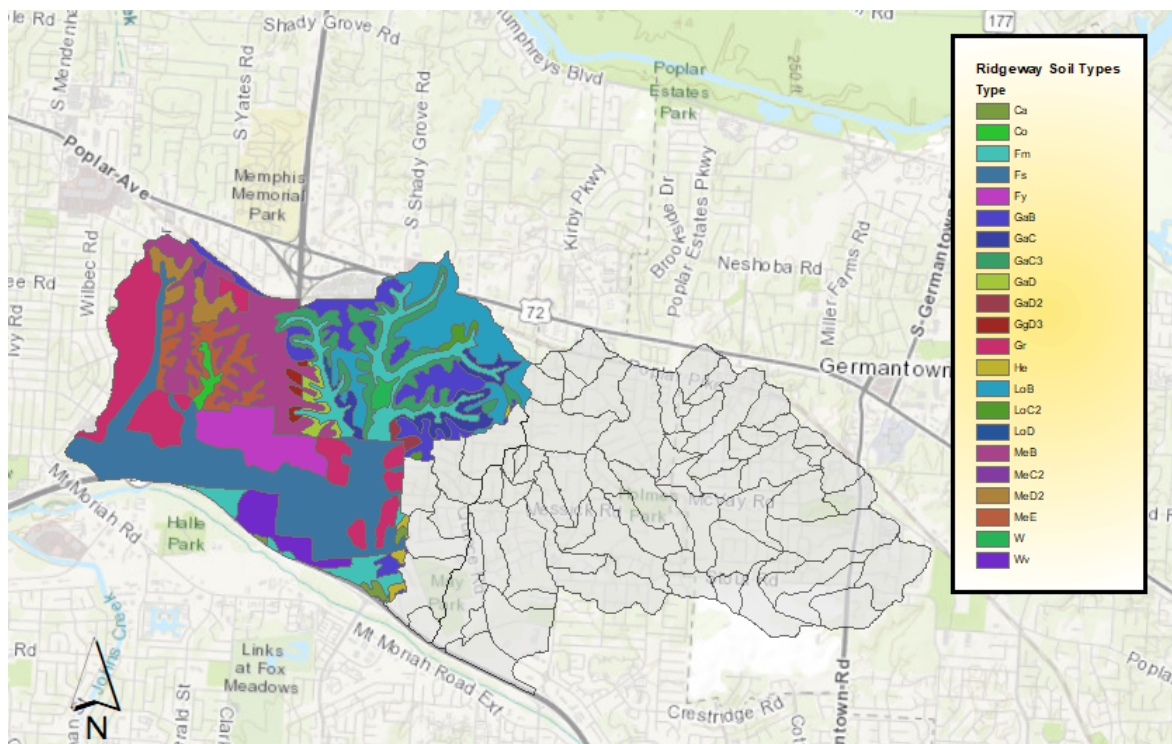


Figure 6: Ridgeway Soils

Table 2: Ridgeway Soils

Map unit symbol	Map Unit Name	Hydrologic Soil Rating	Acres in AOI	Percent of AOI
Ca	Calloway silt loam, 0 to 2 percent slopes	D	10.1	0.50%
Calloway silt loam consists of nearly level somewhat poorly drained soil that formed in loess. The surface layer is brown or dark greyish brown silt loam. The uppermost 20 inches is fairly well aerated and readily penetrated by roots and water, but the underlying fragipan restricts roots and slows drainage.				
Co	Collins silt loam, 0 to 2 percent slopes, occasionally flooded, brief duration	B	16.2	0.80%
Collins silt loam consists of deep, level, moderately well drained, silty soil on first bottoms. It has a silt loam texture to a depth of 3 feet or more. Grey mottles below a depth of about 18-inch are indications of wetness. The available water capacity is high and the water table is about 24 inches below the surface in winter and spring when some areas are flooded for short periods.				
Fm	Falaya silt loam	B/D	182.8	8.90%
Falaya silt loam consists of somewhat poorly drained, strongly acid, mainly level silty soil on bottom lands. The surface layer is brown, friable loam about 6" thick. In winter and spring, the water table is often within a foot of the surface. Floods cover most areas during winter and spring, but the floodwater seldom stands more than a few hours.				
Fs	Filled land, silty (udorthent, silty)		427.9	20.70%
Filled Land, silty consists of soil material that has been moved for leveling and building up sites for industrial, commercial, or residential development. This mapping includes some gravel pits that have been filled in and are suitable for farming.				

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Map unit symbol	Map Unit Name	Hydrologic Soil Rating	Acres in AOI	Percent of AOI
Fy	Filled land, sandy (udorthent, loamy)		114.8	5.60%
GaB	Grenada silt loam, 2 to 5 percent slopes	C/D	152.7	7.40%
Grenada silt loam consists of moderately, well drained, silty soil that has a fragipan. It formed in loess more than 4 feet thick. It is moderately well drained on broad ridgetops, uplands, and short side slopes as the percent slope increases. Runoff is slow and in the spring and soil dries out slowly. The uppermost 24 inches is readily penetrated by roots and water, but the underlying fragipan restricts roots and slows drainage.				
GaC	Grenada silt loam, 5 to 8 percent slopes	C/D	59.1	2.90%
Grenada silt loam consists of moderately, well drained, silty soil that has a fragipan. It formed in loess more than 4 feet thick. It is moderately well drained on broad ridgetops, uplands, and short side slopes as the percent slope increases. Runoff is slow and in the spring and soil dries out slowly. The uppermost 24 inches is readily penetrated by roots and water, but the underlying fragipan restricts roots and slows drainage.				
GaC3	Grenada silt loam, 5 to 8 percent slopes, severely eroded	D	139	6.70%
Grenada silt loam consists of moderately, well drained, silty soil that has a fragipan. It formed in loess more than 4 feet thick. It is moderately well drained on broad ridgetops, uplands, and short side slopes as the percent slope increases. Runoff is slow and in the spring and soil dries out slowly. The uppermost 24 inches is readily penetrated by roots and water, but the underlying fragipan restricts roots and slows drainage.				
GaD	Grenada silt loam, 8 to 12 percent slopes	C/D	21.5	1.00%
Grenada silt loam consists of moderately, well drained, silty soil that has a fragipan. It formed in loess more than 4 feet thick. It is moderately well drained on broad ridgetops, uplands, and short side slopes as the percent slope increases. Runoff is slow and in the spring and soil dries out slowly. The uppermost 24 inches is readily penetrated by roots and water, but the underlying fragipan restricts roots and slows drainage.				
GaD2	Grenada silt loam, 8 to 12 percent slopes, eroded	C/D	8.5	0.40%
Grenada silt loam consists of moderately, well drained, silty soil that has a fragipan. It formed in loess more than 4 feet thick. It is moderately well drained on broad ridgetops, uplands, and short side slopes as the percent slope increases. Runoff is slow and in the spring and soil dries out slowly. The uppermost 24 inches is readily penetrated by roots and water, but the underlying fragipan restricts roots and slows drainage.				
GgD3	Grenada complex, 5 to 12 percent slopes, severely eroded	C/D	10.9	0.50%
Grenada silt loam consists of moderately, well drained, silty soil that has a fragipan. It formed in loess more than 4 feet thick. It is moderately well drained on broad ridgetops, uplands, and short side slopes as the percent slope increases. Runoff is slow and in the spring and soil dries out slowly. The uppermost 24 inches is readily penetrated by roots and water, but the underlying fragipan restricts roots and slows drainage.				
Gr	Graded land, silty materials(udorthent, silty)		255.7	12.40%
Graded Land, silty consists of areas that have been graded in preparation for subdivisions and for commercial and industrial building. The slope after grading is generally 1% to 5%. In most areas the soil profiles have been disturbed to such an extent that they can no longer be identified; however, Grenada, Loring and Memphis soils were predominant in these areas before grading.				
He	Henry silt loam	D	10.7	0.50%

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Map unit symbol	Map Unit Name	Hydrologic Soil Rating	Acres in AOI	Percent of AOI
Henry silt loam consists of poorly drained silty soil on broad flats. Formed in loess, it is a nearly level silty soil. Surface runoff is slowed or ponded.				
LoB	Loring silt loam, 2 to 5 percent slopes	C	186.7	9.00%
Loring silt loam consists of deep, moderately well drained, nearly level to sloping silty soil that has a fragipan. It was formed in loess. The soil is strongly acid in reaction. The weak fragipan slightly retards aeration and drainage.				
LoC2	Loring silt loam, 5 to 8 percent slopes, eroded	C/D	11	0.50%
Loring silt loam consists of deep, moderately well drained, nearly level to sloping silty soil that has a fragipan. It was formed in loess. The soil is strongly acid in reaction. The weak fragipan slightly retards aeration and drainage.				
LoD	Loring silt loam, 8 to 12 percent slopes, east	C/D	4	0.20%
Loring silt loam consists of deep, moderately well drained, nearly level to sloping silty soil that has a fragipan. It was formed in loess. The soil is strongly acid in reaction. The weak fragipan slightly retards aeration and drainage.				
MeB	Memphis silt loam, 2 to 5 percent slopes, northern phase	B	243.9	11.80%
Memphis silt loam is a deep, well drained, strongly acid soil on uplands. Formed in loess, it is strongly acid and the root zone is very deep. The available water capacity is high. Runoff is the main limitation and erosion is the main management problem.				
MeC2	Memphis silt loam, 5 to 8 percent slopes, eroded	B	3.9	0.20%
Memphis silt loam is a deep, well drained, strongly acid soil on uplands. Formed in loess, it is strongly acid and the root zone is very deep. The available water capacity is high. Runoff is the main limitation and erosion is the main management problem.				
MeD2	Memphis silt loam, 8 to 12 percent slopes, eroded	B	44.4	2.20%
Memphis silt loam is a deep, well drained, strongly acid soil on uplands. Formed in loess, it is strongly acid and the root zone is very deep. The available water capacity is high. Runoff is the main limitation and erosion is the main management problem.				
MeE	Memphis silt loam, 12 to 20 percent slopes	B	89.1	4.30%
Memphis silt loam is a deep, well drained, strongly acid soil on uplands. Formed in loess, it is strongly acid and the root zone is very deep. The available water capacity is high. Runoff is the main limitation and erosion is the main management problem.				
W	Water		12.5	0.60%
Area holding water – perennial lakes and ponds				
Wv	Waverly silt loam, 0 to 2 percent slopes, occasionally flooded, long duration	B/D	59.6	2.90%
Waverly Series consists of poorly drained, level, silty soils on low, broad first bottoms. Waverly silt loam is found along the small rivers and creeks. This soil is flooded nearly every year. Water stands in low spots and excess water drains away slowly.				
Totals for Area of Interest			2,064.90	100.00%

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Balmoral Soils:

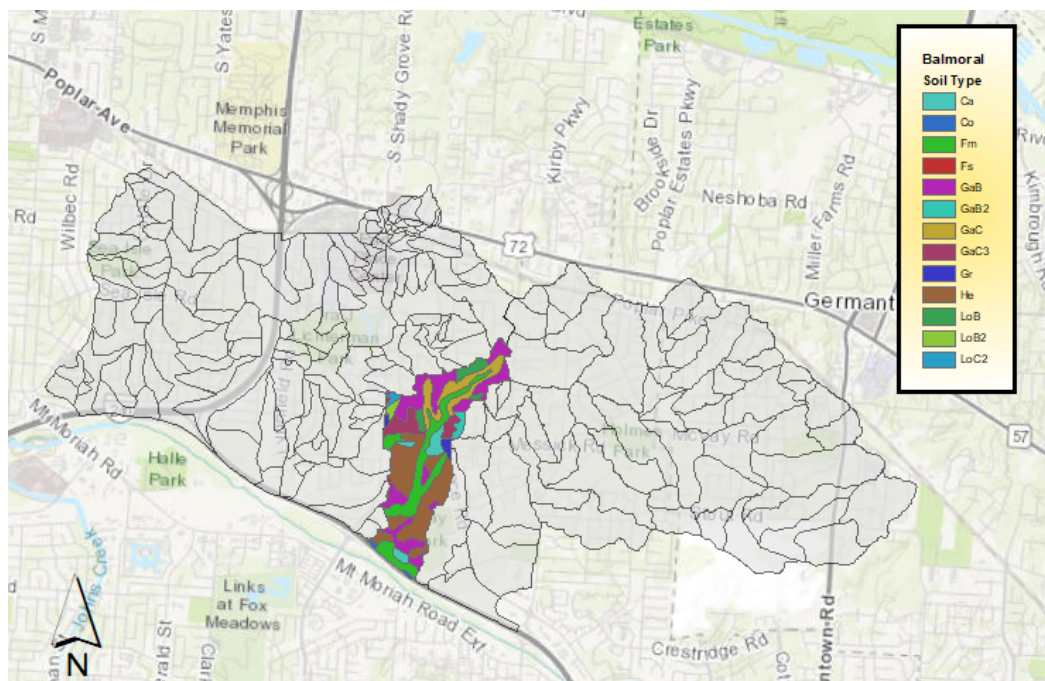


Figure 7: Balmoral Soils

Table 3: Balmoral Soils

Map unit symbol	Map Unit Name	Hydrologic Soil Rating	Acres in AOI	Percent of AOI
Ca	Calloway silt loam, 0 to 2 percent slopes	D	12.6	4.30%
Calloway silt loam consists of nearly level somewhat poorly drained soil that formed in loess. The surface layer is brown or dark greyish brown silt loam. The uppermost 20 inches is fairly well aerated and readily penetrated by roots and water, but the underlying fragipan restricts roots and slows drainage.				
Co	Collins silt loam, 0 to 2 percent slopes, occasionally flooded, brief duration	B	1.9	0.60%
Collins silt loam consists of deep, level, moderately well drained, silty soil on first bottoms. It has a silt loam texture to a depth of 3 feet or more. Grey mottles below a depth of about 18-inch are indications of wetness. The available water capacity is high and the water table is about 24 inches below the surface in winter and spring when some areas are flooded for short periods.				
Fm	Falaya silt loam	B/D	54.9	18.80%
Falaya silt loam consists of somewhat poorly drained, strongly acid, mainly level silty soil on bottom lands. The surface layer is brown, friable loam about 6" thick. In winter and spring, the water table is often within a foot of the surface. Floods cover most areas during winter and spring, but the floodwater seldom stands more than a few hours.				
Fs	Filled land, silty (udorthent, silty)		1	0.30%
Filled Land, silty consists of soil material that has been moved for leveling and building up sites for industrial, commercial, or residential development. This mapping includes some gravel pits that have been filled in and are suitable for farming.				
GaB	Grenada silt loam, 2 to 5 percent slopes	C/D	70.5	24.10%

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Map unit symbol	Map Unit Name	Hydrologic Soil Rating	Acre in AOI	Percent of AOI
Grenada silt loam consists of moderately, well drained, silty soil that has a fragipan. It formed in loess more than 4 feet thick. It is moderately well drained on broad ridgetops, uplands, and short side slopes as the percent slope increases. Runoff is slow and in the spring and soil dries out slowly. The uppermost 24 inches is readily penetrated by roots and water, but the underlying fragipan restricts roots and slows drainage.				
GaB2	Grenada silt loam, 2 to 5 percent slopes, eroded	C	4.9	1.70%
Grenada silt loam consists of moderately, well drained, silty soil that has a fragipan. It formed in loess more than 4 feet thick. It is moderately well drained on broad ridgetops, uplands, and short side slopes as the percent slope increases. Runoff is slow and in the spring and soil dries out slowly. The uppermost 24 inches is readily penetrated by roots and water, but the underlying fragipan restricts roots and slows drainage.				
GaC	Grenada silt loam, 5 to 8 percent slopes	C/D	30.2	10.30%
Grenada silt loam consists of moderately, well drained, silty soil that has a fragipan. It formed in loess more than 4 feet thick. It is moderately well drained on broad ridgetops, uplands, and short side slopes as the percent slope increases. Runoff is slow and in the spring and soil dries out slowly. The uppermost 24 inches is readily penetrated by roots and water, but the underlying fragipan restricts roots and slows drainage.				
GaC3	Grenada silt loam, 5 to 8 percent slopes, severely eroded	D	18.4	6.30%
Grenada silt loam consists of moderately, well drained, silty soil that has a fragipan. It formed in loess more than 4 feet thick. It is moderately well drained on broad ridgetops, uplands, and short side slopes as the percent slope increases. Runoff is slow and in the spring and soil dries out slowly. The uppermost 24 inches is readily penetrated by roots and water, but the underlying fragipan restricts roots and slows drainage.				
Gr	Graded land, silty materials (udorthent, silty)		4.5	1.50%
Graded Land, silty consists of areas that have been graded in preparation for subdivisions and for commercial and industrial building. The slope after grading is generally 1% to 5%. In most areas the soil profiles have been disturbed to such an extent that they can no longer be identified; however, Grenada, Loring and Memphis soils were predominant in these areas before grading.				
He	Henry silt loam	D	76.2	26.00%
Henry silt loam consists of poorly drained silty soil on broad flats. Formed in loess, it is a nearly level silty soil. Surface runoff is slowed or ponded.				
LoB	Loring silt loam, 2 to 5 percent slopes	C	11.9	4.10%
Loring silt loam consists of deep, moderately well drained, nearly level to sloping silty soil that has a fragipan. It was formed in loess. The soil is strongly acid in reaction. The weak fragipan slightly retards aeration and drainage.				
LoB2	Loring silt loam, 2 to 5 percent slopes, eroded	C/D	3.2	1.10%
Loring silt loam consists of deep, moderately well drained, nearly level to sloping silty soil that has a fragipan. It was formed in loess. The soil is strongly acid in reaction. The weak fragipan slightly retards aeration and drainage.				
LoC2	Loring silt loam, 5 to 8 percent slopes, eroded	C/D	2.5	0.80%
Loring silt loam consists of deep, moderately well drained, nearly level to sloping silty soil that has a fragipan. It was formed in loess. The soil is strongly acid in reaction. The weak fragipan slightly retards aeration and drainage.				
Totals for Area of Interest			292.4	100.00%

South Germantown Soils:

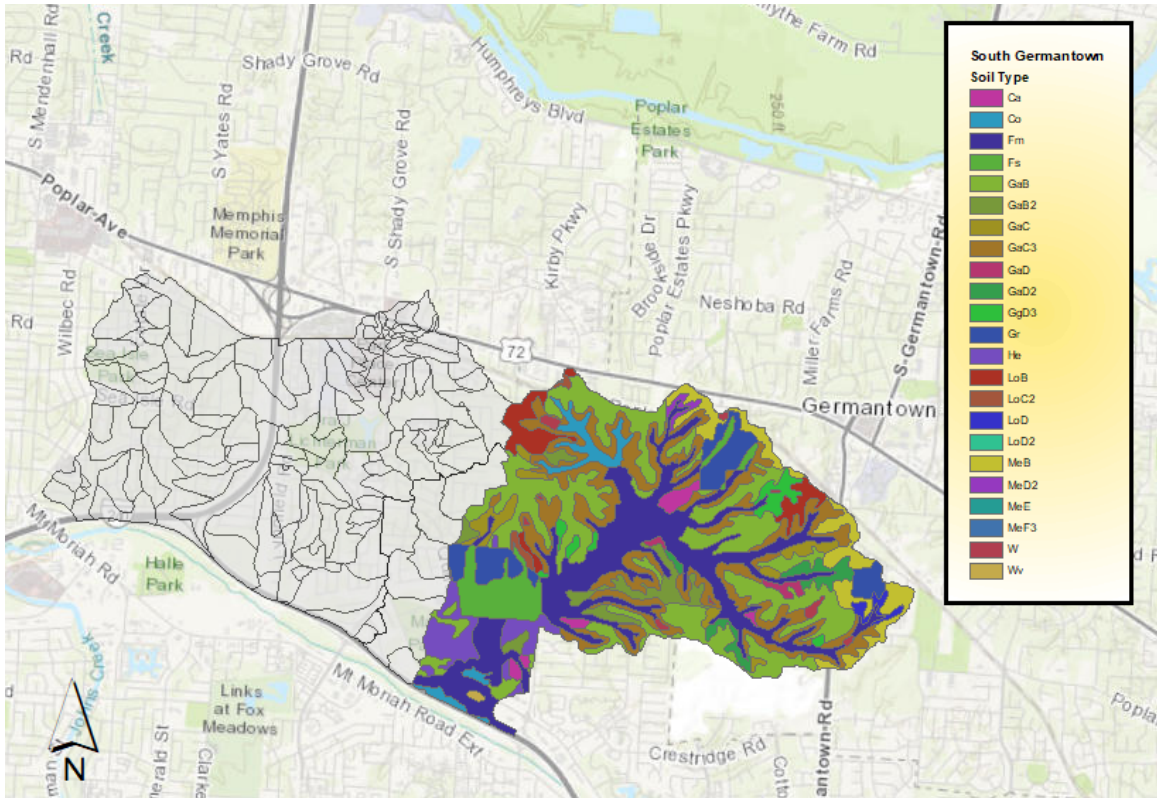


Figure 8: South Germantown Soils

Table 4: South Germantown Soils

Map unit symbol	Map Unit Name	Hydrologic Soil Rating	Acres in AOI	Percent of AOI
Ca	Calloway silt loam, 0 to 2 percent slopes	D	27.5	1.30%
<p>Calloway silt loam consists of nearly level somewhat poorly drained soil that formed in loess. The surface layer is brown or dark greyish brown silt loam. The uppermost 20 inches is fairly well aerated and readily penetrated by roots and water, but the underlying fragipan restricts roots and slows drainage.</p>				
Co	Collins silt loam, 0 to 2 percent slopes, occasionally flooded, brief duration	B	56	2.60%
<p>Collins silt loam consists of deep, level, moderately well drained, silty soil on first bottoms. It has a silt loam texture to a depth of 3 feet or more. Grey mottles below a depth of about 18-inch are indications of wetness. The available water capacity is high and the water table is about 24 inches below the surface in winter and spring when some areas are flooded for short periods.</p>				
Fm	Falaya silt loam	B/D	462.1	21.20%
<p>Falaya silt loam consists of somewhat poorly drained, strongly acid, mainly level silty soil on bottom lands. The surface layer is brown, friable loam about 6" thick. In winter and spring, the water table is often within a foot of the surface. Floods cover most areas during winter and spring, but the floodwater seldom stands more than a few hours.</p>				
Fs	Filled land, silty (udorthent, silty)		92.5	4.30%

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Map unit symbol	Map Unit Name	Hydrologic Soil Rating	Acres in AOI	Percent of AOI
Filled Land, silty consists of soil material that has been moved for leveling and building up sites for industrial, commercial, or residential development. This mapping includes some gravel pits that have been filled in and are suitable for farming.				
GaB	Grenada silt loam, 2 to 5 percent slopes	C/D	495.5	22.80%
Grenada silt loam consists of moderately, well drained, silty soil that has a fragipan. It formed in loess more than 4 feet thick. It is moderately well drained on broad ridgetops, uplands, and short side slopes as the percent slope increases. Runoff is slow and in the spring and soil dries out slowly. The uppermost 24 inches is readily penetrated by roots and water, but the underlying fragipan restricts roots and slows drainage.				
GaB2	Grenada silt loam, 2 to 5 percent slopes, eroded	C	72.5	3.30%
Grenada silt loam consists of moderately, well drained, silty soil that has a fragipan. It formed in loess more than 4 feet thick. It is moderately well drained on broad ridgetops, uplands, and short side slopes as the percent slope increases. Runoff is slow and in the spring and soil dries out slowly. The uppermost 24 inches is readily penetrated by roots and water, but the underlying fragipan restricts roots and slows drainage.				
GaC	Grenada silt loam, 5 to 8 percent slopes	C/D	50.7	2.30%
Grenada silt loam consists of moderately, well drained, silty soil that has a fragipan. It formed in loess more than 4 feet thick. It is moderately well drained on broad ridgetops, uplands, and short side slopes as the percent slope increases. Runoff is slow and in the spring and soil dries out slowly. The uppermost 24 inches is readily penetrated by roots and water, but the underlying fragipan restricts roots and slows drainage.				
GaC3	Grenada silt loam, 5 to 8 percent slopes, severely eroded	D	392.4	18.00%
Grenada silt loam consists of moderately, well drained, silty soil that has a fragipan. It formed in loess more than 4 feet thick. It is moderately well drained on broad ridgetops, uplands, and short side slopes as the percent slope increases. Runoff is slow and in the spring and soil dries out slowly. The uppermost 24 inches is readily penetrated by roots and water, but the underlying fragipan restricts roots and slows drainage.				
GaD	Grenada silt loam, 8 to 12 percent slopes	C/D	11.2	0.50%
Grenada silt loam consists of moderately, well drained, silty soil that has a fragipan. It formed in loess more than 4 feet thick. It is moderately well drained on broad ridgetops, uplands, and short side slopes as the percent slope increases. Runoff is slow and in the spring and soil dries out slowly. The uppermost 24 inches is readily penetrated by roots and water, but the underlying fragipan restricts roots and slows drainage.				
GaD2	Grenada silt loam, 8 to 12 percent slopes, eroded	C/D	41.6	1.90%
Grenada silt loam consists of moderately, well drained, silty soil that has a fragipan. It formed in loess more than 4 feet thick. It is moderately well drained on broad ridgetops, uplands, and short side slopes as the percent slope increases. Runoff is slow and in the spring and soil dries out slowly. The uppermost 24 inches is readily penetrated by roots and water, but the underlying fragipan restricts roots and slows drainage.				
GgD3	Grenada complex, 5 to 12 percent slopes, severely eroded	C/D	38.8	1.80%
Gr	Graded land, silty materials(udorthent, silty)		112.7	5.20%

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Map unit symbol	Map Unit Name	Hydrologic Soil Rating	Acres in AOI	Percent of AOI
Graded Land, silty consists of areas that have been graded in preparation for subdivisions and for commercial and industrial building. The slope after grading is generally 1% to 5%. In most areas the soil profiles have been disturbed to such an extent that they can no longer be identified; however, Grenada, Loring and Memphis soils were predominant in these areas before grading.				
He	Henry silt loam	D	81.9	3.80%
Henry silt loam consists of poorly drained silty soil on broad flats. Formed in loess, it is a nearly level silty soil. Surface runoff is slowed or ponded.				
LoB	Loring silt loam, 2 to 5 percent slopes	C	72.2	3.30%
Loring silt loam consists of deep, moderately well drained, nearly level to sloping silty soil that has a fragipan. It was formed in loess. The soil is strongly acid in reaction. The weak fragipan slightly retards aeration and drainage.				
LoC2	Loring silt loam, 5 to 8 percent slopes, eroded	C/D	9.1	0.40%
Loring silt loam consists of deep, moderately well drained, nearly level to sloping silty soil that has a fragipan. It was formed in loess. The soil is strongly acid in reaction. The weak fragipan slightly retards aeration and drainage.				
LoD	Loring silt loam, 8 to 12 percent slopes, east	C/D	13	0.60%
Loring silt loam consists of deep, moderately well drained, nearly level to sloping silty soil that has a fragipan. It was formed in loess. The soil is strongly acid in reaction. The weak fragipan slightly retards aeration and drainage.				
LoD2	Loring silt loam, 8 to 12 percent slopes, eroded	C/D	0	0.00%
Loring silt loam consists of deep, moderately well drained, nearly level to sloping silty soil that has a fragipan. It was formed in loess. The soil is strongly acid in reaction. The weak fragipan slightly retards aeration and drainage.				
MeB	Memphis silt loam, 2 to 5 percent slopes, northern phase	B	119.1	5.50%
Memphis silt loam is a deep, well drained, strongly acid soil on uplands. Formed in loess, it is strongly acid and the root zone is very deep. The available water capacity is high. Runoff is the main limitation and erosion is the main management problem.				
MeD2	Memphis silt loam, 8 to 12 percent slopes, eroded	B	8.8	0.40%
Memphis silt loam is a deep, well drained, strongly acid soil on uplands. Formed in loess, it is strongly acid and the root zone is very deep. The available water capacity is high. Runoff is the main limitation and erosion is the main management problem.				
MeE	Memphis silt loam, 12 to 20 percent slopes	B	0.1	0.00%
Memphis silt loam is a deep, well drained, strongly acid soil on uplands. Formed in loess, it is strongly acid and the root zone is very deep. The available water capacity is high. Runoff is the main limitation and erosion is the main management problem.				
MeF3	Memphis silt loam, 12 to 30 percent slopes, severely eroded	B	0	0.00%

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Map unit symbol	Map Unit Name	Hydrologic Soil Rating	Acres in AOI	Percent of AOI
Memphis silt loam is a deep, well drained, strongly acid soil on uplands. Formed in loess, it is strongly acid and the root zone is very deep. The available water capacity is high. Runoff is the main limitation and erosion is the main management problem.				
W	Water		15.7	0.70%
Area holding water – perennial lakes and ponds				
Wv	Waverly silt loam, 0 to 2 percent slopes, occasionally flooded, long duration	B/D	2.90	0.10%
Waverly Series consists of poorly drained, level, silty soils on low, broad first bottoms. Waverly silt loam is found along the small rivers and creeks. This soil is flooded nearly every year. Water stands in low spots and excess water drains away slowly.				
Totals for Area of Interest			2,176.30	100%

2.1.4 Precipitation

According to various reporting sources, the annual average precipitation in Memphis ranges from 49.7 to 53.7 inches. Precipitation is somewhat evenly distributed throughout the year at each location with March through May and November through December typically the wetter months. The monthly average precipitation from various sources is presented in Table 5.

Three project rain gauges were temporarily located within the Ridgeway drainage basin. Five-minute rainfall data was recorded at the gauges from December 2017 to April 2018 and collected by the University of Memphis Research Foundation (UMRF) personnel on behalf of the City of Memphis for use in calibration of the Ridgeway stormwater model.

The rain gauges were located in the basin as follows.

- EM28446: Fire Station No. 21 – S. Mendenhall Road, north of Poplar Avenue
- EM28449: Fire Station No. 25 – Willow Road, north of Overton High School
- EM28451: Fire Station No. 41 – Ridgeway Road, north of Quince Road

Monthly precipitation totals collected by the three rain gages are provided in Table 5 along with the historic data. Data from the three monitoring stations demonstrates that precipitation across the basin may vary greatly. Figure 9 through Figure 11 shows the rain fall depths collected at each of these Fire Stations.

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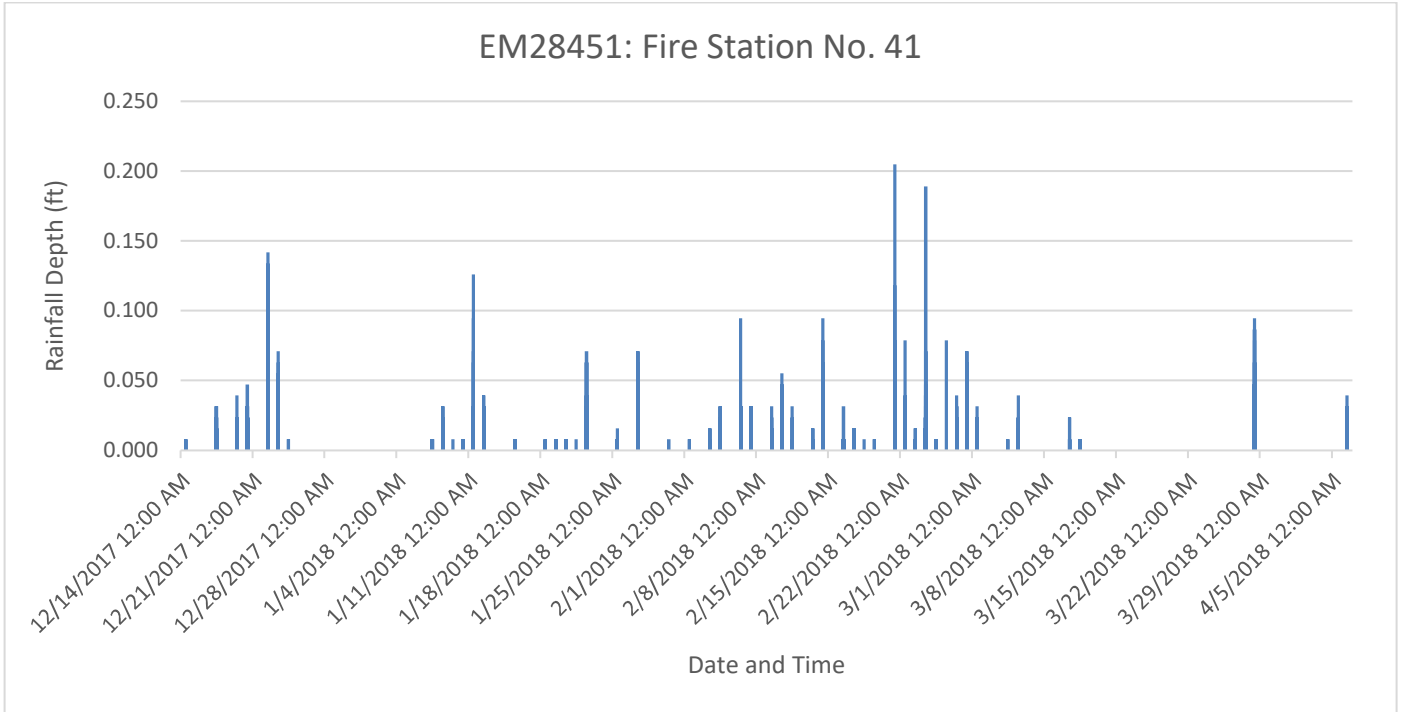


Figure 11: Fire Station No. 41 Rainfall Data

Figure 12 shows a map of the stream and rain gauge locations.

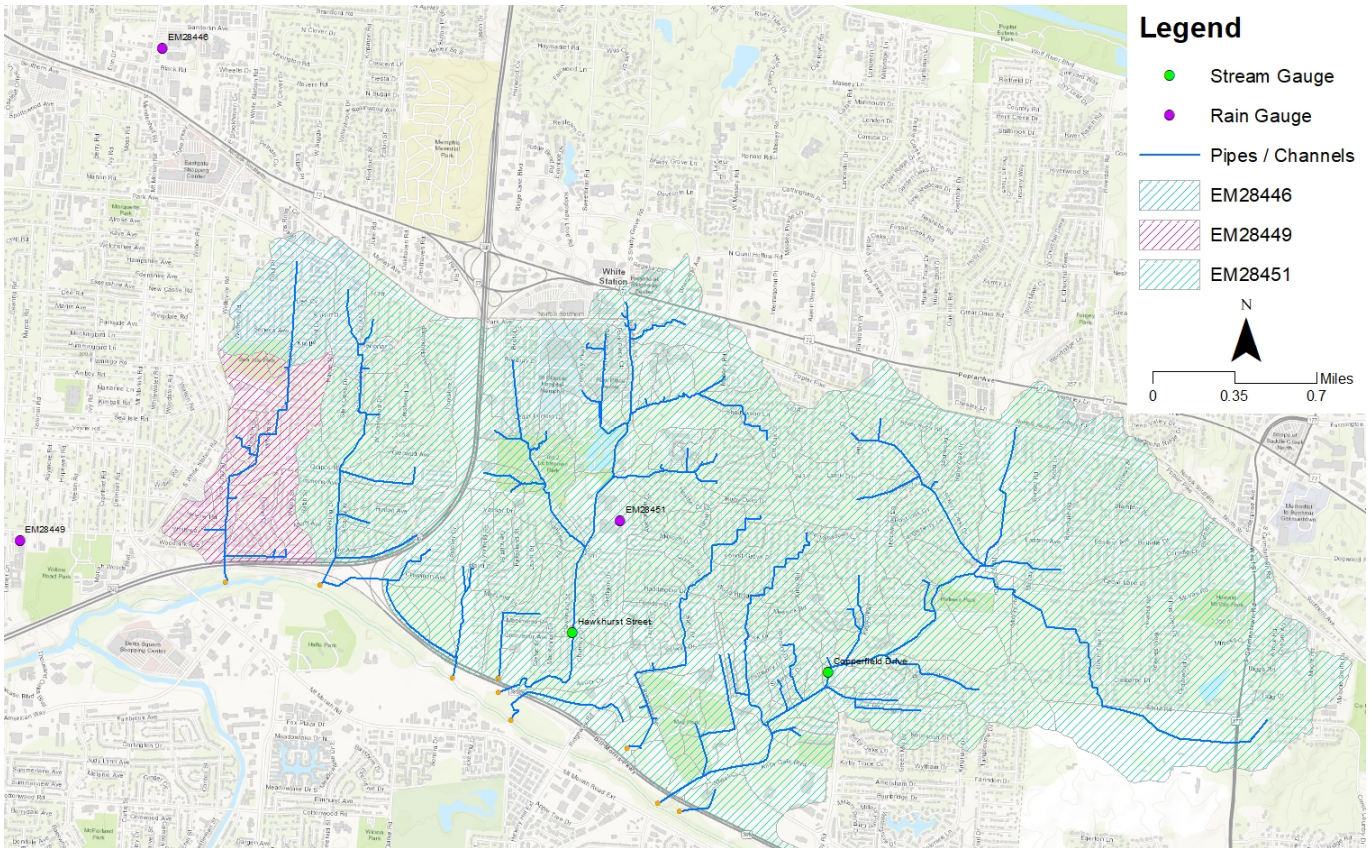


Figure 12: Rain and Stream Gauge Locations

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Table 5: Monthly Average Precipitation (Inches)

Month	Memphis Int'l Airport per U.S. Climate Data (1981-2010)	USGS	NOAA (1961-1990)	EM28446* Fire Station No. 21	EM28449* Fire Station No. 25	EM28451* Fire Station No. 41
January	4.0	6.1	4.3	3.5	3.6	4.0
February	4.4	4.7	4.5	13.3	13.8	15.3
March	5.2	5.1	5.4	3.6	3.8	3.7
April	5.5	4.6	5.2	0.3**	0.4**	0.3**
May	5.2	4.2	5.2	-	-	-
June	3.6	3.7	3.8	-	-	-
July	4.6	3.5	4.0	-	-	-
August	2.9	3.0	3.3	-	-	-
September	3.1	2.8	3.6	-	-	-
October	4.0	2.7	3.2	-	-	-
November	5.5	4.4	4.9	-	-	-
December	5.7	4.9	4.5	6.1**	5.7**	6.3**
Total	53.7	49.7	52.8	26.8**	27.3**	29.6**

* Project rain gages collected data from 12/14/17 through 4/12/18

** Partial period

2.1.5 Stream Flow

Two stream gauges were temporarily located in the Ridgeway Basin. Similarly, the precipitation gages, five-minute stream depth was recorded at the gauges from October 2017 to April 2018 and collected by the UMRF personnel on behalf of the City of Memphis for use in calibration of the Ridgeway stormwater model.

The stream level gauges were located as follows:

- Cooperhill Dr (2030639) – Ridgeway, west of Copperfield Drive near Kirby Road
- Hawkhurst St (2034477) – Ridgeway, east of Hawkhurst Street near Bill Morris Parkway

The Cooperhill Dr gauge was located in the main South Germantown channel just downstream (southwest) of Kirby Road. This location was just downstream of a road crossing and is a natural channel. The channel upstream and downstream of Kirby Road were fairly wide and open approximately 70-feet wide and 10-feet deep.

The Hawkhurst St gauge was located in a Ridgeway channel just downstream (south) of Macinness Drive. This location was just downstream of a box culvert (road crossing) and a transition from concrete channel to concrete box to concrete channel. The channel upstream and downstream of the box were fairly wide, open and straight approximately 40-feet wide and 10-feet deep. Figure 13 and Figure 14 includes a chart of observed precipitation at each gage throughout the monitoring period.

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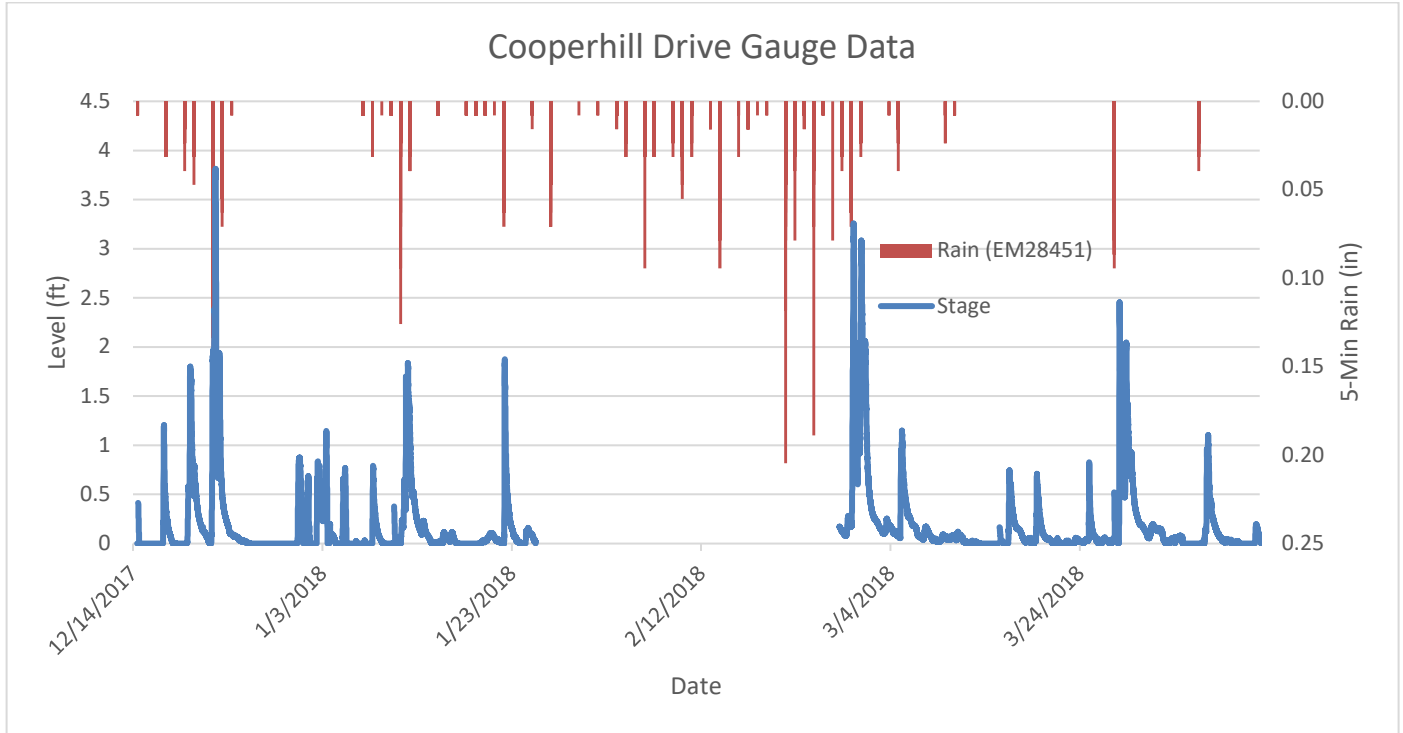


Figure 13: Cooperhill Drive Gauge Data

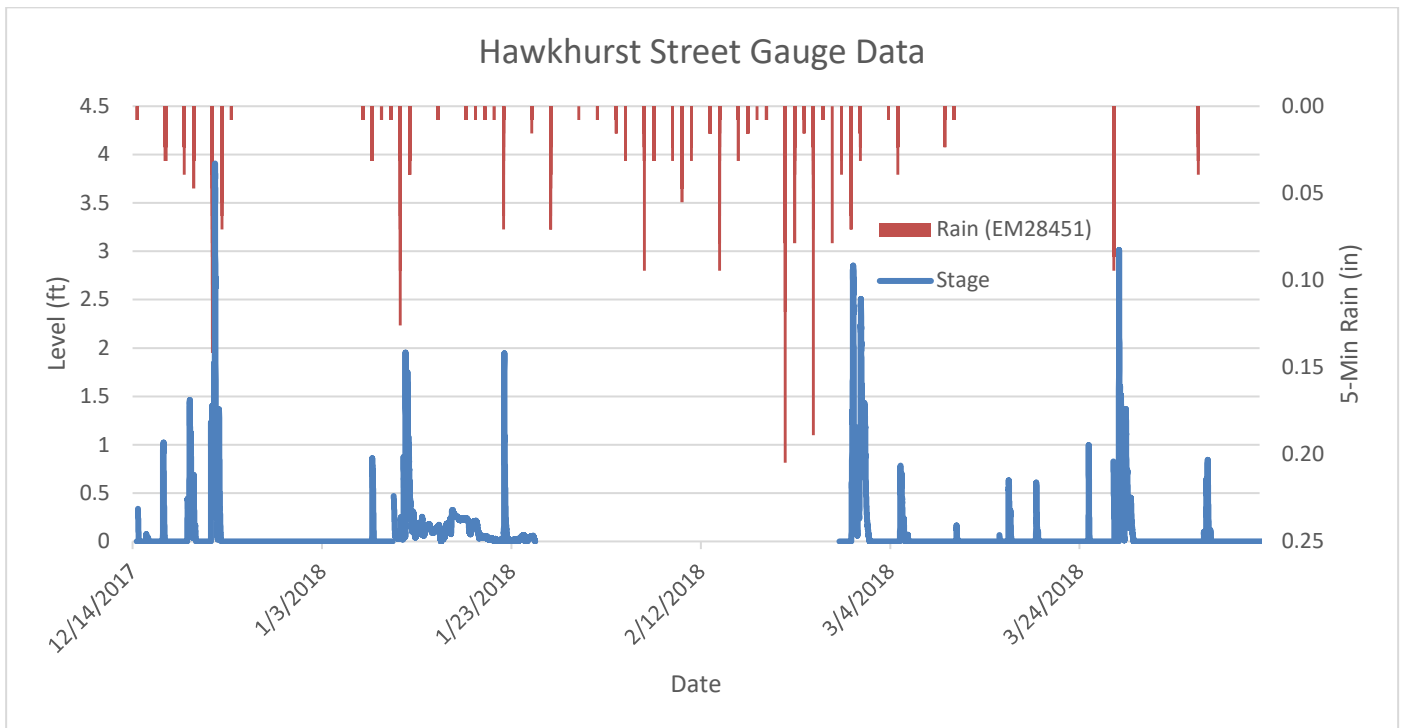


Figure 14: Hawkhurst Street Gauge Data

For the most part, both locations had fairly reliable depth readings throughout the monitoring period. The biggest issue during monitoring period was the possibility of freezing temperatures during the winter which could result in errors in depth measurement. Temperature, in Celsius, was recorded at each gauge. Thus, only gauge data recorded for temperatures above freezing were used for model calibration purposes.

2.1.6 Federal Emergency Management Agency (FEMA) Flood Insurance Study (FIS)

The Ridgeway drainage system discharges to the Nonconnah Creek. The 2013 Federal Emergency Management Agency (FEMA) Flood Insurance Study (FIS) for Shelby County, Tennessee has developed flood risk data for various areas of Shelby County for the purpose of establishing flood insurance rates. Ridgeway was studied from its confluence with Nonconnah Creek, where the base floodwater surface elevation is 227.3 feet, southward approximately 3.5 miles to Millbranch Road where the regulatory base flood water surface elevation is 240.3. Figure 15 depicts the floodway and the 1.0 percent and the 0.2 percent annual chance of flood hazard, traditionally referred to as the 100-year floodplain and 500-year floodplain, for the Ridgeway drainage area as determined by the FEMA FIS.

The 2013 FEMA FIS Flood Profile for Ridgeway (Panel 79) shows a 1 percent annual chance of backwater extending about 0.8 miles upstream from the Confluence with Mckellar Lake. No impacts from Nonconnah Creek were assumed for this study, especially due to backwater from the Mississippi.

As will be summarized in Section 3 of this report, flooding and drainage issues reported by the residents through surveys and public meetings are occurring in the upper reaches of the Ridgeway drainage area outside the floodway and floodplain areas defined by FEMA.

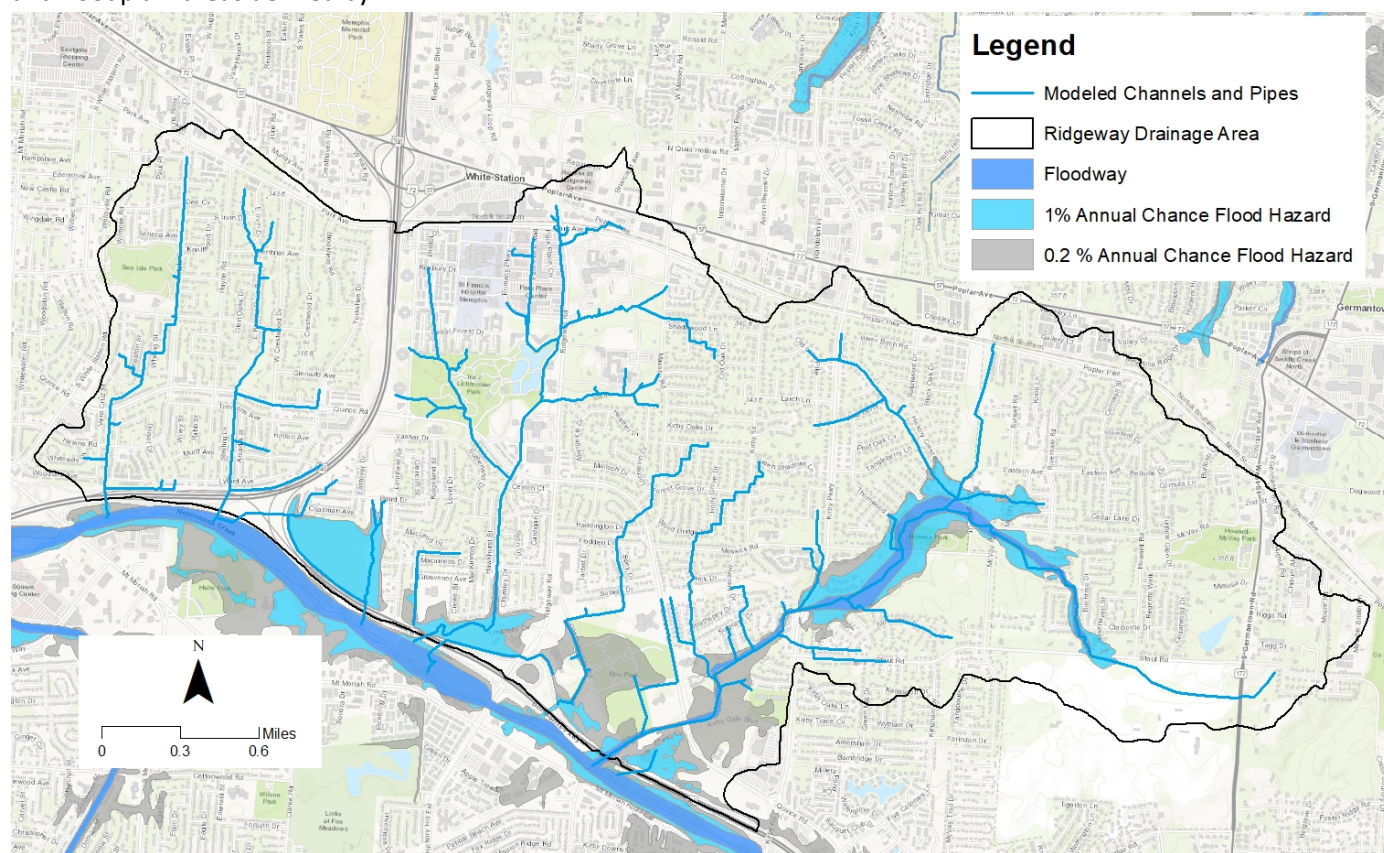


Figure 15: FEMA Inundation Areas

2.3 System Inventory

The Ridgeway Basin is bounded by the Nonconnah Creek to the south, Park Avenue (which changes to Poplar Pike) to the north, just east of South Germantown Road to the east, and just west of White Station Road to the west. With few exceptions, the stormwater is collected in circular pipes and flows downstream into an open channel network. The water will flow through a culvert at rectangular pipes (road crossings) before flowing into the Nonconnah Creek.

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Figure 16 depicts the major portions of the Ridgeway drainage network. These are the components that were incorporated into the computer model for analysis.

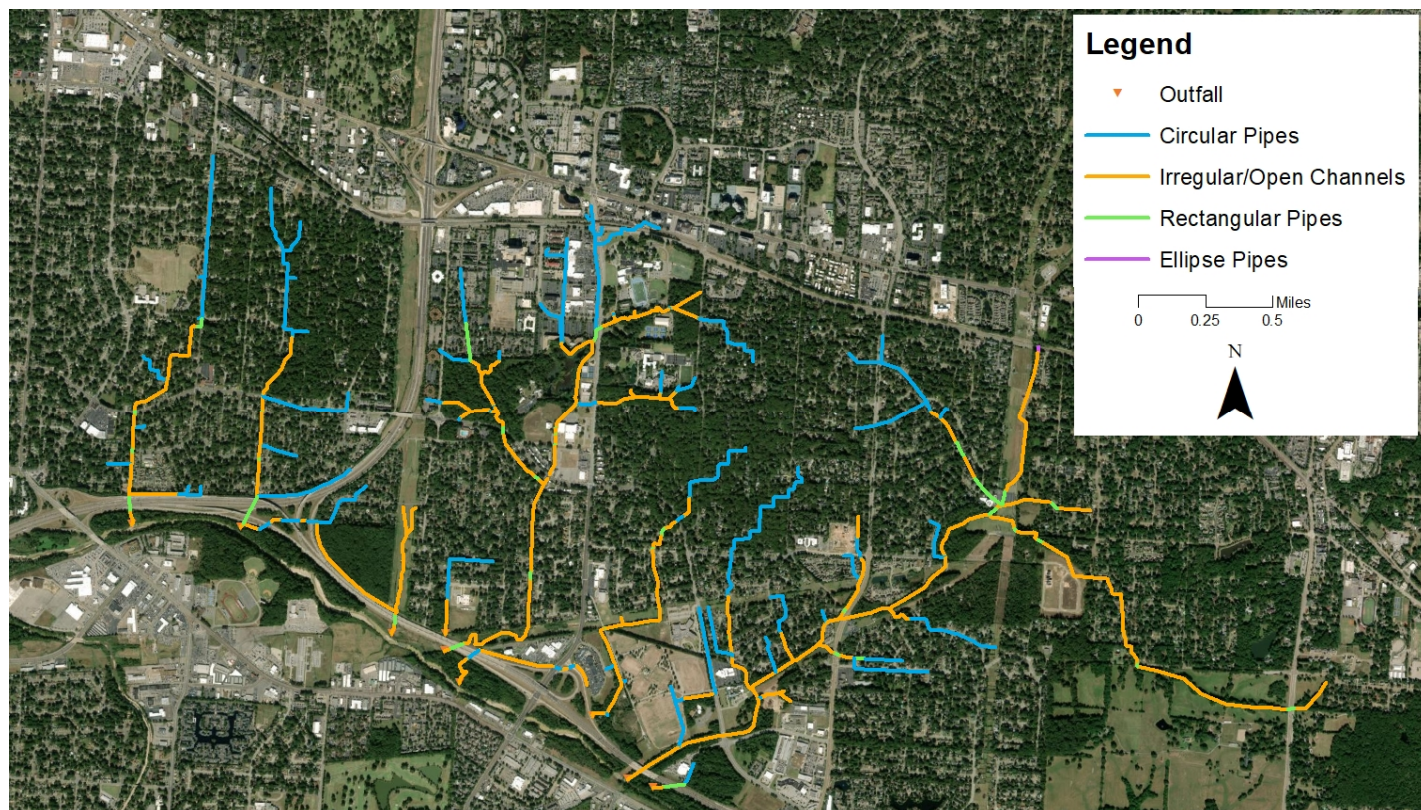


Figure 16: Modeled Network by Channel Type

2.3.1 GIS

Existing data regarding the Ridgeway study area previously gathered by the city was provided to the study team in GIS format. Several layers were furnished including topographic contours, roads, parcels and the drainage network. Additionally, the University of Memphis Center for Applied Sciences and Engineering Research (CEASER) had performed a desktop review of record drawings and aerial photography to locate drainage structures and channels in the study area. A link to the record drawings was included in the City furnished files. The following text summarizes how the project team utilized and supplemented the City furnished GIS files in support of this study.

- Record drawings: Scanned drawings from previous development projects were available in the GIS by link to a server supported by CEASER. The drawings consisted of record information in a variety of formats ranging from a full set of plans to simply a plan page showing a section of a utility feature. These drawings were referenced as the survey progressed in determining system connectivity and when considering improvement scenarios.
- Topographic information: Cross-sections of drainage channels were surveyed by the project team. The GIS-based topographic information furnished by the City was utilized as the main source of topographic information beyond the top of bank within the study area.
- Drainage Features: Primary drainage features depicted in the GIS including channels, pipes, inlets, and crossings were field surveyed and confirmed in a separate GIS layer.
- Photographic Inventory: As a part of the drainage study, all surveyed road crossings and outfalls were

photographed. These photographs have been georeferenced as a layer in the GIS.

- Several photographs revealed maintenance issues that were summarized and provided to the City for appropriate action. These photos were provided to the City of Memphis.
- Complaints and Known Flooding Conditions: Through public meetings and discussions with the City, known flooding conditions were reviewed with the city and site visits were made. Known Flooding Conditions were discussed with the Owner of the complaint.
- Model Features: The City's GIS files have been updated with new layers utilized for model construction including channel centerlines, pipe network, nodes, and overland flow path and model development including 100-year floodplain, hydrologic basins, land use, and soil types.
- Existing Conditions and Improvement Scenarios: Model results including the modeled portion of the drainage network and the mapped results of inundation for the existing conditions and improvement scenarios for the 2-, 5-, 10-, 25-, 50-, and 100-year storm events have been added to the GIS in new layers.

The new and updated GIS layers are included in the final electronic delivery of the study.

2.3.2 Survey

To facilitate the Ridgeway drainage study and in particular the development of the stormwater model, the following features were surveyed.

- Stream gauge locations: A cross section of the channel and the elevation of each stream gauge were surveyed. The surveyed data allowed the modeler to determine the elevation and estimate the cross-sectional area of the flow in at each gauge location.
- Open channels: Both vegetative and concrete channels were surveyed. Cross sections were surveyed at varying intervals to delineate each significant change in channel geometry, changes in direction of flow, at points of concentrated stormwater discharge, and upstream and downstream of structure crossings. The general spacing of surveyed cross sections was kept at 500 feet or less.
- Pipes 24 inches and larger in the drainage network: The existing GIS files were utilized to identify the general location of the piped drainage network. The piping system was then followed upstream with the survey stopping once the piping reduced to less than 24 inches.
- Pipes downstream of a flooding concern: Through public meetings and discussions with the City, known flooding conditions were documented in the GIS. The drainage networks downstream of these known flooding conditions were surveyed regardless of size.
- Structures: Structures including headwalls, bridges, and inlets were surveyed.

Final quantities for Ridgeway field surveys were 449 Inlets, 353 pipe segments, 337 cross sections, and 5880 total survey points.

In addition to the delivering the survey information in GIS format, an AutoCAD point file of the surveyed features is also a part of the final electronic delivery of the study.

2.3 Public Outreach

2.3.1 Public Identified Drainage Issues - Historic

Prior to initiating this study, the City provided historical flooding information that had been reported by Ridgeway area residents and/or observed by City personnel during extreme wet weather events.

2.3.2 Public Meetings

Public outreach was a key element of the drainage study. It provided the opportunity for the study team to interactively communicate with the residents in Ridgeway drainage area. The experiences and observations along with photographs and videos shared by the residents allowed the team to identify areas of concern within the basin and compare the stormwater model against actual conditions.

Two public meetings were conducted by the study team. Representatives of the City attended both meetings. The public meetings were announced through the City's Engineering Office, Councilman Collins' Office, homeowners' associations, the study team's project website, e-newsletters, e-blasts, and paid media.

- Public Meeting #1 was held on Thursday April 19, 2018.
- Public Meeting #2 was held on Tuesday April 24, 2018.

Each meeting included a short presentation describing the goals and objectives of the study and then explaining the study process. Afterwards, large scale plans of the drainage area were made available so that residents could point out and discuss areas of concern. Additionally, survey forms were provided so that residents could describe drainage issues and flooding events in detail.

2.3.3 Website

A project specific website was developed for this project, <https://ridgewaybasinstudy.com>. The website was updated through the duration of the data gathering and analysis activities. The purpose of the website was two-fold. It communicated progress of the study to the public and allowed the public to communicate back to the team by email or by completing the on-line survey. Significant updates through completion of the model were reported on the website.

Section 3 - Summary of Analysis and Results

3.1 Hydrologic and Hydraulic (H&H) Model

To study the drainage characteristics of the Ridgeway drainage area, a hydrologic and hydraulic (H&H) model was prepared using Innowyze’s InfoSWMM hydraulic modeling software. The model is a computer-generated version of the Ridgeway drainage system that the study team utilized to simulate different storms and stormwater runoff situations. The study area characteristics summarized in Section 2 of this Volume provided the foundation for model construction. Volume 2 details how these characteristics were used to establish the initial model parameters.

Historic information and public input along with the collected precipitation and stream data were then utilized to calibrate and validate the model. Table 4 in Volume 2 summarizes the initial model parameter values and the adjusted values as a result of the calibration process.

Three storm events were selected from the December 12, 2017 to April 12, 2018 monitoring period for use in calibrating and validating the stormwater model. Table 6 summarizes these events.

Table 6: Calibration Storms

Calibration Storm	Start Date	Duration (hr)	Depth (in)	Approximate Recurrence Interval *
1	12/22/2017	27	4.0	~ 2 year
2	2/27/2018	37	5.1	< 2 year
3	3/28/2018	19	2.1	< 2 year

*Note: Estimated from Memphis and Shelby County Storm Water Management Manual, Volume 2, Figure 2-2

While the model calibration process was underway, the Ridgeway drainage area experienced several wet weather events. To validate the model calibration, project team members drove through areas of the Ridgeway drainage basin to observe drainage conditions and flooding. During the monitoring period, rain events as measured at the three fire stations (Fire Stations No. 21, 25, 41) were incorporated into the model to validate the calibration by comparing model results to the observations of the project team. The model validation run is included in the final electronic delivery of the model.

Meetings were held with City of Memphis personnel throughout the calibration process. Calibration review meetings were held on October 6, 2020 and November 16, 2020. As the model was calibrated, the study team and City also reviewed the existing drainage and flooding conditions and discussed potential solutions.

3.2 System Performance and Design Criteria

Once calibrated, the InfoSWMM model was utilized to:

- Evaluate existing system performance under a variety of design storms
- Investigate the ability of potential solutions to minimize and / or alleviate drainage issues.

The Memphis and Shelby County Storm Water Management Manual (SWMM) sets forth design criteria for proper system performance. While many areas of the City were developed under less stringent guidelines than those set forth in the SWMM, it was important to identify those areas under current development conditions that were not performing at a satisfactory level. For this study, the ability of the system to carry the 10-year, 24-hour design storm without flooding was considered the minimum acceptable level of service.

The following design criteria as set forth in the SWMM was utilized to appropriately size any proposed solutions.

- For open channel sections the maximum hydraulic grade line (HGL) should be maintained within top of bank for:

- The 10-Year Design Storm event for minor systems (less than 10 acres)
- The 100-Year Design Storm event for major systems (greater than 10 acres)
- For closed pipe sections, the pipe system should be able to convey flows for:
 - The 10-Year Design Storm event with no surface flooding
 - The 50-Year Design Storm event with no surface flooding where a portion of the storm sewer also serves as a culvert for a major intersection, major conveyance, or state route.
- Detention/Retention facilities should operate with no flooding for the 10-Year Design Storm per Section 8.2 of the SWMM.
- Design rainfall was based on the NRCS Type II 24-hour storm event.

Section 3.3 below discusses the model results for the existing conditions of the Ridgeway drainage area and Section 3.4 reviews the solutions selected for evaluation. This Volume 1 focuses on the 10-year, 24-hour design storm and the 100-year, 24-hour design storm. The results for all design storms are included in the electronic deliverable to the City.

3.3 Existing Conditions

The InfoSWMM model was run to evaluate existing system performance under the 2-, 5-, 10-, 25-, 50-, and 100-year, 24-hour design storm events as set forth in the SWMM, Volume 2. The precipitation depth for each of these events is:

- 2-year, 24-hour: 4.01 inches
- 5-year, 24-hour: 4.89 inches
- 10-year, 24-hour: 5.58 inches
- 25-year, 24-hour: 6.52 inches
- 50-year, 24-hour: 7.27 inches
- 100-year, 24-hour: 8.02 inches

The existing conditions model and results are discussed extensively in Volume 2. Once the flood extents were mapped, each area was analyzed to identify any flooded areas. The flooded areas identified by the model include:

- Area between Quince Road to Sea Isle Road: while no street flooding or flooding of nearby houses has been reported, the model shows that the 100-year event approaches houses in the area.
- Around Ridgeway Middle School along Quince Road: while the model did not include the drainage system around the school, the model did not indicate flooding at the school building. However flooding was indicated in the parking lot of grass in May Park.
- Open channel along Kirby Parkway between Sulgrave Drive and Messick Road: the model indicates that minor flooding occurs at a low spot on Kirby Parkway and in a nearby field. Flooding resulting from the 100-year event approaches nearby houses.

The areas detailed above are shown in Figure 17 through Figure 19.

For each of these areas, the model indicated that flooding resulted from limited capacity in the downstream channels and pipes. These facilities quickly become overwhelmed during the peak of the rain event, especially for the larger design storms.



Figure 17: Between Quince Road and Sea Isle Road

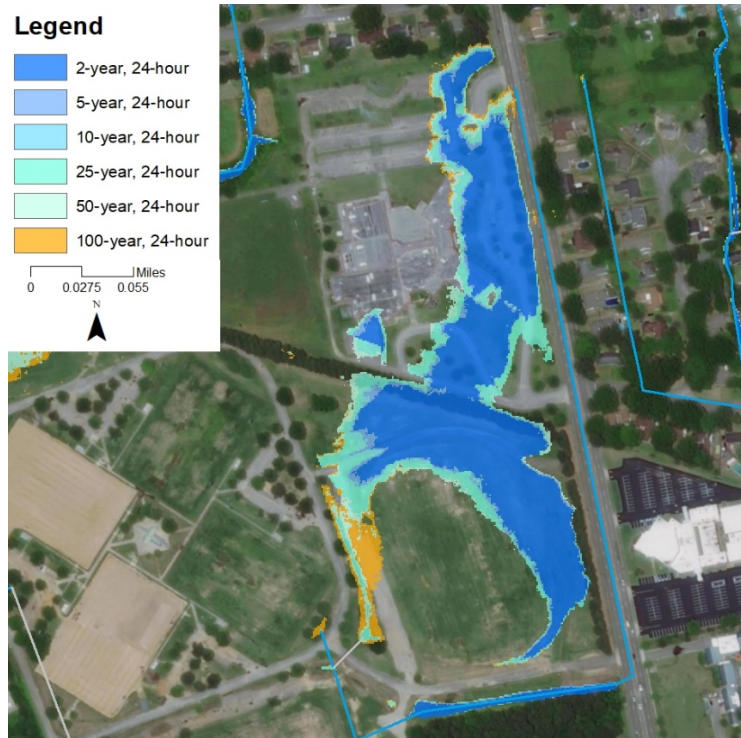


Figure 18: Ridgeway Middle School Along Quince Road

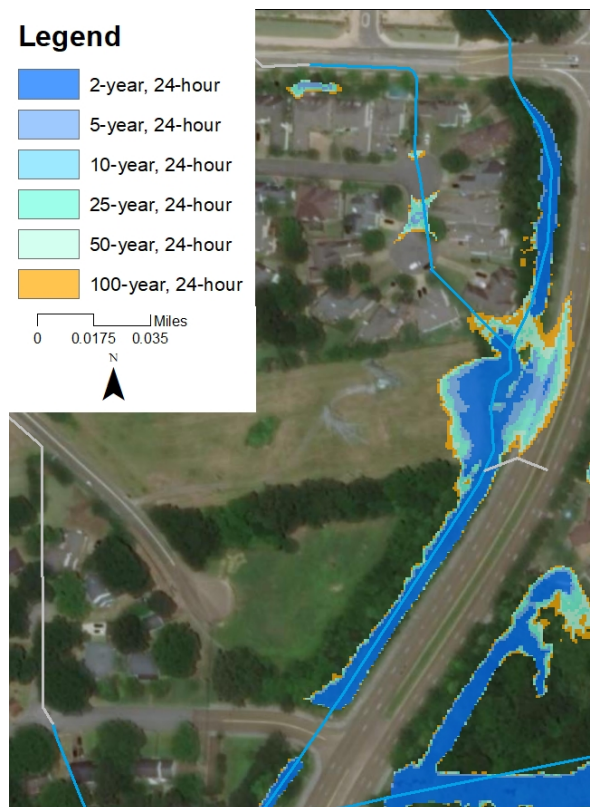


Figure 19: Along Kirby Parkway Between Sulgrave Drive and Messick Road

3.4 Solution Analysis

After meeting met with the City of Memphis on January 7, 2021, each of the flooded areas were determined to be a lower priority and further modeling to identify system improvements was not deemed necessary at this time. After the completion of this project, should any area in the Ridgeway basin becomes an issue due to flooding, the following actions to reduce flooding in these areas are recommended:

- Increase channel areas or box culverts as necessary
- Addition of underground storage/detention area
- Clean channels or create new ones as necessary
- Add inlets to the existing stormwater collection system

It should be noted that should other areas become identified as flooding areas, additional modeling may be required. The current model has been developed to evaluate system performance at a basin planning level. For site-specific neighborhood flooding issues, it is recommended that additional modeling be performed on a local level. Modeling done on a local level could help identify issues that result in localized flooding at houses as opposed to the larger basin flooding issues identified by the current model.

References

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Searches (Tool was researched a number of times throughout the performance of this study)
- Shelby County Register of Deeds on-line GIS tool. Shelandra Y. Ford. (Tool was researched a number of times
throughout the performance of this study)

