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# Midlothian Community Special Area Plan Alternative Stormwater Management Plan

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# Midlothian Community Special Area Plan Alternative Stormwater Management Plan

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## Introduction:

**Purpose:** Stormwater management and retention has caused complications for planners, engineers, and citizens all over the world. Conventional stormwater management is focused on removing stormwater from a site as quickly as possible to prevent flooding by using curb and gutter or piping systems to remove water[1]. This has been the standard in most development plans for stormwater management all over the world, but it does come with its fair share of complications that lead to the introduction of alternative or green stormwater management systems. The conventional stormwater management practice is the proven most efficient way to quickly remove water and prevent flooding but can also cause complications that are devastating to downstream waters by increasing the frequency and size of floods, altering stream channel morphology, and reducing groundwater recharge, which make less water available for drinking water withdrawal and stream base flows[2]. Alternative stormwater management systems are the future in new and developing areas to help minimize the environmental impacts of conventional stormwater systems. In areas, like Midlothian located in Chesterfield County, Virginia, which is seeing major new development and redevelopment and is planning on doing more moving into the future have a great opportunity to implement alternative or green stormwater management practices to help minimize conventional stormwater environmental impacts in the future. The purpose of this project is to provide recommendations of implementation of best management practices of alternative stormwater management techniques in the Midlothian area in Chesterfield County. The two major goals are to provide Chesterfield County with a guide to implement best practices for alternative stormwater management in new development and

[1] *Chapter 3 Fundamentals of Stormwater Management*. (n.d.). Retrieved September 19, 2022, from https://nacto.org/wp-content/uploads/2015/04/wd-08-20a_ch3.pdf
[2] Ibid

redevelopment and to help minimize the effects of conventional stormwater and development on the environment in Chesterfield County.

**Client:** The main client for this plan is the Chesterfield County Planning Department which is in charge of planning for approximately 344,000 citizens over 437 square miles in central Virginia. This project will focus mainly on the Midlothian area in Chesterfield County as based on the Midlothian Community Special Area Plan, which is only 8 square miles but contains 9 percent of the county's population[3].

## Literature Review:

This literature review will analyze the common elements, advantages and disadvantages, and implementation of alternative stormwater management and retention practices that will best fit the Midlothian area in Chesterfield County. This will be implementing best practices and low-impact development techniques like rain gardens, green roofs, permeable pavement, and green spaces to name a few[4]. Also, finding the right places to implement these alternative stormwater management practices will be key in finding their true potential. This study area is located in an area that contains one major highway for the region and that is considered to be a commercial corridor and can benefit from a change in conventional stormwater management practices. Understanding how different types of developments (residential and commercial) affect stormwater systems differently will also be key in implementing the best management practices of alternative stormwater management systems. These alternative stormwater practices

[3] "Comprehensive Plan." Comprehensive Plan | Chesterfield County, VA, May 2019. https://www.chesterfield.gov/874/Comprehensive-Plan.
[4] Roy, S. P., Krishnan, G., Adams, R. R., & Goo, R. (2009). Sustainable Stormwater Management. *The Military Engineer*, *101*(659), 67–68. http://www.jstor.org/stable/44530661

and low-impact development can be implemented in new development and redevelopment to help decrease the environmental impacts of conventional stormwater management. Since most erosion is caused by stormwater runoff it is essential to help manage the impacts with the best possible practices that are available[5]. Alternative stormwater management practices have been shown to reduce pollution, recharge groundwater, and ultimately control flow into rivers and streams, which is a major benefit to implementation of these stormwater management practices[6]. These water management practices when implemented with the conventional stormwater management already in place in Chesterfield will help minimize flooding risks and environmental impacts in the county in the future.

**Conventional Stormwater Management:**

To understand how to fix the problem of conventional stormwater management it is crucial to understand how it works in the first place along with the positives and negatives. Conventional stormwater management comes in the form of gutters, storm drains, pipes and other structures to collect and carry stormwater away into local streams as quickly as possible[7]. This is the standard practice for not only the Midlothian Community Special Area Plan but also the rest of the United States. This type of stormwater management does the job of getting water away from urban areas but falls short in many other categories that are essential for helping retain and clean water before leaving an area. Conventional stormwater management is usually incorporated with development, which leads to loss of pervious surfaces, and this leads to less of a chance for

[5] Taylor, D. A. (2007). Growing Green Roofs, City by City. *Environmental Health Perspectives*, *115*(6), A306–A311. http://www.jstor.org/stable/4139296

[6] Subramanian, R. (2016). Rained Out: Problems and Solutions for Managing Urban Stormwater Runoff. *Ecology Law Quarterly*, *43*(2), 421–448. http://www.jstor.org/stable/44132107

[7] Holm, B. A., Holm, K. E., Shelton, D. P., Rodie, S. N., Feehan, K. A., & Franti, T. G. (2014, July). *Stormwater Management: What Stormwater Management is and Why it is Important* . NebGuide. Retrieved April 7, 2023, from https://extensionpublications.unl.edu/assets/pdf/g2238.pdf

stormwater to infiltrate into the ground[8]. Water flowing over concrete and asphalt can cary oil, chemicals, and trash from surfaces straight into storm drains which ultimately lead to streams and rivers downstream from these stormwater systems[9]. This can cause major environmental impacts to waters downstream and creates water quality and abundance issues for the future. Along with the risks of pollution and loss of groundwater is the major risk of flooding, which can cause property damage and cost citizens, the county, and the state a lot of money. Once conventional stormwater management has sent waters downstream very quickly it tends to erode stream channels and causes loss of natural floodplain, which is essential in preventing flooding[10]. The average annual cost of flood damage in the United States is around $2 billion and the loss of pervious surface is one of the main components of this damage[11]. Stormwater management projects also lack funding in many areas around the United States, leading to these already ineffective practices to also not be maintained or built correctly. Stormwater management is practically invisible to citizens so it is hard to get funding, which is why underfunding is considered the "single biggest challenge" facing stormwater management[12]. These problems that are occurring are also only expected to get worse as more areas are developed and impervious surfaces are increased. It is expected that climate change is going to make the problems associated with conventional stormwater management only worse in the future and could render conventional stormwater managements effectiveness and functionality even more than it already is[13]. All of these issues now, and the impending issues in the future, are reason enough to look

[8] Subramanian, R. (2016). Rained Out: Problems and Solutions for Managing Urban Stormwater Runoff. *Ecology Law Quarterly*, *43*(2), 421–448. http://www.jstor.org/stable/44132107
[9] Ibid
[10] Ibid
[11] Ibid
[12] Landers, J. (2009). Stormwater Management: THE NEXT FRONTIER. *Water Environment & Technology*, *21*(5), 32–35. http://www.jstor.org/stable/24711990
[13] Subramanian, R. (2016). Rained Out: Problems and Solutions for Managing Urban Stormwater Runoff. *Ecology Law Quarterly*, *43*(2), 421–448. http://www.jstor.org/stable/44132107

into changing stormwater management practices to involve more green and pervious surfaces and help reduce these issues before they are too overwhelming for local and state governments.

**Construction and Development:**

Much of this project area is currently developed or still under development stages, which makes controlling stormwater that much more difficult. Runoff from construction is the major source of sediment loss in urban areas under development and pollutants area also carried from sites into waterways[14]. It is stated that every year that construction on around 850,000 acres of land across the United States discharges 5 billion pounds of sediment and then damages 26,000 miles of waterways[15]. Most of these sites in the early stages of development are not connected to any stormwater management systems and therefore construction sites have to implement measures to keep sediment and stormwater onsite until they are connected. The first development stage is removing all vegetation leaving just bare soil with nothing to stop or slow down rainfall leading to whatever is onsite to be quickly carried offsite into waterways[16]. Most new developments are required to have a stormwater management plan that includes placing preventive measures to stop sediment and pollution from leaving a site, but they do fall short in some ways. Silt fence is one of the common stormwater management practices and is a synthetic fabric that is placed around sites to control sediment loss but is only 85% effective in filtering sediment from stormwater[17]. As development continues the sites will start to place vegetation where there isn't impervious area but that still falls short when combined with conventional stormwater practices.

[14] Broz, B. (2017, May). *Controlling Runoff and Erosion at Urban Construction Sites*. University of Missouri Extension. Retrieved April 10, 2023, from https://extension.missouri.edu/publications/g1509
[15] ALLEN, A. (2011). AT THE EPA, MUDDIED WATERS. *Landscape Architecture*, *101*(10), 30–30. http://www.jstor.org/stable/44795776
[16] Broz, B. (2017, May). *Controlling Runoff and Erosion at Urban Construction Sites*. University of Missouri Extension. Retrieved April 10, 2023, from https://extension.missouri.edu/publications/g1509
[17] Ibid

The Environmental Protection Agency (EPA) proposed a stormwater permit to limit post-construction stormwater runoff which included increased use of alternative or green stormwater practices[18]. This could be one of the first steps in holding developers accountable after construction has ended in managing stormwater on their sites in the future.

**Green Roofs:**

Green roofs are systems that can be incorporated into all types of buildings to fit the needs of different regions and climates and have many more benefits aside from stormwater management. Green roofs, by definition, "is a layer of vegetation planted over a waterproofing system that is installed on top of a flat or slightly–sloped roof", they are also known as eco or vegetative roofs[19]. Green roofs are shown to hold up to 90% of stormwater in a rain event and 30-60% annually which allows for stormwater management plans to use smaller catch basins, smaller retention basins, and less piping[20]. This in turn will lead to less cost initially and lower maintenance costs in the future to conventional stormwater systems. Other benefits of green roofs include money and energy saving measures that will be enticing to developers and building owners in the long run. Green roofs can double triple the longevity of a roofs lifespan due to the reduction of UV degradation placed on a roof and reduction of variations in roof temperature lead to the roof to not expand and contract as much[21]. This will lead to less maintenance costs for roofs in the future and therefore offset the cost of the green roof installation over time. The other benefit of green roofs is reduced energy consumption which in return leads to less costs for the

[18] Novel EPA Stormwater Permit May Be Model For Post-Construction Limits. (2010). *Inside EPA's Water Policy Report*, *19*(4), 3–4. https://www.jstor.org/stable/26833134
[19] U.S. Department of the Interior. (n.d.). *What is a Green Roof*. National Parks Service. Retrieved September 20, 2022, from https://www.nps.gov/tps/sustainability/new-technology/green-roofs/define.htm
[20] Lindell, J., Cabanting, D. G., & Mitchell, T. M. (2008). Green Roof Systems. *The Military Engineer*, *100*(651), 49–50. http://www.jstor.org/stable/44531410
[21] Ibid

building owner. Temperatures of green roofs have been shown to be 50 to 60° F cooler than nearby black rubber roof surfaces, leading to reduced cooling costs for the overall building[22]. This makes the installation of green roofs offset the initial installation costs, when compared to conventional roofs, when the benefits of the owner and the general public are accounted for due to reduced cost for the owner and the public[23]. While the green roof practice is one of the best alternative stormwater management practices it does come with its share of complications. Green roofs can lead to higher initial costs of installation as compared to conventional roofs due to the need for the extra materials to create a green roof (vegetation, liner, roof supports, etc.) and the increased weight loading on rooftops could exclude green roofs in redevelopment projects if building integrity may be compromised[24]. The advantages of green roofs seem to outweigh the cons in the long run but initial cost may be enough to turn away developers and building owners from incorporating green roofs into their projects.

**Rain Gardens:**

Rain gardens are green infrastructure systems that provide many different benefits in developing and developing areas in respect to stormwater management. Rain gardens are, "landscaped depressions that treat on-site stormwater discharge from impervious surfaces such as roofs, driveways, sidewalks, parking lots and compacted lawns," by filtering stormwater runoff to prevent pollution and recharge groundwater supply[25]. Rain gardens are typically small in size and therefore are easier to implement into new development and redevelopment without extensive

[22] Ibid
[23] Amy W. Ando, & Noelwah R. Netusil. (2013). A Tale of Many Cities: Using Low-Impact Development to Reduce Urban Water Pollution. *Choices*, *28*(3), 1–6. http://www.jstor.org/stable/choices.28.3.06
[24] U.S. Department of the Interior. (n.d.). *What is a Green Roof*. National Parks Service. Retrieved September 20, 2022, from https://www.nps.gov/tps/sustainability/new-technology/green-roofs/define.htm
[25] EPA. (n.d.). *Stormwater Best Management Practice - Bioretention (Rain Gardens)* . Retrieved September 20, 2022, from https://www.epa.gov/system/files/documents/2021-11/bmp-bioretention-rain-gardens.pdf

impacts to the built environment. Rain gardens are seen as a "surgical approach" to stormwater management because they can be placed where they are needed and do not require extensive construction or costs[26]. Rain gardens also can be implemented into single family home properties easier due to the variations in size rain gardens can be constructed at. The estimated costs of a rain garden project in the city of Maplewood, Minnesota is 75 to 85% the cost of a conventional curb and gutter stormwater system and reduces stormwater runoff by 80% annually[27]. Other benefits of rain gardens include increased population values, biodiversity, and reduction in flooding, among many others[28].This makes rain gardens a more cost efficient choice in stormwater management, and other economic benefits, due to lower installation costs and versatility of placing and size.

**Permeable Pavement:**

Permeable pavement is a green infrastructure alternative to what is typically an impervious surface that allows stormwater to infiltrate through the surface of the pavement to the ground below as opposed to running off[29]. This helps slow down the speed of water and allows it to turn into ground water after being filtered through stone and the ground before entering the overall water supply. Permeable pavements also reduce need for retention ponds, concentration of pollutants, and can cool water temperatures which will lower stress and impacts onto nearby

[26] Sipes, J. L. (2009). HERE, THERE, AND EVERYWHERE. *Landscape Architecture*, *99*(12), 30–39. http://www.jstor.org/stable/44795421
[27] Ibid
[28] USDA. (n.d) *Rain Gardens.* Natural Resources Conservation Service. Retrieved September 20, 2022, from https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwiy97rb3aP6AhX8E1kFHQMxAOQQFnoECDUQAQ&url=https%3A%2F%2Fwww.nrcs.usda.gov%2Fwps%2FPA_NRCSConsumption%2Fdownload%3Fcid%3Dstelprdb1248876%26ext%3Dpdf&usg=AOvVaw0CmWV8xe65l-V8GjQe2k6k
[29] EPA. (n.d.). *Stormwater Best Management Practice - Permeable Pavements* . Retrieved September 20, 2022, from https://www.epa.gov/system/files/documents/2021-11/bmp-permeable-pavements.pdf

waters[30]. Permeable pavements can also be implemented on public and private scales for a lower overall cost as compared to traditional impervious pavement. A study in Lancaster, PA, showed that permeable pavement's maintenance costs over a 5 and 10 year span after installation were actually shown to be less expensive than traditional asphalt and underground storm drains[31]. This shows that the initial installation cost of permeable pavement is offset by the future maintenance cost and benefits due to the multiple benefits of permeable pavement as compared to traditional pavement. Permeable pavement has also been shown to provide some safety elements by reducing average traffic speeds due to the sound and texture of permeable pavement as compared to asphalt[32]. Disadvantages to permeable pavement stem from the actual making of these pavers as opposed to the implementation. Industry standards are not the best when creating these permeable pavers and may cause for different batches to be made slightly differently leading to increased or decreased porosity may lead to increased maintenance cost and decreased effectiveness[33]. The introduction of permeable pavement will help with new development and redevelopment where traditional pavement is in the plan, and used in combination with other alternative stormwater practices can help reduce stormwater runoff all around.

**Commercial Corridor and Stormwater Management:**

The Midlothian Community Special Area Plan is very interesting and important to the rest of the county, and surrounding counties, for its proximity to major highways for the surrounding area.

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[30] Selbig, W. R. (2019, March 17). *Evaluating the potential benefits of permeable pavement on the quantity and quality of stormwater runoff completed*.U.S. Geological Survey. Retrieved September 20, 2022, from https://www.usgs.gov/centers/upper-midwest-water-science-center/science/evaluating-potential-benefits-permeable-pavement

[31] PROBLEM SOLVERS: Lancaster revitalizes intersection with permeable pavement to reduce stormwater. (2014). *Water Environment & Technology*, *26*(11), 55–57. http://www.jstor.org/stable/44010268

[32] McIntyre, L. (2007). POROUS PAVEMENT MAN. *Landscape Architecture*, *97*(3), 110–115. http://www.jstor.org/stable/44675276

[33] Ibid

One of the major highways of this area is the US-60/ Midlothian Turnpike corridor that runs through the middle of the study area. US-60/ Midlothian Turnpike is a main corridor that connects to Route 288, and ultimately Interstate 64, also also a hub for residential and commercial development that can be easily accessed by those in the community and those in the surrounding areas. A commercial corridor is an "area along a major arterial roadway for the sale of the widest variety of goods and services to the community and the surrounding region," which fits the description of US-60/Midlothian Turnpike perfectly[34]. With an abundance of shopping centers and commercial buildings mixed in with residential development the US-60/Midlothian Turnpike commercial corridor is a prime example of a developed area with a large loss of pervious surface due to development. Commercial development is using land to build offices, retail stores, or factories, which leads to large areas losing pervious surface to place buildings and parking lots. Commercial properties receive a higher volume of traffic and with that leads to more oils and chemicals from cars and increased trash from consumers, both of which are things that do not belong in waterways[35]. The increased impervious surface also created more stormwater runoff and less infiltration into the soil leading to most of these pollutants going straight into waterways and impacting downstream[36]. All of these issues with commercial without any alternative stormwater management practices can lead to major problems in the future for the environment and citizens.

[34] *Commercial Corridor Definition*. Law Insider. (n.d.). Retrieved February 6, 2023, from https://www.lawinsider.com/dictionary/commercial-corridor
[35] *Stormwater Control Measures for Commercial Properties*. Tinkers Creek Watershed Partners. (2017, June 27). Retrieved April 7, 2023, from https://www.tinkerscreek.org/stormwater-control-measures-commercial-properties/
[36] Ibid

**Conclusion:**

The current stormwater management in Chesterfield County is going to face more and more strain and development continues in the county and the Midlothian Community Special Area is going to be a hotspot of new development and redevelopment in the future. To help take some of this wear and tear and strain away from the existing conventional stormwater management the listed alternative stormwater management practices can be implemented. Implementing the alternative stormwater management practices into new development and redevelopment along with existing conventional stormwater conveyances methods that can benefit the overall water quality and environment of this area. While these alternative stormwater management practices are not a “one size fits all solution” they will be able to benefit these areas in ways beyond stormwater management and may be able to save Chesterfield County some money in the long run.

## Existing Conditions

### 1) Introduction and Study Area:

Chesterfield is a county in Virginia located south of the City of Richmond, east of Powhatan and Amelia county, north of Dinwiddie County and the City of Petersburg, and west of Henrico and Prince George county and Charles City. Chesterfield County is home to approximately 344,000 citizens over 437 square miles. This document will discuss the "study area" which is the Midlothian Community Special Area Plan located in the northwestern portion of the county as shown below in red in Figure 1.

**Figure 1.1: Chesterfield County and Midlothian Community Special Area Plan**

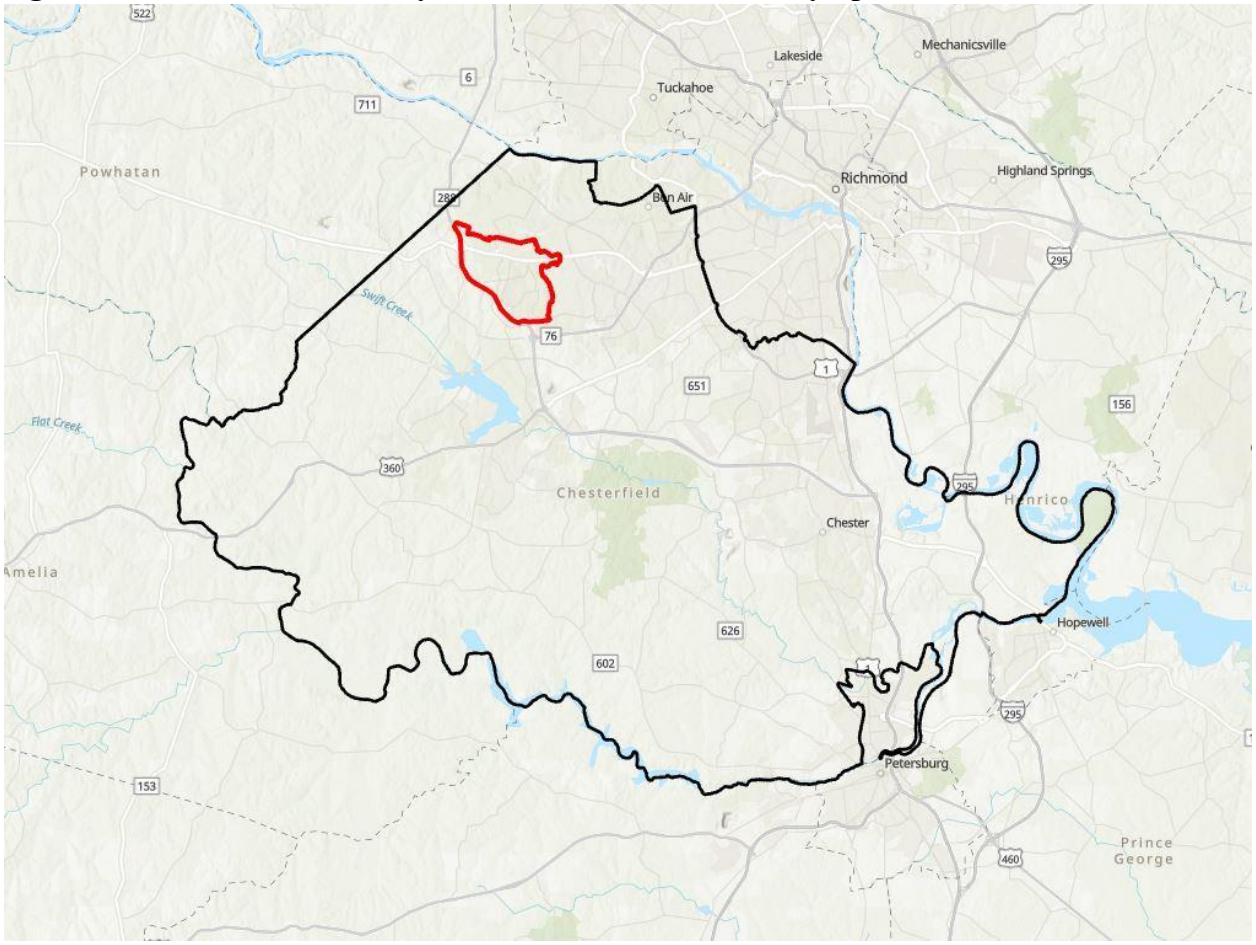
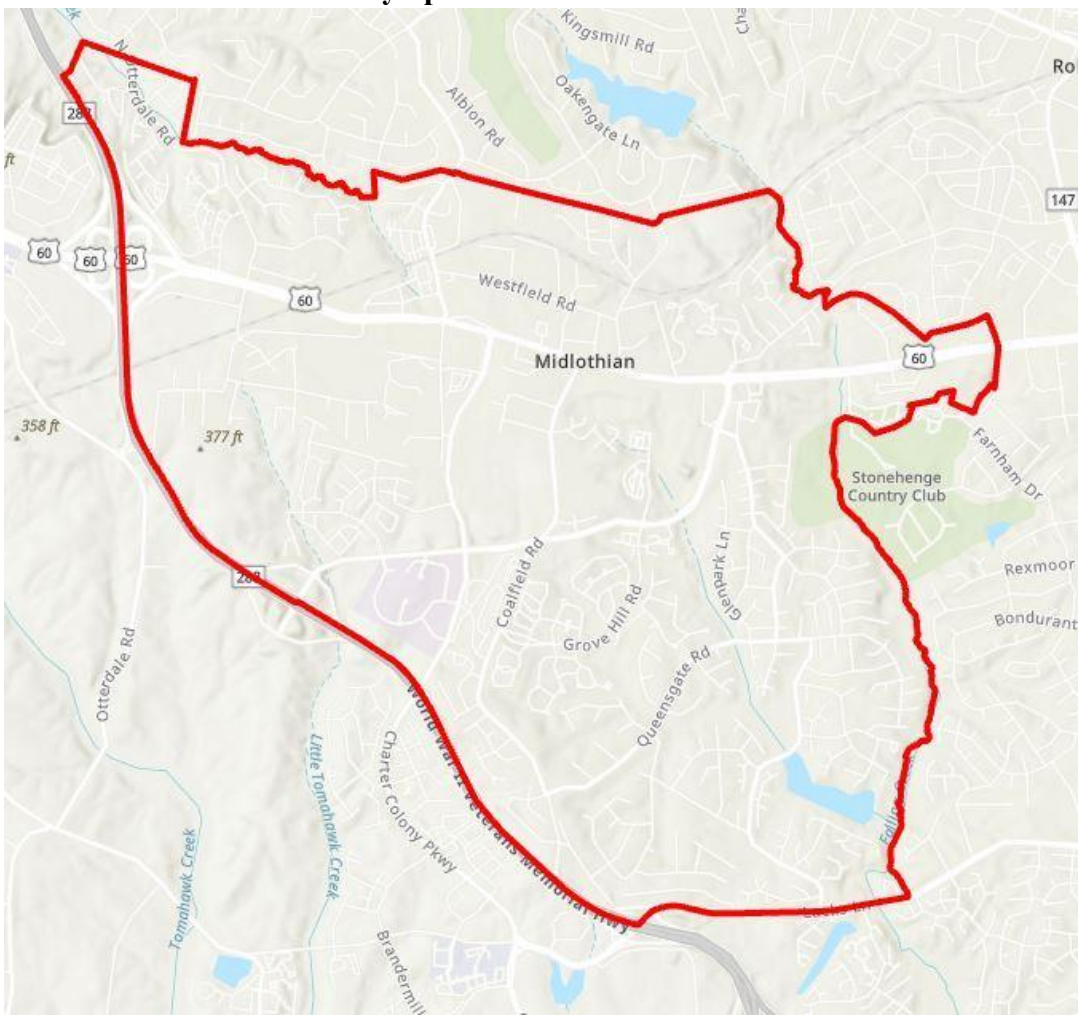


**Figure 1.2: Midlothian Community Special Area Plan**




The study area is 8 square miles of Chesterfield's total 437 square miles of land mass and 28,718 citizens, which is 8% of the total population of Chesterfield County. Route 60/Midlothian Turnpike has a 3.75 mile stretch through the northern portion of the study area and is bounded to the west by Route 288. The study area is composed of mostly residential and commercial development as well as government property which includes four schools (Brightpoint Community College, Midlothian High School, Midlothian Middle School, and JB Watkins Elementary School) and other public services like a firehouse and post office. The location of this area makes it a prime spot for future development and redevelopment in Chesterfield due to its proximity to highways, other counties, and schools.

**2) Land Use, Land Cover and Zoning:**

Land use for this project area is split into many different categories but are mostly residential and commercial. Most of the project area is classified as Suburban Residential II, which is single family dwellings located within a subdivision[37]. Along the Route 60/ Midlothian Turnpike roadway includes land use of Community Mixed Use, Residential Mixed Use, Regional Mixed Use, Medium High Residential, Corporate Office, and Community Business[38]. This shows that the area along this roadway includes commercial development along with residential and shows a high amount of development and loss of pervious area. The amount of commercial development and the high density residential for the rest of the project area is key is seeing how much impervious surface has been and can be created for this area due to the type of development that has and can occur. Current land cover for the study area has commercial and residential development, shown in black, and a large portion of area left undeveloped and either left in forest, grass, or crop/farmland, which is shown in various shades of green and yellow. The majority of residential development is single family housing which is associated with many subdivisions in the study area. The total area that is zoned "R" for residential is approximately 6 square miles. Considering the whole study area is only approximately 8 square miles, the residential zoning accounts for close to 75% of the study area's total area. The total area for commercial zoning, which is shown as the "C" layer, only encompasses approximately 0.75 square miles of area within the study area. This makes residential and commercial development close to 85% of the current zoning within the study area. Most of the study area is classified under residential zoning, but much of this area has not been developed yet so it has the potential for new development in the future. Residential subdivisions located in the study area include

[37] "Comprehensive Plan." Comprehensive Plan | Chesterfield County, VA, May 2019. https://www.chesterfield.gov/874/Comprehensive-Plan.
[38] Ibid

Charter Colony, Stonehenge, Otterdale, and Salisbury to name a few. Most of the commercial development is located along Route 60/ Midlothian Turnpike and include grocery stores like Kroger, Walmart, and Sam's Club, a plethora of restaurants to choose from, as well as many shopping centers like Sycamore Square, Ivymont, and Midlothian Station.

**Figure 2.1: Midlothian Community Special Area Plan Land Use**

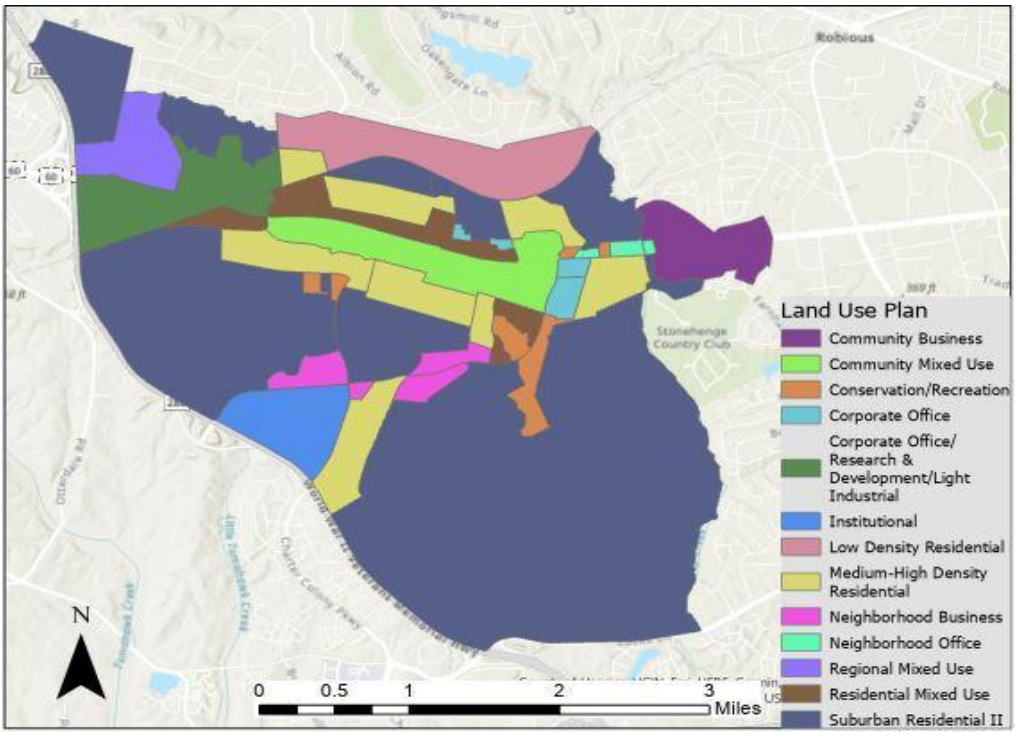


**Figure 2.2: Midlothian Community Special Area Plan Land Cover**

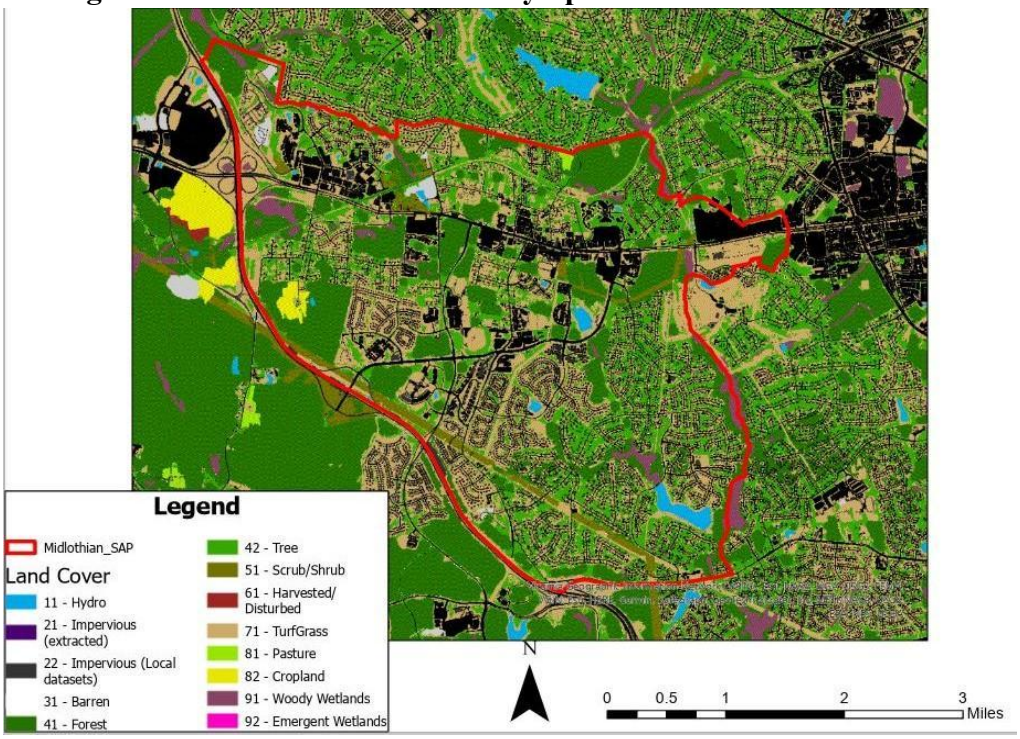
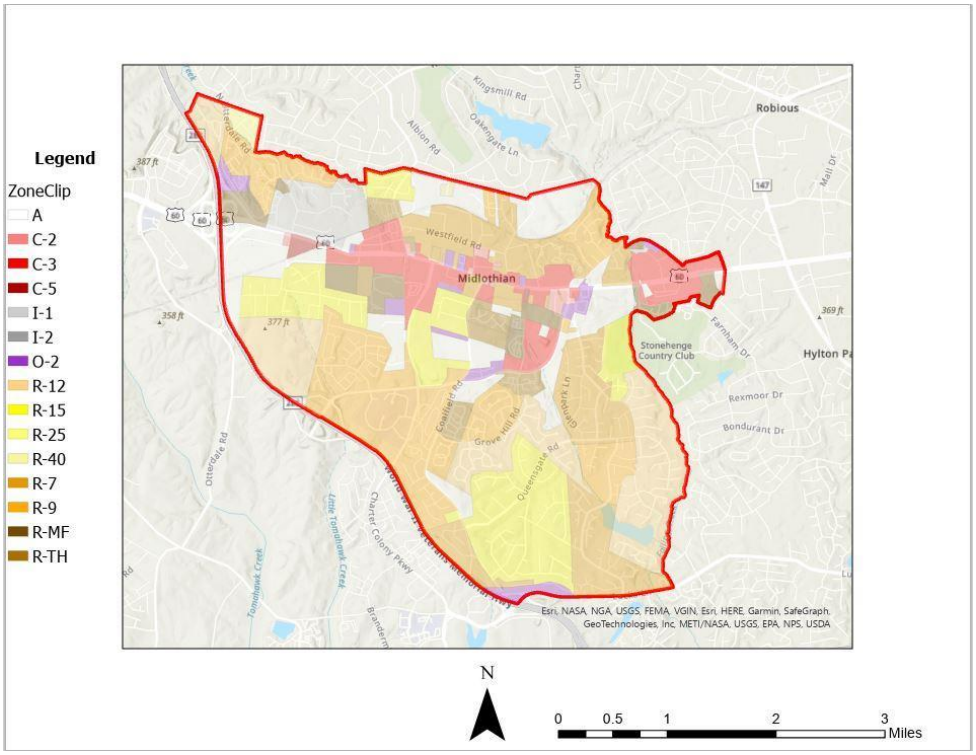



**Figure 2.3: Midlothian Community Special Area Plan Zoning**



**3) Environmental Features:**

This project will be focused on stormwater management in the Midlothian Community Special Area Plan so it is key to show the existing environmental features within the study area. Chesterfield, like many counties located in the Chesapeake Bay Preservation Area, include areas that are considered RPA or RMA. RPA features, shown in green below, are a one hundred foot buffer off of perennial streams or any environmental feature that is connected to perennial streams like wetlands or open water features. RPA buffers add protection to waterways which will eventually flow into the Chesapeake Bay to prevent further pollution and deterioration to the health and wellbeing of the Chesapeake Bay. While it is still allowed to build or adjust RPA, wetlands, and streams to new development or redevelopment there are many actions that must take place before that will be improved so for the most part these environmental features are protected from and changes and therefore will be excluded from future development. These environmental features are in areas with less or no development at all and are vital for protection of the waters of Chesterfield County and ultimately the state of Virginia into the Chesapeake Bay. The floodplain features that are shown show areas that are connected to all types of stream channels located in the study area, this includes perennial, intermittent, and ephemeral streams. The floodplains show areas that are prone to flooding during times of high precipitation and therefore could be more susceptible to issues related to poor stormwater management practices put in place.

**Figure 3.1: Environmental Features in the Midlothian Community Special Area Plan**

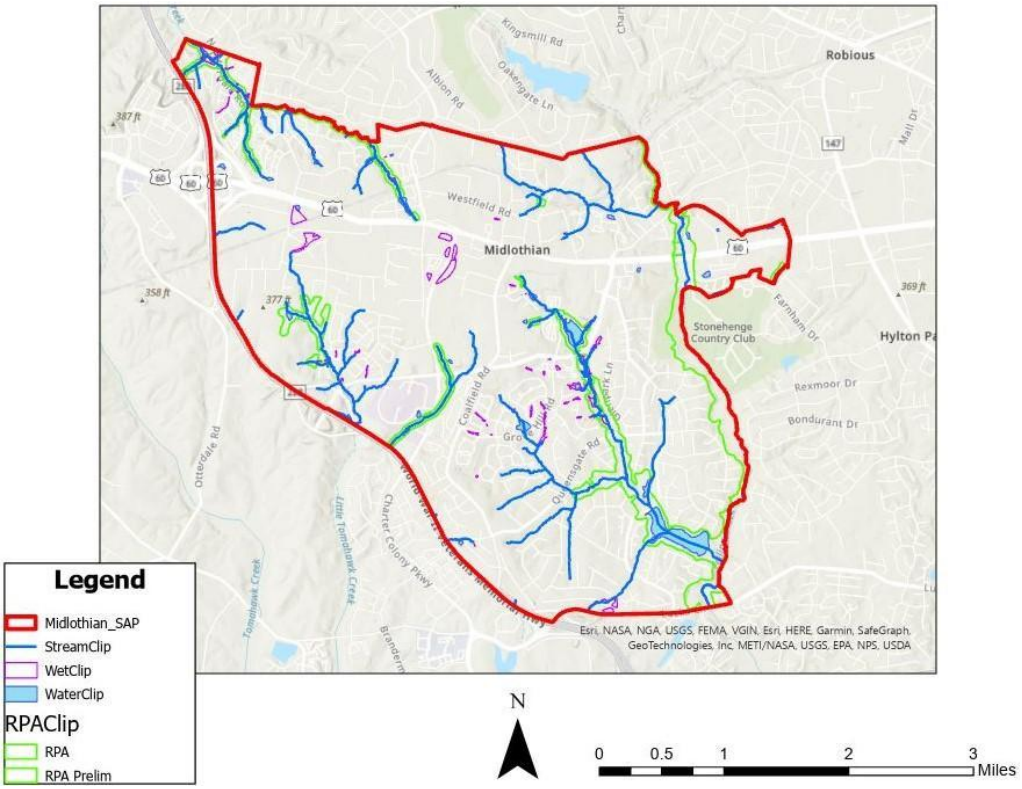
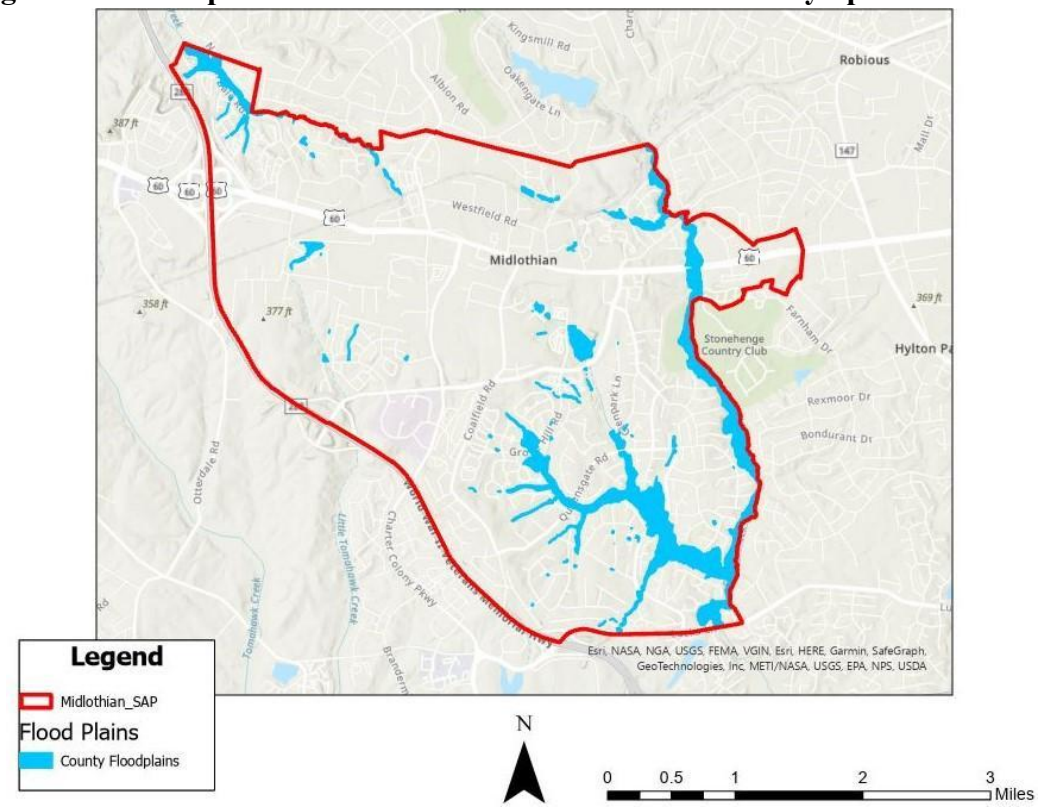



**Figure 3.2: Floodplain Features in the Midlothian Community Special Area Plan**

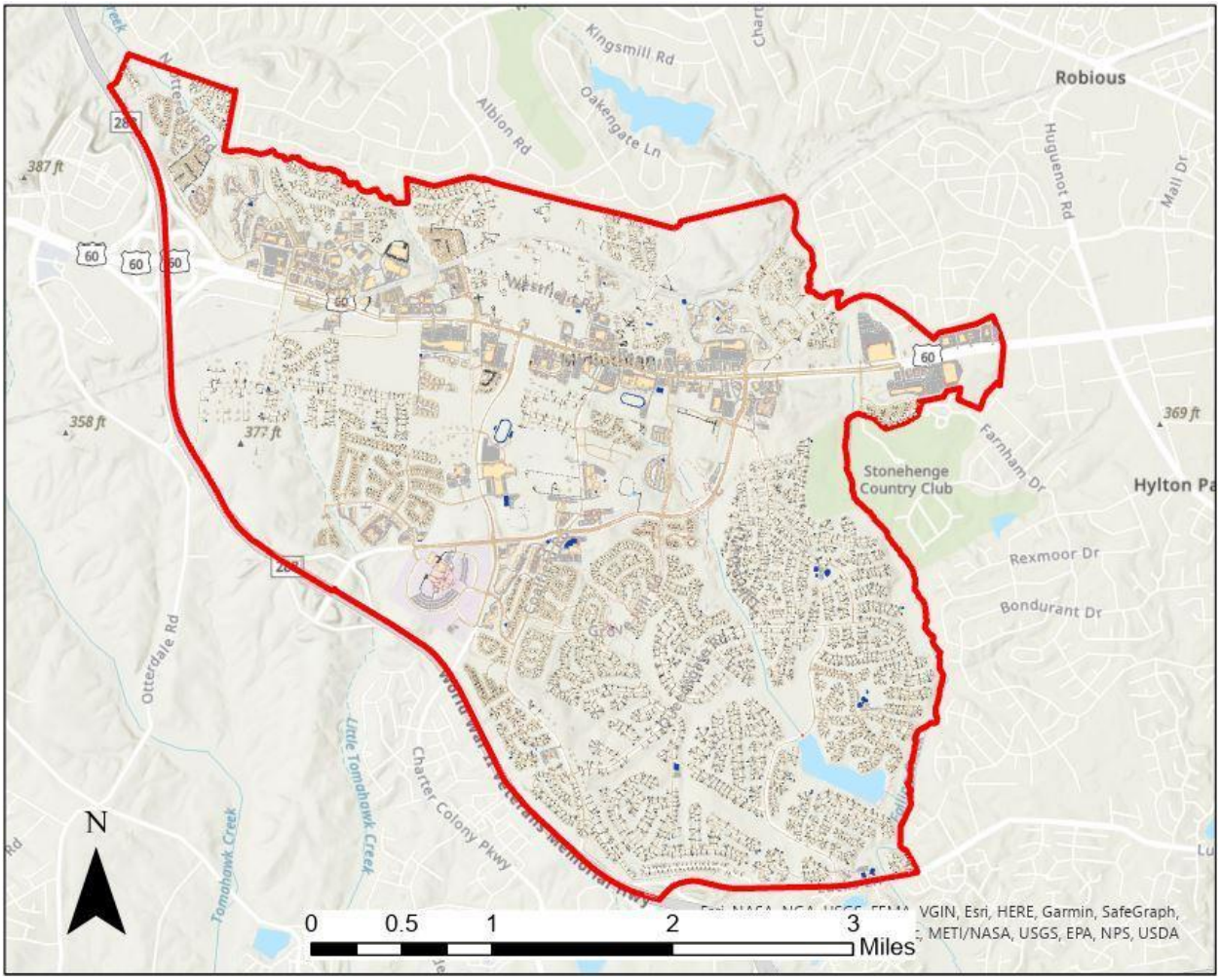


## Research Findings

### Impervious Area:

This project's study area is the Midlothian Community Special Area Plan which is located in the northeastern portion of Chesterfield County, Virginia. This area is a development hub located along US-60/ Midlothian Turnpike which includes residential and commercial developments along this 3.75 mile stretch of highway. With this development in this area there has been a loss of green and pervious surfaces that lead to environmental complications, especially with stormwater systems. The Midlothian Community Special Area Plan makes up 8 square miles of Chesterfield County's 437 square miles and is a development hub. As seen in Figure 4 below the impervious area is of the Midlothian Community Special Area Plan (shown in red) and the impervious areas, which include buildings, roads, and other development areas that are not green space, are shown throughout the area. Out of the 8 square miles of the Midlothian Community Special Area Plan 2.4 square miles of that area is in impervious condition, which is 30% of the total area, and more is still developing daily.

**Figure 4: Midlothian Community Special Area Plan Impervious Area**

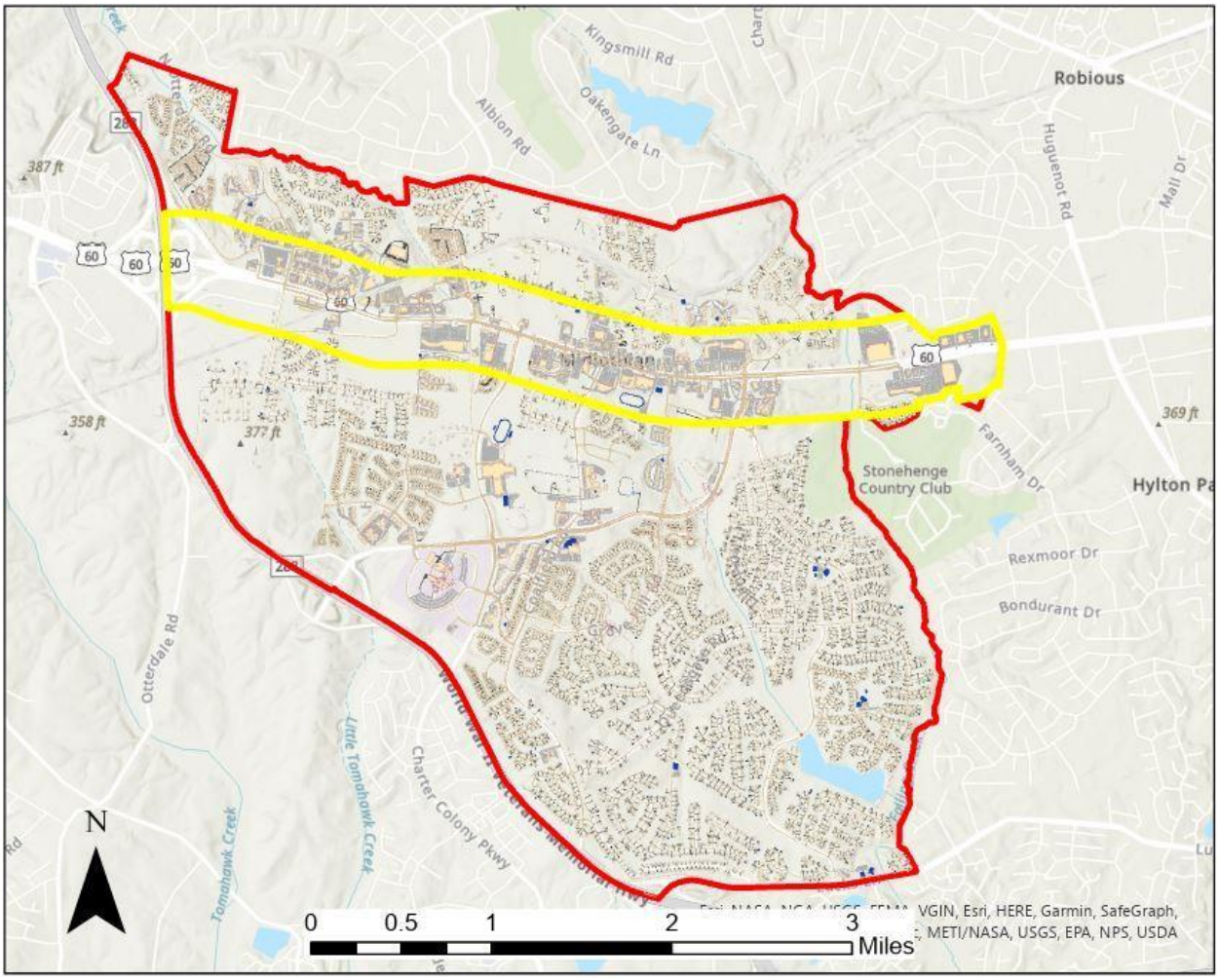



Commercial corridors like the US-60/ Midlothian Turnpike, which runs directly through the Midlothian Community Special Area Plan, are essential to the economy and development of many counties but they do seem to come at a cost to the environment and water systems in certain areas. Commercial corridors, by definition, are an "area along a major arterial roadway for the sale of the widest variety of goods and services to the community and the surrounding region," which are common all across the United States and are just like the US-60/ Midlothian Turnpike seen in our study area[39] . This commercial corridor contains 4 major shopping centers,

[39] *Commercial Corridor Definition*. Law Insider. (n.d.). Retrieved February 6, 2023, from https://www.lawinsider.com/dictionary/commercial-corridor

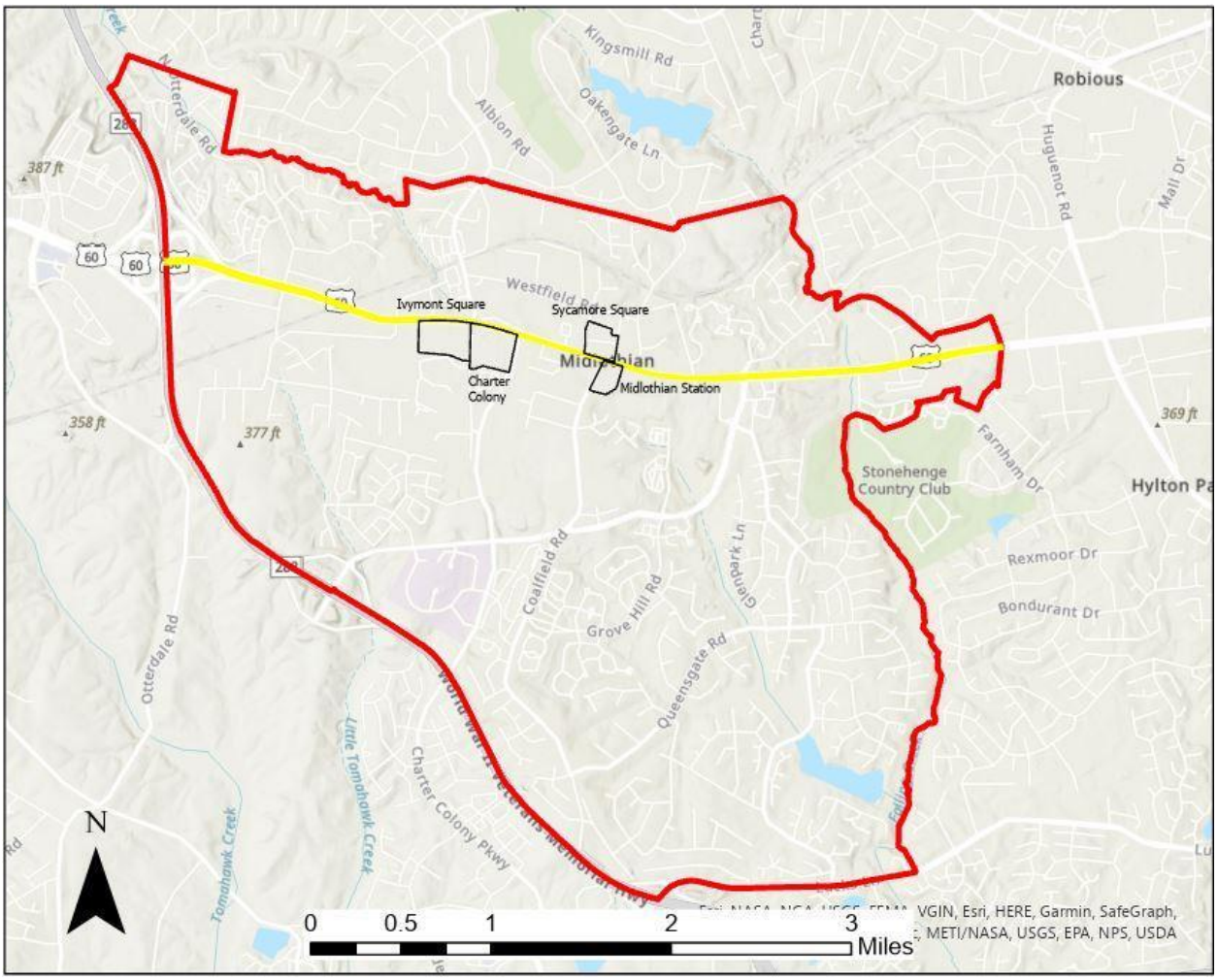
a few single family subdivisions, and many other commercial developments including some large superstores like Wal-Mart in the eastern portion of the study area. Most of the commercial developments for this study area are within a 0.25 mile buffer along US-60/ Midlothian Turnpike, shown below in Figure 5, which comes out to 1.68 square miles of the Midlothian Community Special Area Plan's 8 square miles. Of the 1.68 square miles buffer around 0.88 square miles of that is in impervious condition, which is around 52% of the total area. Many of this area is still developing and that percentage of impervious areas will continue to grow into the future.

**Figure 5: US-60/ Midlothian Turnpike Buffer Zone Impervious Area**



The 4 major shopping centers along the US-60/ Midlothian Turnpike are major development hubs and lead to a percentage of impervious area that is continuing to grow. The 4 major shopping centers, shown in Figure 6 below, are Ivymont Square, Charter Colony, Sycamore Square, and Midlothian Station and are all in different stages of development.

**Figure 6: Midlothian Community Special Area Plan Shopping Centers**




Ivymont Square is one of the older of the 4 shopping centers with construction beginning in 1990 and being complete before others were even started. As shown below in Figure 7 below most of Ivymont Square (approximately 22 acres) is in impervious condition (approximately 20 acres),

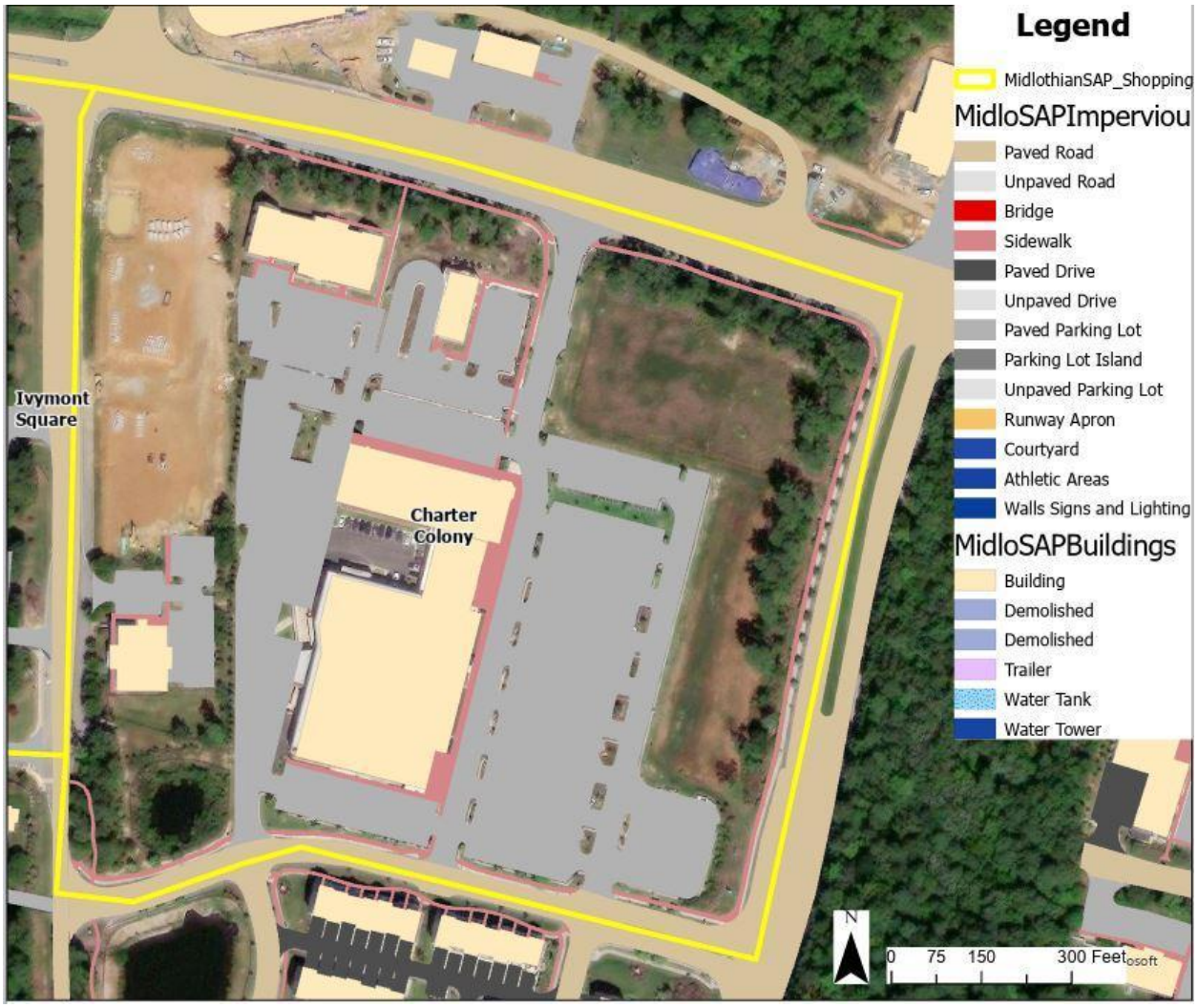
which is 91% of the total area. Most of the pervious area in Ivymont Square is related to buffer areas between US-60/ Midlothian Turnpike to the north and the Charter Colony subdivision to the south. Other pervious areas include islands within the parking lot. Stormwater systems for Ivymont Square include traditional curb and gutter systems with piping.

**Figure 7: Ivymont Square Impervious Area**


Charter Colony is directly east of Ivymont Square and is one of the newer commercial developments not only within the Midlothian Community Special Area Plan but in Chesterfield County. As shown below in Figure 8 Charter Colony (approximately 22 acres) is still in development and approximately 15 acres is in impervious conditions, which is around 68 percent impervious. The northeastern and northwestern portions of Charter Colony, as shown in Figure 8, are currently in development and will increase the impervious area in the near future. The

stormwater management for this Charter Colony includes curb and gutter to piping and a BMP retention pond in the southwestern portion of the shopping center.

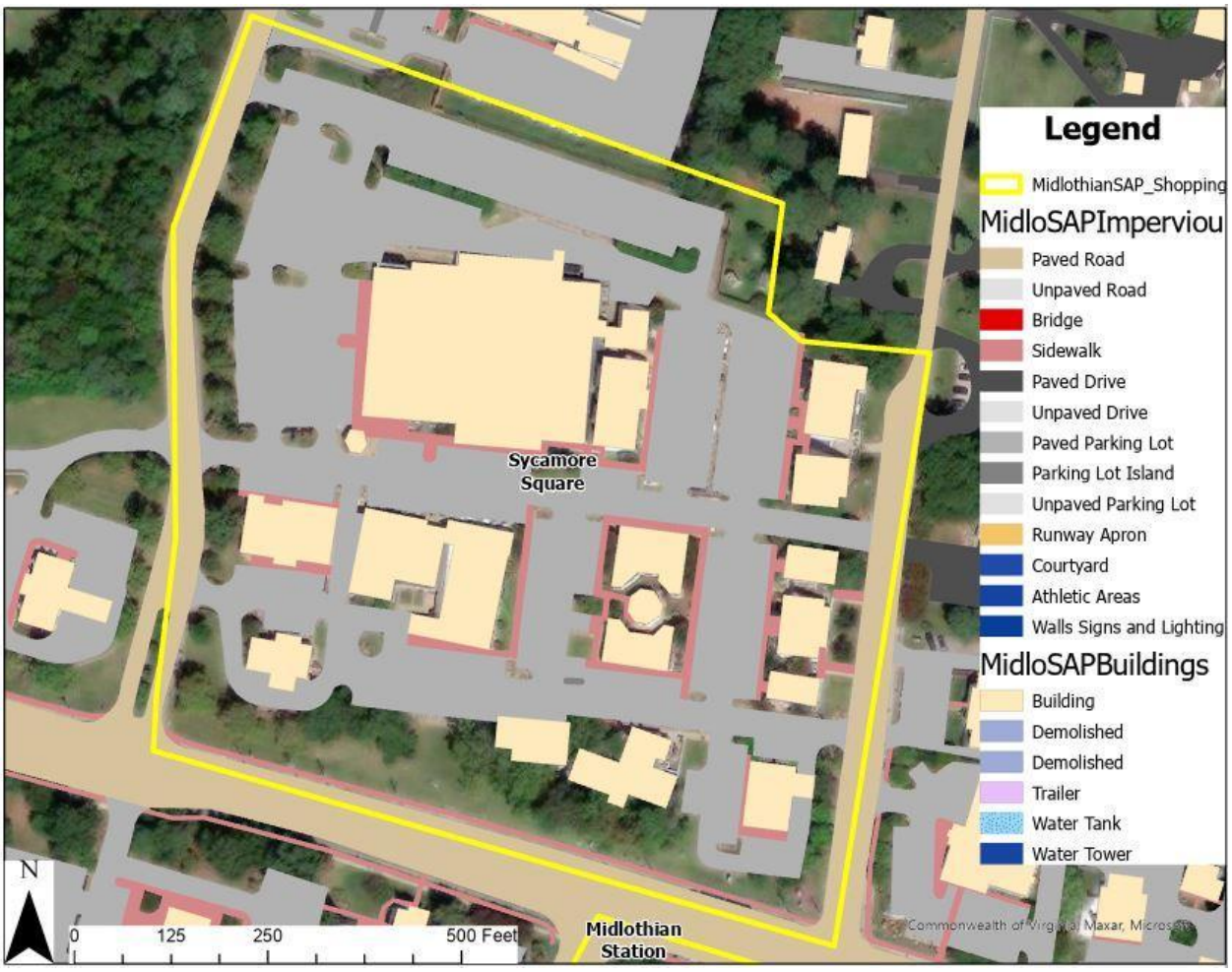
**Figure 8: Charter Colony Impervious Area**




Sycamore Square is one of the older shopping centers of this project and as shown in Figure 9 most of Sycamore Sqaure's 12 acres about approximately 9 acres of that is in impervious area, which comes out to 75 percent of the total area. Most pervious areas in Sycamore Square are associated with parking lot islands and buffers between Sycamore Square and the major roadways around the shopping center (US-60/ Midlothian Turnpike and Sycamore Square

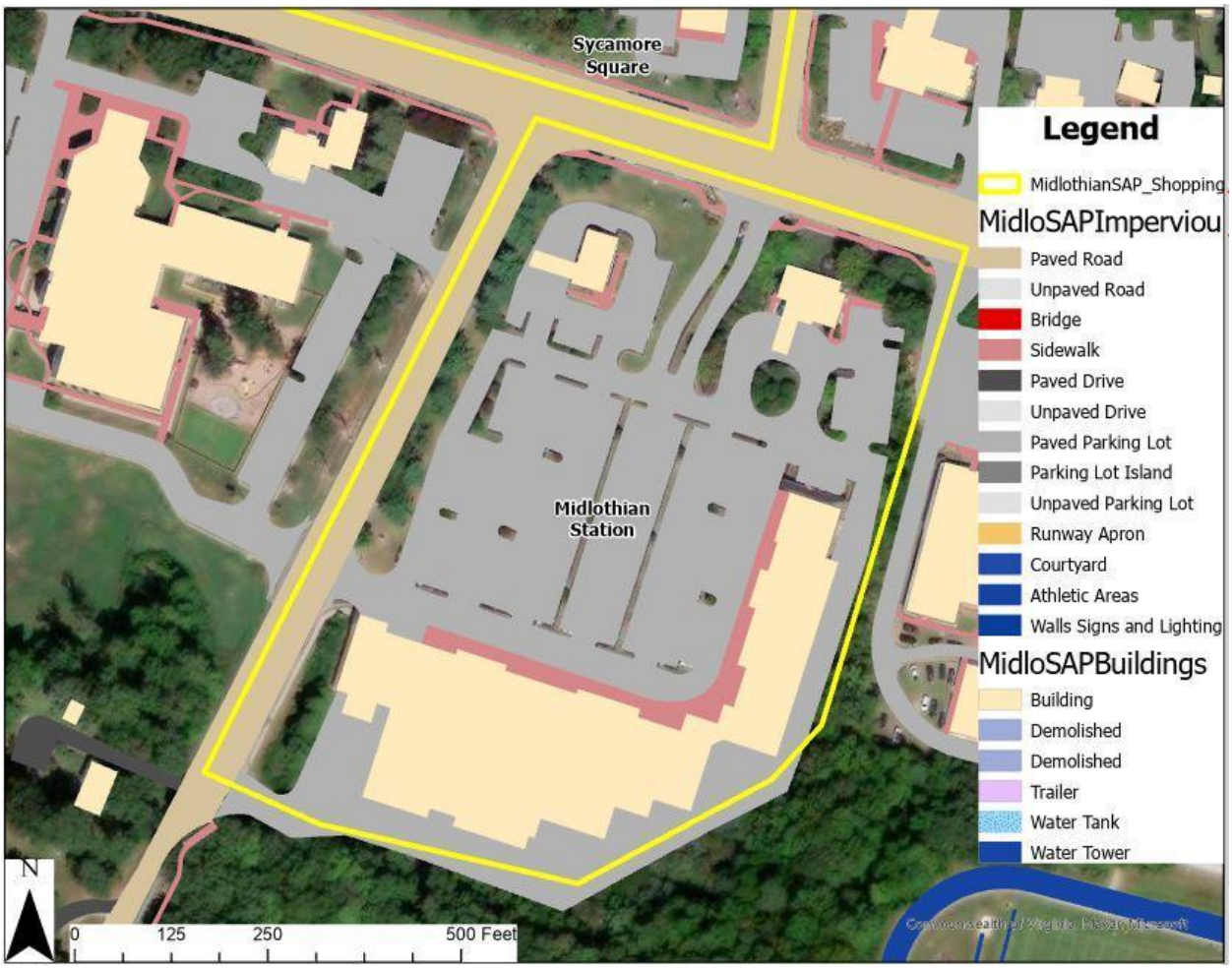
Drive). The stormwater systems for Sycamore Square include traditional curb and gutter systems with piping.

**Figure 9: Sycamore Square Impervious Area**




Midlothian Station is another one of the older shopping centers in the area and shown in Figure 10 many of Midlothian Station's 9 acres in impervious conditions (approximately 7 acres), which is around 78 percent of the total area. Like the other shopping centers most of the pervious areas come in the form of parking lot islands and buffer areas between roadways. The stormwater systems for Midlothian Station include traditional curb and gutter systems with piping.

**Figure 10: Midlothian Station Impervious Area**




**Green Stormwater:**

Green stormwater practices are needed to help offset the loss of pervious areas in the Midlothian Community Special Area Plan to help decrease the stormwater complications of that area already occurring and will continue into the future as more pervious surface is lost. To include some green stormwater practices into the Midlothian Community Special Area Plan and the 4 shopping centers listed above it is crucial to note where green stormwater practices are already in place in Chesterfield County and surrounding similar counties. Chesterfield County has many public rain gardens like the ones located at Clover Hill, Enon, Midlothian, and LaPrade libraries

and also one at Pocahontas State Park and many others located around the county[40]. Many surrounding counties and cities including the City of Richmond have included green roofs into their developments and could also be brought into Chesterfield County's development. VCU has included green roofs into their educational buildings like the Pollack Building and VCU Rice River Center as a way to decrease runoff by reducing stormwater volume and flow[41]. Henrico County has recently proposed a 2.3 billion dollar "GreenCity" plan that will build a more environmentally sustainable development which, along with other green initiatives, will include green roofs[42]. These examples are the fact that these types of green stormwater practices can be included and work in areas very similar to Chesterfield County and the Midlothian Community Special Area Plan and can help decrease the effects of stormwater runoff in Chesterfield County.

[40] *Chesterfield County Rain Gardens. Ecosystem Services.* (2017, February 28). Retrieved February 3, 2023, from https://ecosystemservices.us/portfolio-items/chesterfield-county-rain-gardens/
[41] *Green Roofs*. Sustainability. (n.d.). Retrieved February 2, 2023, from https://sustainability.vcu.edu/campus/buildings/green-roofs/
[42] Fitzgerald, M. (2022, July 8). *$2.3 billion Henrico County's Ecodistrict Breaking Ground Next Year*. Richmond Times-Dispatch. Retrieved February 1, 2023, from https://richmond.com/business/local/2-3-billion-henrico-county-ecodistrict-breaking-ground-next-year/article_b665e5a7-723e-5572-b946-56d5c6d0670a.html

## Recommendations

Recommendations were based on findings and data analysis. These recommendations are intended to introduce alternative or green stormwater infrastructure to the Midlothian Community Special Area Plan in Chesterfield County. The recommendations for this plan are intended to introduce alternative or green stormwater infrastructure into new and existing development that can range in size and cost. These projects will take cost and investment from the county and other stakeholders and will require proper planning to be implemented. These recommendations are mostly focused on the commercial corridor of US-60/ Midlothian Turnpike but will hopefully be able to be a guide in all areas around Chesterfield County. There are three broad goals that are then broken down into implementable and attainable objectives and actions.

**Goal 1: Increase education about stormwater management**

Informing the public and other stakeholders about the benefits of alternative stormwater infrastructure and the cost effective practice that will increase to less cost in the future and a better long-term investment will increase the implementation of alternative stormwater management systems into new and existing developments.

**Objective 1.1: Educate developers, commercial, multi-family, and industrial property owners on their role in introducing alternative stormwater infrastructure and improving water quality.**

Teaching the benefits of alternative stormwater infrastructure to the stakeholders that will be affecting the properties the most with continued development and long term ownership is key in decreasing the negative effects of conventional stormwater management in existing and future

developments. Giving these stakeholders the increased knowledge of more eco-friendly stormwater management techniques will only help the negative effects in the future.

- Action 1.1.1: Create a comprehensive guide for alternative stormwater management practices that include costs and implementation to allow for stakeholders to make informed decisions on the techniques that allow for better management practices and fee reductions.
- Action 1.1.2: Promote stakeholders to seek funding for alternative stormwater management practices from Federal, State and local governments to support implementation.

**Objective 1.2: Educate the public on the impacts of stormwater management and the positive effects of alternative stormwater management practices in public and private settings.**

- Action 1.2.1: Create a website or page within Chesterfield County Government's site that gives facts of all types of stormwater management practices.
- Action 1.2.2: Show areas where alternative stormwater management practices are already being implemented across Chesterfield County as either a webpage or GIS layer.

**Goal 2: Create incentives that will support change to alternative stormwater development**

Giving stakeholders incentives or benefits to incorporate alternative stormwater management practices into new and existing developments will increase the chances of these actually being implemented.

**Objective 2.1: Develop policies that incentivize participation in alternative stormwater infrastructure.**

Increased incentives to include alternative stormwater infrastructure in developments will lead to these best management practices being included in new and existing developments. Policies that can decrease fees, costs, and taxes for developers and other stakeholders will make implementation more feasible for stakeholders.

- Action 2.1.1: Update the public on new and ongoing alternative stormwater management projects that are occurring in Chesterfield County and compare costs and benefits.
- Action 2.1.2: Create a guidebook that will inform stakeholders and developers on the current grants on the federal, state, and local level that are available for implementation of alternative stormwater infrastructure into new and existing development.
- Action 2.1.3: Establish policies that will allow alternative stormwater management practices to be covered by grants.

**Objective 2.2: Create and maintain an environment that promotes alternative stormwater infrastructure development through public support.**

Private landowners and citizens are more likely to participate and push for alternative stormwater management infrastructure if they are more educated on the benefits and know that their local government is supportive of implementation. If the public is pushing for developers to be more environmentally conscious in new and existing developments the many developers will try to please the general public with help from the local government.

- Action 2.2.1: Continue developing public alternative stormwater management infrastructure projects to allow the public to become familiar with alternative stormwater management, and to promote its successes.
- Action 2.2.2: Create and update ongoing GIS-based data inventory to include base data, data on existing alternative stormwater management projects, and data on potential sites for implementing alternative stormwater management projects.

**Goal 3: Create policies that will implement improvements to stormwater management and increase alternative stormwater management practices**

By creating policies that include the implementation of alternative stormwater management into new and existing developments it will ensure that they are put in place in the future. All of the other goals and objectives will show the benefits of including alternative stormwater management and this goal will put them into place.

**Objective 3.1: Require new developments to include some type of alternative stormwater management infrastructure.**

Creating policy that states that new developments must include some sort of alternative stormwater management practice is essential in creating a precedent in including more and more alternative stormwater management practices in the future.

- Action 3.1.1: Promote that new multi-family or commercial developments will need increased green space or rain gardens as forms of alternative stormwater management.

- Action 3.1.2: Inform homeowners on alternative stormwater management practices that can be implemented on their property before development or in the future.

## Implementation

Implementation for this alternative stormwater management plan for the Midlothian Community Special Area Plan will rely on a relationship between all stakeholders to agree to include these practices in new and existing developments. The Implementation section of this plan includes a general timeline of actions organized in Phases.

### Timeline for Implementation

#### Phase 1

The first phase of implementation is focused on informing the community and developers of current alternative stormwater management practices in their area and how they can be implemented in their community. The actions listed in this phase will be long term and ongoing.

- Action 1.1.1: Create a comprehensive guide for alternative stormwater management practices that include costs and implementation to allow for stakeholders to make informed decisions on the techniques that allow for better management practices and fee reductions.
- Action 1.2.1: Create a website or page within Chesterfield County Government's site that gives facts of all types of stormwater management practices.
- Action 1.2.2: Show areas where alternative stormwater management practices are already being implemented across Chesterfield County as either a webpage or GIS layer.

- Action 2.1.1:  Update the public on new and ongoing alternative stormwater management projects that are occurring in Chesterfield County and compare costs and benefits.

**Phase 2**

The second phase of implementation will be based on finding and securing funding for alternative stormwater management projects to be placed within the community. This phase is based on increasing the implementation of alternative stormwater management by taking away the upfront costs to incentivise stakeholders to include them in development.

- Action 1.1.2: Promote stakeholders to seek funding for alternative stormwater management practices from Federal, State and local governments to support implementation.
- Action 2.1.2: Create a guidebook that will inform stakeholders and developers on the current grants on the federal, state, and local level that are available for implementation of alternative stormwater infrastructure into new and existing development.

**Phase 3**

The third phase is based on changing policies within Chesterfield to include alternative stormwater management practices into new developments in the future and informing the public of the options available before development occurs. This phase combined with Phase 1 and 2 will combine the community outreach efforts and funding to make the community make the decision to want to place these alternative stormwater management practices into their community.

- Action 2.2.1: Continue developing public alternative stormwater management infrastructure projects to allow the public to become familiar with alternative stormwater management, and to promote its successes.
- Action 2.1.3: Establish policies that will allow alternative stormwater management practices to be covered by grants.
- Action 2.2.2: Create and update ongoing GIS-based data inventory to include base data, data on existing alternative stormwater management projects, and data on potential sites for implementing alternative stormwater management projects.
- Action 3.1.1: Promote that new multi-family or commercial developments will need increased green space or rain gardens as forms of alternative stormwater management.
- Action 3.1.2: Inform homeowners on alternative stormwater management practices that can be implemented on their property before development or in the future.

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