Old Ivy Road Mixed-Use Development

A Technical Report submitted to the Department of Civil Engineering

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On my honor as a University Student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments

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Introduction

Design Problem Statement

Our group was tasked with designing and developing a mixed-use residential and commercial development for a 35.8 acre parcel along Old Ivy Road. The client requested 250 to 300 housing units divided into single family homes (10-15%), townhomes (20-30%), and apartment units (60-70%) with adequate parking. A minimum of two commercial buildings are required for the lot, as well as amenities for the housing developments. The goals include the development through the design phase and the pre and post construction phases.

Design Objectives

Our team prepared a site plan incorporating green infrastructure, traffic planning for construction, site grading for proper drainage, stormwater planning, and construction planning. We created six versions of our site plan to be completed throughout the length of the project to allow for redesigns and edits as other pieces of the site changed, such as the grading, road design, and stormwater management practices. In our site plan we have chosen to use essential urban planning techniques such as prioritizing walking, biking, and public transit. We did this through the addition of walking trails, sidewalks, and bus stops, as well as emphasizing connectivity of pedestrian access throughout the site.

A stormwater management plan as well as a grading plan were included as design goals for the site. The grading plan outlined the changes made to the grade of the post-development land, and the stormwater management plan covered the modification of the existing pond into a stormwater retention pond. The goal was to better suit the projected post-development stormwater volumes. A traffic plan was created to visualize and plan road closures, detours, and other construction related changes to traffic on surrounding roads. Additionally, we aimed to create construction related deliverables including a project schedule, scoping for a trade, and list of potential subcontractor partners.

Background

Affordable and sustainable housing is seen as a big issue within Albemarle County. The county website defines affordable housing as "when rent or mortgage, plus utilities, costs no more than 30% of a household's pre-tax income (Albemarle County, VA)." A family in the county making the median household income of $123,000 "- assuming a 30-year, 6.0% fixed rate mortgage, with a $25,000 down payment, and a monthly debt of $1,000" can afford to purchase a home for $393,000 but the median home sale price in the first quarter of 2023 is $458,798 - which is 16% higher than what is within their financial means. When considering the rental property market, which is also a concern of the County, it is estimated that "-today, a modest

2-bedroom apartment in Albemarle County rents for an average of $1,401 per month.” In order to afford this apartment at no more than 30% of their income, a full time worker in Albemarle County would have to make $26.94/hour or $56,040 annually. This is unrealistic as 62% of those in the county do not meet this income criteria. It is clear that housing needs to be more affordable within the county, which is most directly affected by the increase in its overall supply. This has to be within the sustainable criteria of being close to job centers, having community amenities, and access to public transit - all of which contribute to reducing the cost of living.

However, while the Old Ivy Road development adds housing units, it hasn’t been without controversy. One of the largest present concerns in the community involving this development is safety and traffic. The community opposition is worried that the increase in volume of traffic will further congest the roads, and decrease safety. Indeed, traffic conditions in the area are already poor, and this development will increase overall traffic. As such, a clear plan for accommodating increased traffic from the residents as well as the commercial property is needed. Further concerns stem from the beliefs that density will rise, taxes will go up, gentrification will increase, and infrastructure will become more problematic. However, academic institutions in Charlottesville believe that the units added by projects like ours will reduce overall prices and make Charlottesville more accessible to everybody. We will keep a conscious count on the number of units in the development, and also will keep the public engaged on the project to build trust and knowledge.

Design

Site Design

Required Design Elements

The design of the site included all of the elements required by the client. This includes a mix of residential and commercial area, residential amenities, parking, relocating the Rivanna Trail, etc. (Dewberry Project Requirements, Appendix D). Figure 1 lays out all of the required components of the site plan in regards to Dewberry’s requirements.

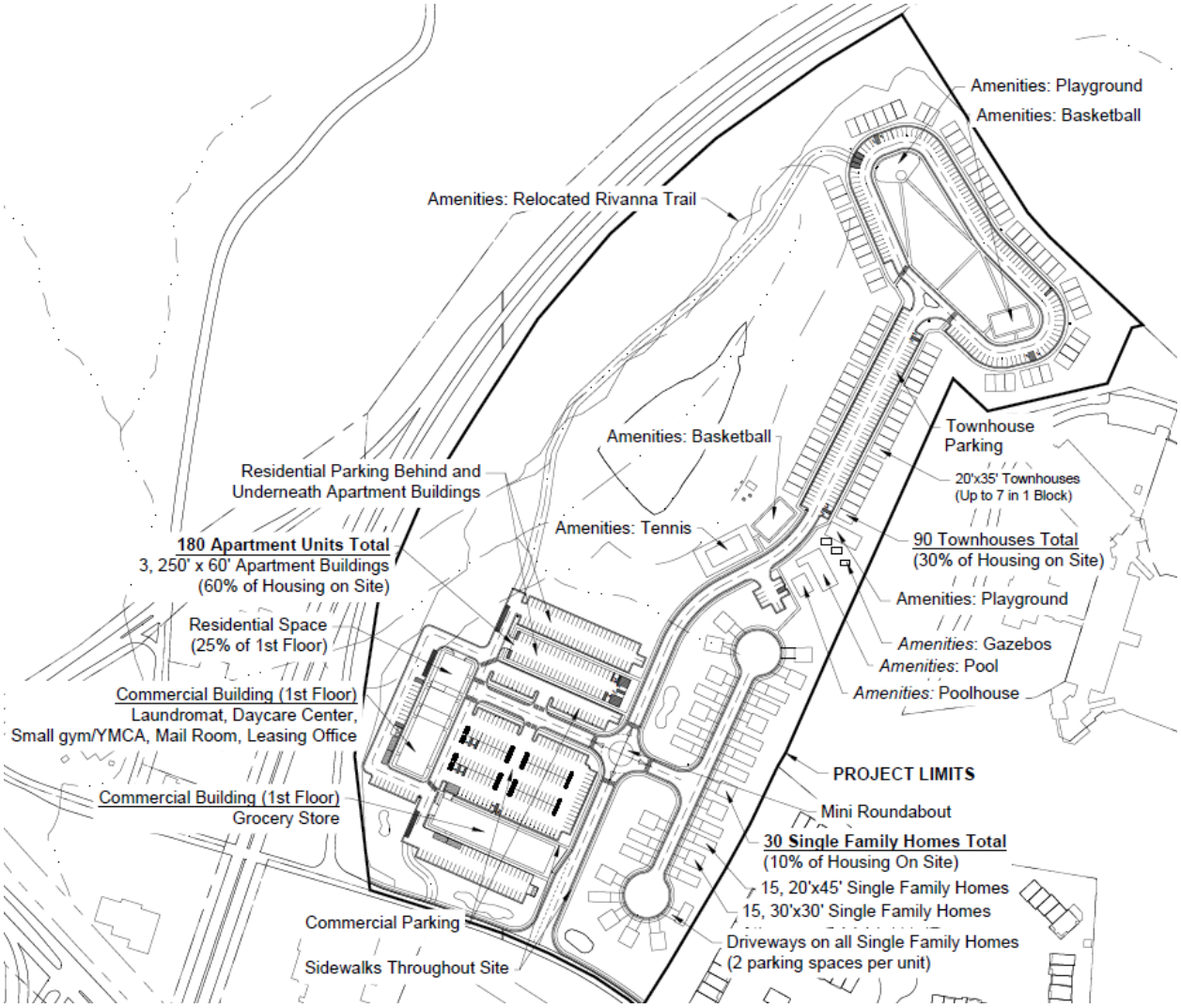

Figure 1. Dewberry Project Requirements Summarized on Site Plan

Residential/Commercial Design Areas

The design of the mixed use residential and commercial area followed all Project Requirements and relevant Albemarle County Code requirements (Project Requirements, Appendix D; Albemarle County Code of 1998). Our team aimed to create 300 housing units. The apartment units were planned to be constructed with the required two commercial buildings to create a mixed-use area that will foster community and allow for greater walkability. The ranges for each housing type were as follows:

- 30 Single Family Homes (10% of units)
- 90 Townhouse Units (30% of units)
- 180 Apartment Units (60% of units)

We centralized all commercial parking for the site between the southern and western apartment buildings which both had 1st floor commercial. We then put all residential parking behind each apartment building as well as 1 floor of underground parking underneath each

apartment building so that residents would not have to walk as far, and so there was a clear delineation between commercial and residential areas (allowing residents to tow if someone parks inside of their spot as there would be towing signs in front of all residential parking entrances). The parking layout also portrays 2 box truck/loading dock spaces behind the commercial floor apartment buildings that includes dumpster pad locations as well. The residential parking spaces are as follows:

- Single Family Homes
    - 20’ width x 26+’ varying length driveways, providing 2 spaces per house
- Townhouse Units
    - Total = 202 + 6 ADA
    - Required = 144
    - Visitor/Excess (for Park as well) = 58
    - ADA Car Accessible = 5
    - ADA Van Accessible = 1
- Apartment Unit 1 (All Residential) - 72 Dwelling Units
    - Total = 102 + 4 ADA
    - Required = 98
    - Visitor/Excess = 4
    - ADA Car Accessible = 3 (Underground Parking Area)
    - ADA Van Accessible = 1 (Underground Parking Area)
- Apartment Unit 2 (Grocery Store) - 60 Dwelling Units
    - Total = 89 + 4 ADA
    - Required = 81
    - Visitor/Excess = 8
    - ADA Car Accessible = 3 (Underground Parking Area)
    - ADA Van Accessible = 1 (Underground Parking Area)
- Apartment Unit 3 (Various Commercial) - 48 Dwelling Units
    - Total = 67 + 4 ADA
    - Required = 65
    - Visitor/Excess = 2
    - ADA Car Accessible = 3 (Underground Parking Area)
    - ADA Van Accessible = 1 (Underground Parking Area)

The commercial businesses that we decided would bring the most benefit to the community were a laundromat, a daycare center/YMCA (gym), and a grocery store. This would incentivize more families to move into the area as there are also abundant recreational areas that are safe for children. Living nearby a grocery store also saves on commute times for groceries and miscellaneous items. The proposed commercial layout can be seen in Figure 2.

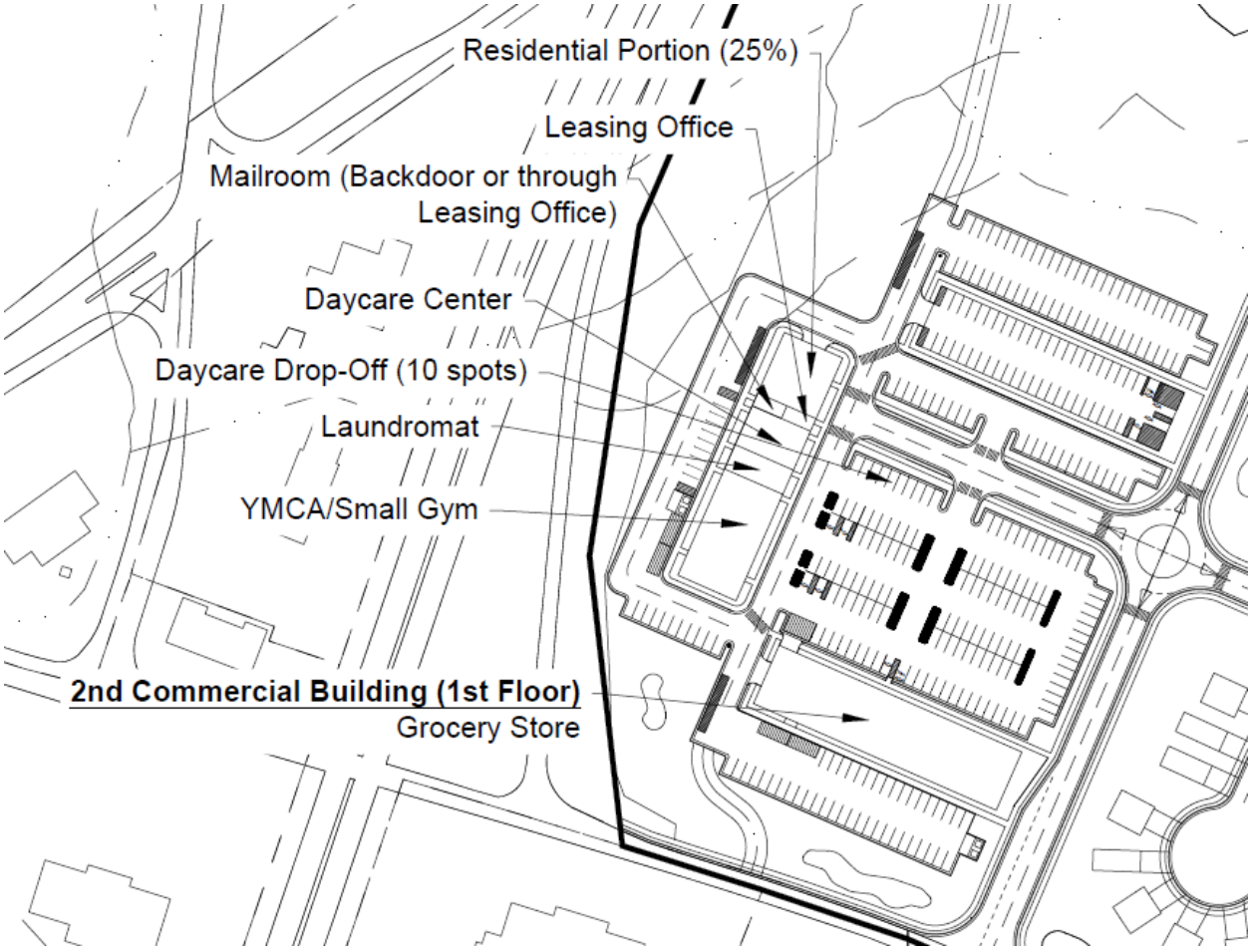

Figure 2. Commercial Floor Layouts

The commercial parking layout and spaces are as follows:

- Apartment Commercial Parking
    - Total = 159 + 6 ADA
    - Required = 152
        - Laundromat (3600 sq. ft.) = 13
        - Daycare (30 kids, 7 employees) = 10 + pickup/dropoff (10)
        - YMCA/Gym (7200 sq. ft.) = 58
        - Trader Joe's/Aldi/Small Grocery Store (11000 sq. ft.) = 61
    - Visitor/Excess = 7
    - ADA Car Accessible = 5
    - ADA Van Accessible = 1
- Apartment Commercial Loading
    - 4 Loading Spaces (12' x 30')
    - 2 Dumpster Pads with 2, 8 cubic yard dumpsters in each

The design of the other residential areas was also in accordance with project requirements and county code. Regarding single family housing, we decided to locate the single family homes around cul-de-sacs and varied the designs to have a mostly even split between houses that were 30’ x 30’ and those that were 20’ x 45’. We had to fit all single family homes into one parcel as that was the only parcel zoned for R1, while all others were zoned R-15 allowing us to put the townhouses and apartment buildings more optimally around the site. We decided to place the apartment buildings closest to the entrance so that the commercial areas could be accessed more readily by those coming into the site that are not residents. We placed the townhouses around the large park to maximize the viewshed area onto the park (helping with community safety for children playing, as well as residential views). We decided to place perpendicular parking in front of the townhouses to allow for easy access by residents who lived there as there was not enough space to design parking areas behind the townhouses without creating significant amounts of additional impervious cover.

Recreational Area Design

Within our design we have made it a priority to maximize the amount of green space and recreational areas available to residents. Despite the provision that states recreational areas do not need to be provided for single-family zoning, we decided to provide these areas with recreation regardless. Our recreational areas are centralized in two locations. The first are recreational areas within the larger park in the townhouse area, and the second is the community pool area centralized on the site itself. This allows almost all residents within the site area to be within 0.25 miles of a recreational area, making it extremely accessible and convenient to access as it is within walking distance.

The large park has future planned amenities within it in order to increase green/recreational space available to residents (Figure 3). We found it important to provide as much recreational space/green space as possible for the various health benefits associated with access to these areas. We also imagined that the large park would provide the future community with a large communal space for open air gatherings and/or a community garden if they so wished. The park would also allow for the site to be more aesthetically pleasing for the residents/families who lived in front of it.

As a part of recreation, a portion of the Rivanna trail has been moved. The Rivanna trail is a beloved part of the Charlottesville community and our team wanted to ensure that we respect its meaning to the community. The trail previously ran through a portion of our site which will be impacted by construction. We wanted to keep its element of winding through the greenery on site, so we have moved portions of the trail plan North to keep it away from the new homes in this community. All recreational areas for the site can be seen in Figure 3 below.

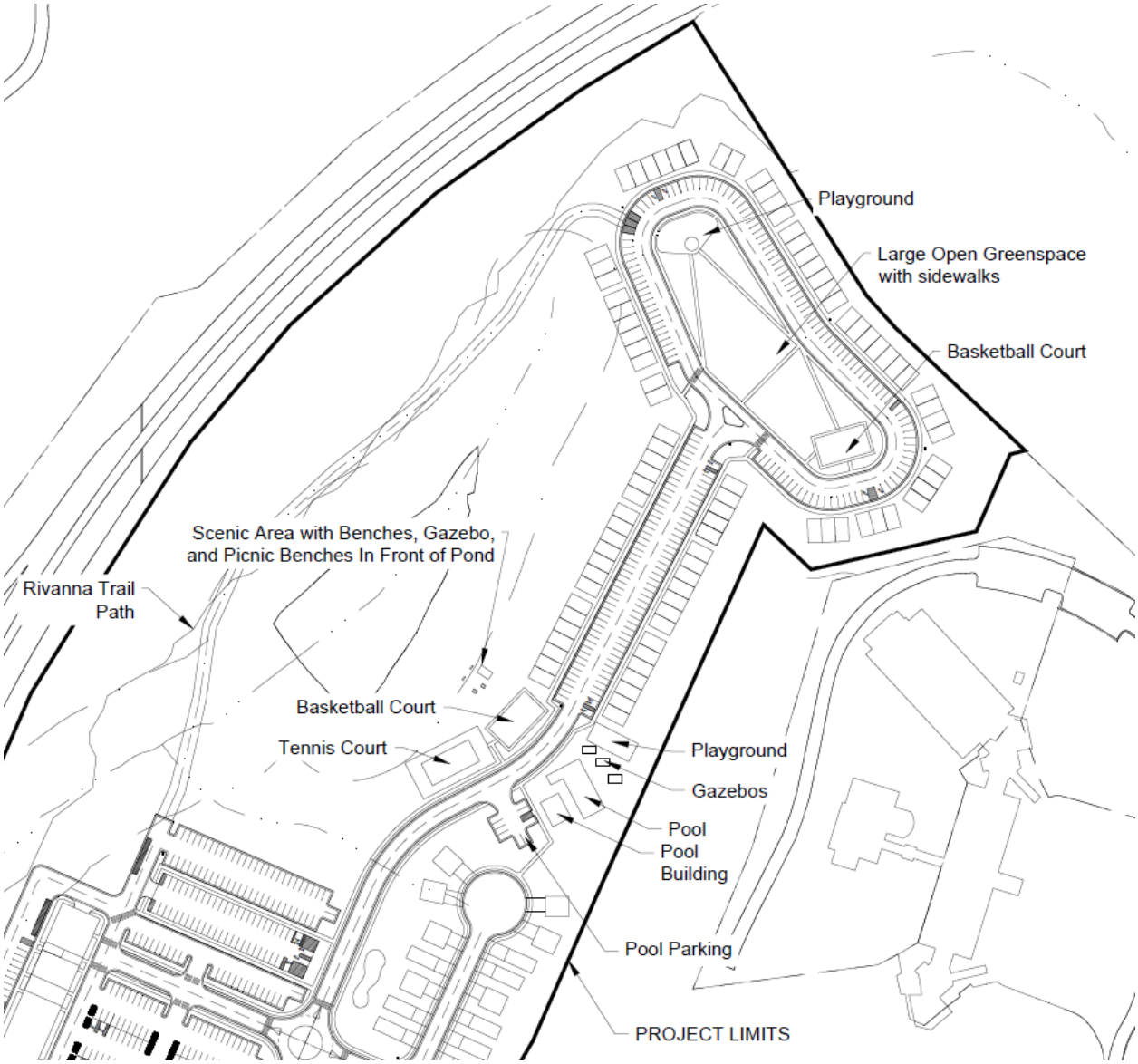

Figure 3. All Planned Recreational Areas on Site

Roadway Design

The design of roads and entrances followed County Code, fire access code, as well as various VDOT standards and design manuals. Since it is a majority residential development, we set the speed limit to be 25 mph throughout the site, except in parking lots and through the roundabout, which will be lower. In addition to that, we modified roads and their entrance radii to be able to accommodate school buses (radius = 45'). We also decided to move the initial site entrance to a different location (Figure 4). Space for an additional right turning lane was added onto the entrance of the site after further traffic analysis in order to relieve potential traffic congestion that might occur while entering the site.

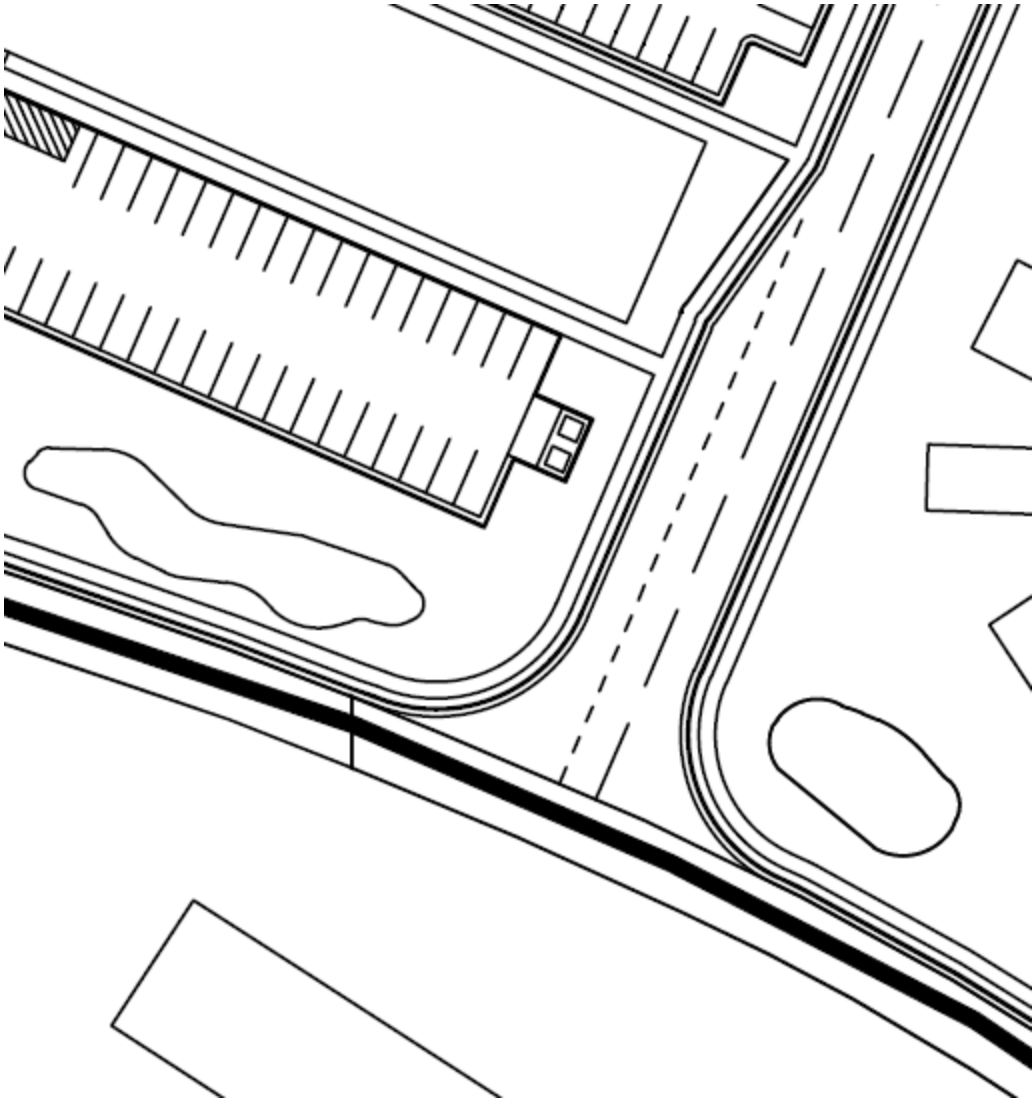

Figure 4. New Entrance and Right Turn Lane

In order to make the site more manageable and to not install traffic signals that must be maintained, we decided to install a single lane mini roundabout to handle traffic entering the commercial area as well as the site itself (Figure 5). This design was chosen since the site we have has a low daily traffic count. The traversable inner island makes the site accessible to larger vehicles, like school buses and commercial box trucks, while still keeping the overall sizing small.

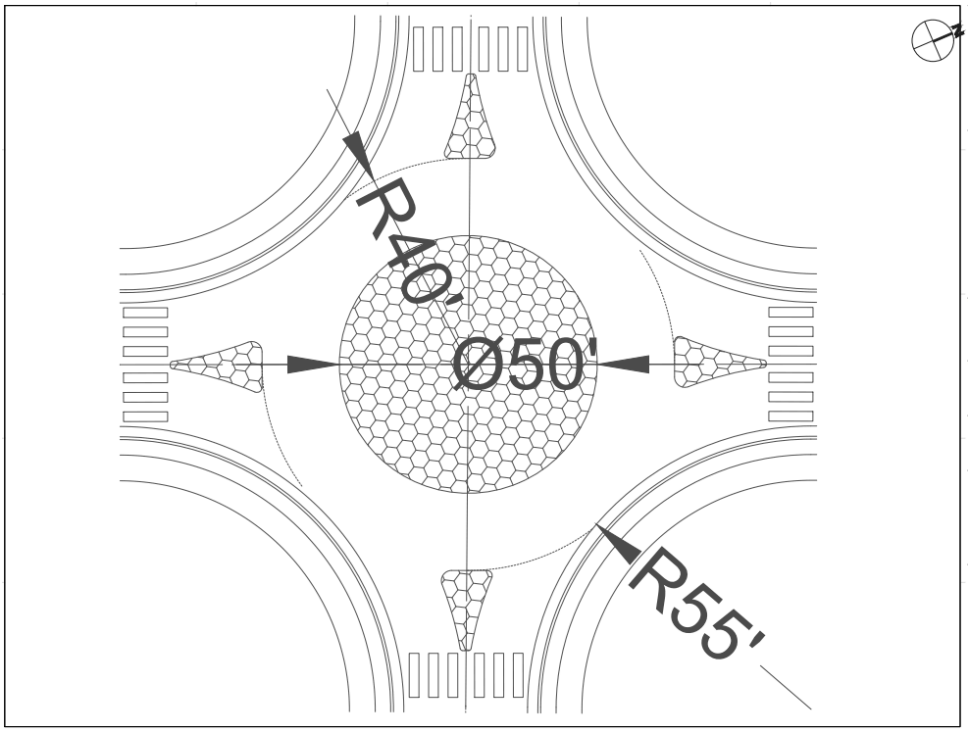

Figure 5. Roundabout Sizing and Radii

Stormwater Plan

We completed the stormwater management plan in tandem with the site plan. The preliminary stormwater plan, see Figure B10 in Appendix B, set out the initial drainage areas along with proposed areas for the locations of best management practices (BMPs). As the grading and site plans became more detailed, we went on to place the BMPs in their final locations. The areas that we had initially reserved for stormwater BMPs were larger than the necessary spaces needed to meet VRRM specifications. These conservative estimates that we made early in the design process gave us more flexibility later in the design. We ended up dividing the space into four drainage areas. Their sizes can be seen below in Table 1.

Table 1. Drainage Area Sizes

Drainage area	Size (acres)
A	2.62
B	2.77
C	5.20
D	25.21

BMP Selection

The final stormwater infrastructure design is shown below in Figure 6. Our best management practices (BMP) strategy consists of several measures. These locations chosen for these BMPs were at the low points within each area. Drainage area A, which is home to half of the single family homes, will have a level 2 bioretention BMP. Similarly, drainage area B will also have one bioretention. The design for drainage area C, which contains the apartment buildings and their associated parking lots, has more diverse infrastructure. The BMPs for this area include one level 2 bioretention basin along with two split filterra systems located on an island between parking spaces. Drainage area B, which is by far the largest area, uses a level 2 wet pond to treat drainage. The detention pond will be constructed on the site of an existing pond, which is already the natural low point on the site. Additionally, storm sewers will be placed periodically throughout the road system to allow for drainage from impervious surfaces. The exact placement of storm sewers is not within the scope of this project.

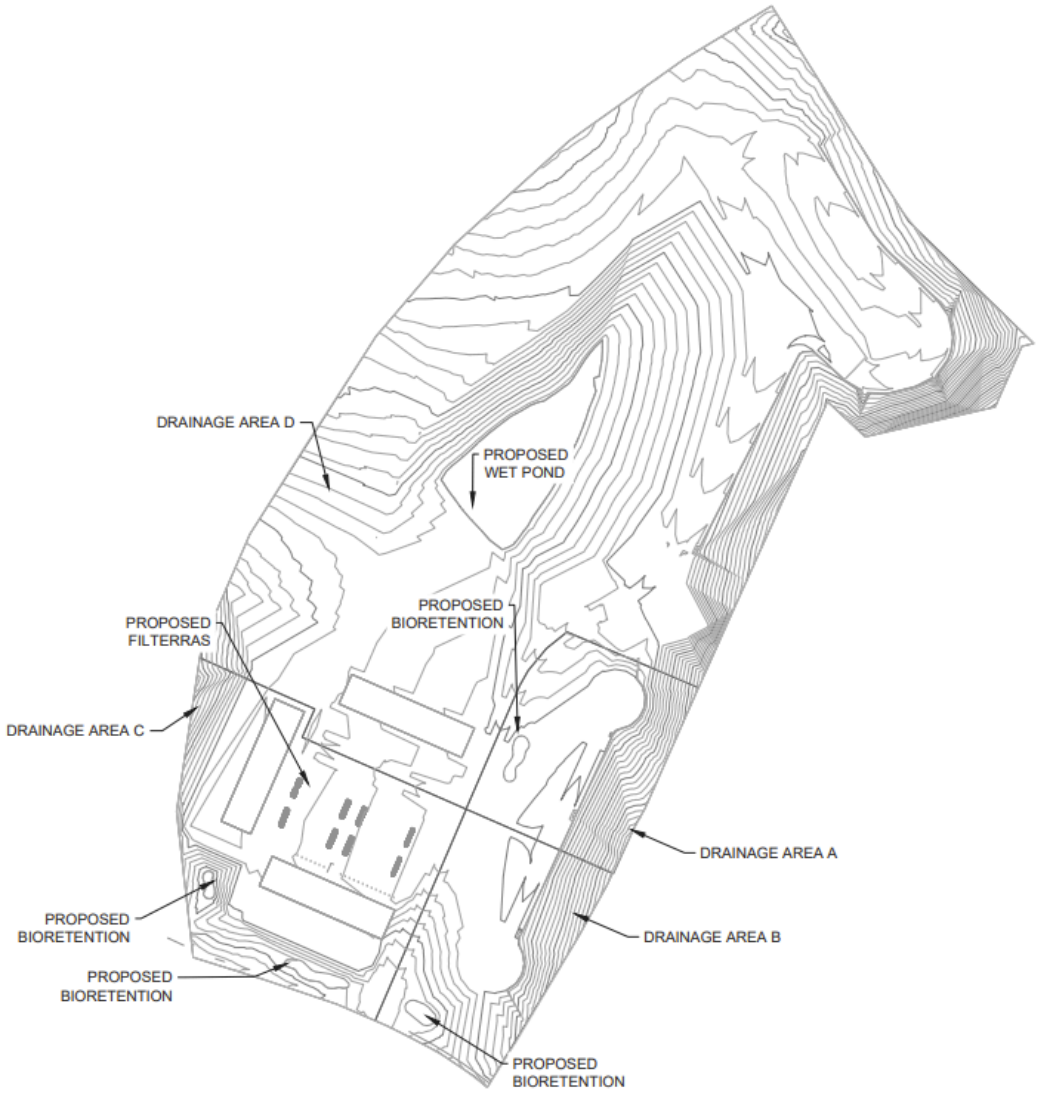

Figure 6. Proposed Stormwater Management Plan with New Grading

Phosphorus Removal

We used the Virginia Runoff Reduction Method (VRRM) to calculate the phosphorus removal of the BMPs on our site. A copy of the spreadsheet is located in Appendix D. The VRRM found that in order to meet Virginia stormwater regulations we needed to reduce the Total Phosphorus (TP) load by 20.28 lb/year. We inputted the final project conditions based on land cover and soil types. We then inputted all proposed BMPs along with the drainage areas in which they will be placed. We found that our proposed BMPs would treat 34.96 lb of TP per year, a removal rate greater than that required by law. Considering this, we determined that there is no need to purchase stormwater credits since our current plan meets local regulations.

Grading Plan

While the existing site is very hilly, the proposed surface is much more shallow. Design constraints, such as a maximum grade of 10% for most roads on the site and a max grade of 2% for parking lots and intersections, meant that roads were not able to follow existing contours very closely. This resulted in large sections of cut. However, the hills on the site also resulted in many voids that will need filling, offsetting the amount of cut volume that is produced. Additionally, minimum K-values, shown in Figure 7, that determine the sharpness of vertical curves restricted us from following the natural contours closely, resulting again in areas of unfavorable cut and fill as seen in Figure 8. Yards and green spaces require between a 3 and 10% grade for aesthetic and drainage purposes. However, a lack of pre-determined grading led to undesirable grades along the western side of the site, particularly west of the single family homes and west of the townhomes. To remedy the large grades, several five-foot retaining walls were placed along the roads, as seen in Figure 9. Even so, grades to the west of the single family homes reach up to 25%, and grades west of the townhomes reach up to 44%. The final volume report for the proposed surface can be seen in Table 2.

Private Street Standards for Albemarle County *										
Street	**Design Speed mph**	**Min. CL radius ft.**	**Max. Grade**	**Min. K-crest**	**Min. K-sag**	**Min. Stopping Sight Dist. Ft.**	**Min. travelway width ft.**	**Min. ROW or easement width**	**Min. shoulder width**	**Sources**
rural 2-lot	(no standard)							30	n/a	14-412A1
rural 3-5 lots	15	40	20%	5	15	100	14	30	3	14-412A2, 410, 415
6 lots or more	same as VDOT standards, see Detail 5									14-412A3, 415
multifamily, nonresidential	n/a	40	10%	5	15	100	20 (curb to curb) **	30	n/a	14-412B
Alleys	n/a	n/a	20%	n/a	n/a	100	12***	20	n/a	14-410

* where standards are not specified (for guardrail or drainage for example) standards are to be as required by VDOT
** or 24' next to perpendicular parking spaces (Zoning Ordinance parking lot requirements, 18-4.12.15)
*** with 14' wide stone base
1. Angle of intersection shall be 80 degrees minimum
2. Temporary turnaround shall be provided on phased streets more than 300ft in length. Cul-de-sacs must be provided for permanent street ends. See the graphic below.
3. Reserved or spite strips are prohibite
4. In the development areas, curb and gutter, sidewalks (5' min.), and planting strips (6' min) are required

Figure 7. Design Standards for Private Streets in Albemarle County

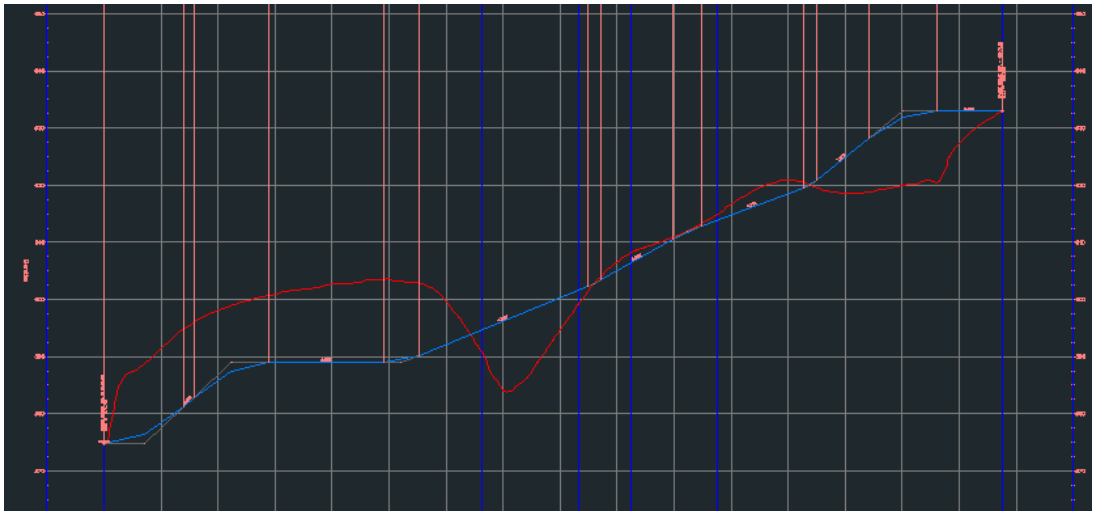

Figure 8. Profile of Main Road Alignment Showing Cut and Fill Areas

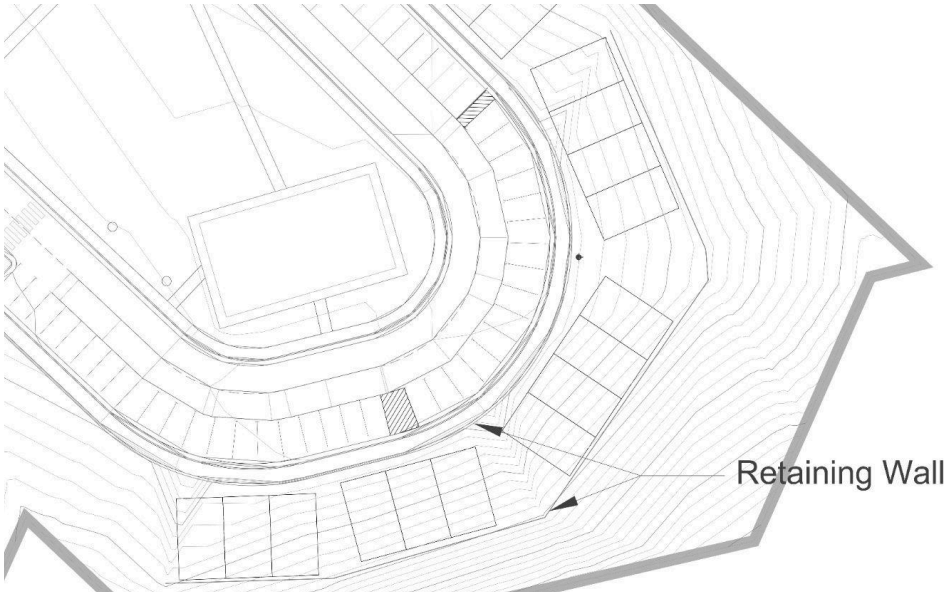

Figure 9. Retaining walls near townhomes

Table 2. Volume calculations for final surface

Total Cut (Cubic Yards)	443986.49
Total Fill (Cubic Yards)	96543.41
Net (Cubic Yards)	347443.07 (Cut)

The level 2 detention pond in the northern section of the site treats almost 60% of the total site's area, which was achieved through a combination of pre-existing grading and additional grading. Earthwork was done to ensure that those sections all drained towards the pond. The site was split into three other drainage areas as well, though smaller and draining into bioretention ponds, outlined in the stormwater plan. The finalized grading plan can be seen in Figure 10.

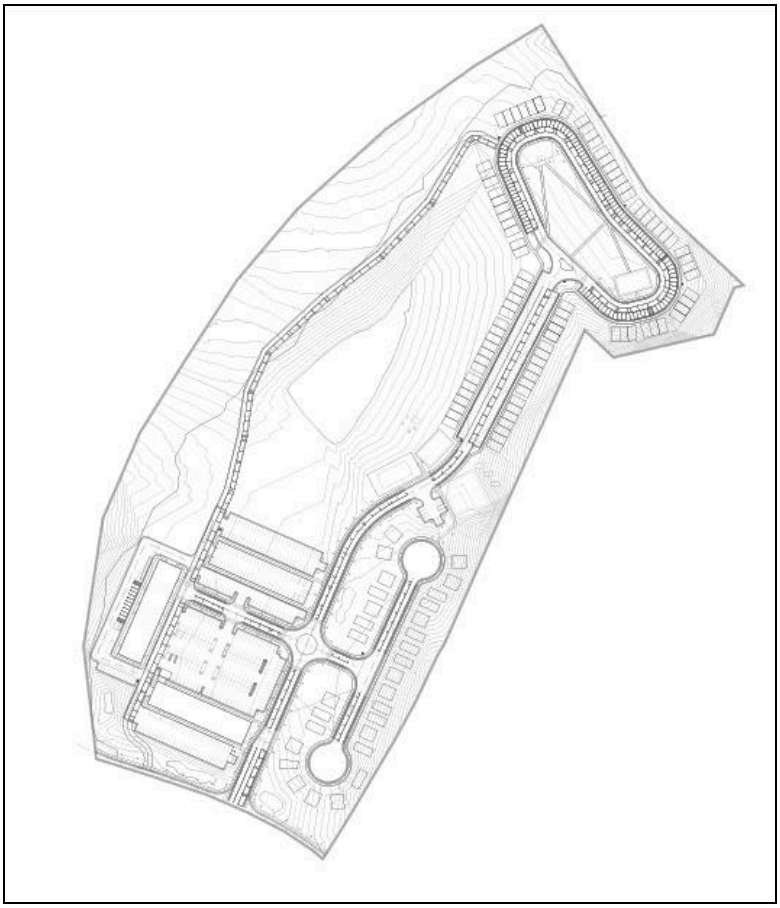

Figure 10. Finalized grading plan

Traffic plan

An iterative traffic plan was created to show how construction would take place with regular traffic flowing through the area and how the completion of the site would affect existing traffic conditions.

To do so, the background traffic conditions had to be analyzed from which conclusions could be drawn. Much of the data and information was drawn from a Traffic Impact Analysis document prepared by Timmons Group for the surrounding area including the site. The key things that were considered when looking into the background traffic conditions were the existing roadways, intersections and points of entrance/exit.

The major roadways which service the site are Old Ivy Rd, Ivy Rd and US 29. Old Ivy Rd is the most important as the site is right off of it. The table below shows what kind of road it is along with its speed limit and ADT.

Table 3. Existing Roadways Feeding into Development

Road Name	Type of Road	Speed Limit (MPH)	ADT (Average Daily Traffic)
Old Ivy Road	Two Lane - Undivided	35	8,300
Ivy Road	Two Lane - Undivided	35	58,000
US 29	Four Lane - Highway	55	58,000

We also analyzed the intersections in the area to see what type they are along with the delays in the AM peak times of 7-9 AM and PM peak times of 4-6 PM as seen in Table 4.

Table 4. Existing Intersections

Intersection	Type	Peak Delay AM (sec/veh)	Peak Delay PM (sec/veh)
Ivy Rd & Canterbury Dr	Signalized	48.2	45.9
Old Ivy Rd & Faulconer Dr	Unsignalized	349.1	20
Old Ivy Rd & Ivy Rd	Signalized	13.3	13.2
Old Ivy Rd & 29 Off Ramp	Unsignalized	87.3 (eastbound) 167.7 (westbound)	27.5 (eastbound) 47.1 (eastbound)

It was also important to see how Old Ivy Rd and subsequently the site is connected to the surrounding traffic network as seen in Figure 11.

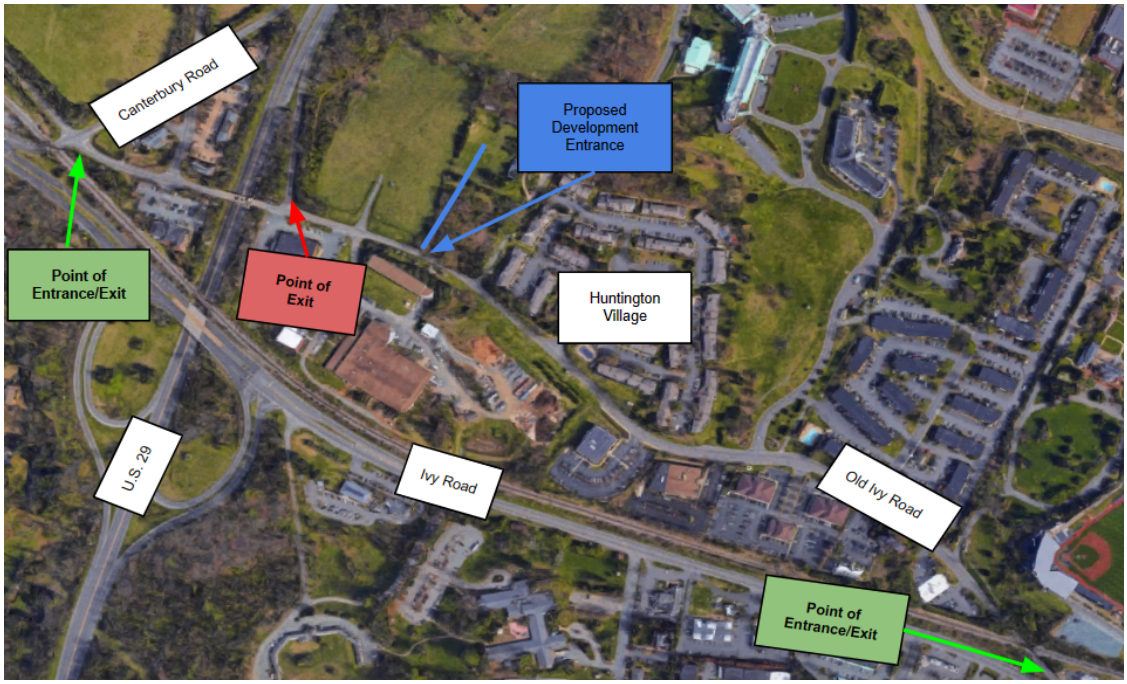

Figure 11. Map of Traffic Network with Roadways and Points of Entrance/Exit

Putting all of this information together, we can conclude that there is a high volume of traffic going through Ivy Rd to get either on or off US 29 during peak times as people commute to and from work. While this traffic doesn't directly go through Old Ivy Rd, passing through the west entrance can be difficult especially as highlighted in the traffic constraints of the eastern entrance.

After development, we believe the typical daily service volume of the development will increase by 2,253 average daily trips to a total of 10,553 veh/day. In order to service this additional load on Old Ivy Road, we're proposing that an additional right turn lane be added to it, leading into the development. Something to keep in mind is that not all of these added trips won't necessarily be impacting Old Ivy Road as some of them will be within the site as residents go to various amenities or commercial spaces throughout the site.

While construction is being worked on, we're proposing that a one way, two lane taper is instituted with a flagger on each side of the closed off section. One of the flaggers will be the lead flagger and communicate either verbally or electronically with the other flagger. This way, only one lane of the road will have to be closed and this will be during off peak hours such as noon and during the evening/night.

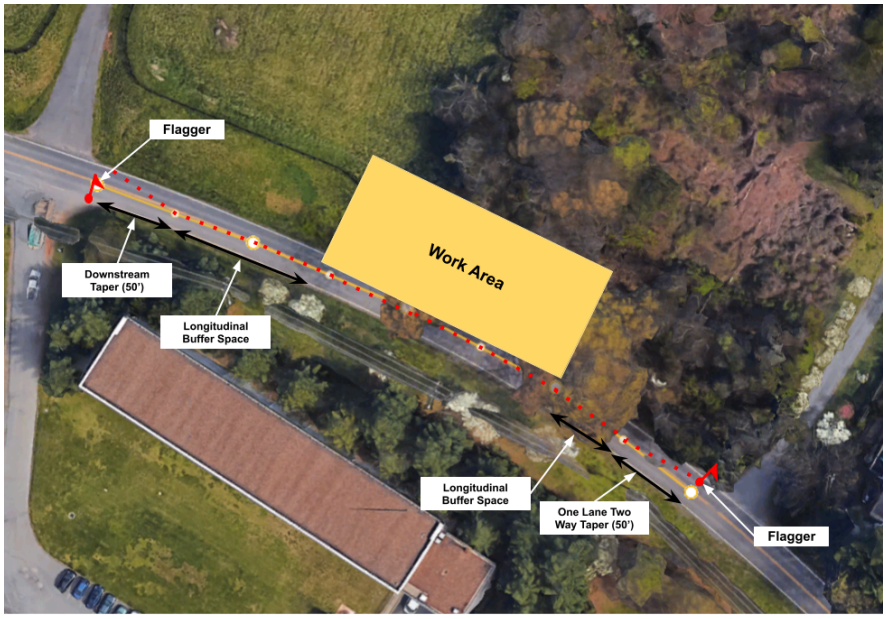

Figure 12. Traffic Plan During Construction

To manage some of the additional traffic load generated by the site, we're also proposing a new intersection as shown in Figure 15. There would be an additional left turn lane entering the site so that traffic isn't backed up on Old Ivy Road westbound. There are also both right and left turn lanes exiting the site to avoid backup in the site as well.

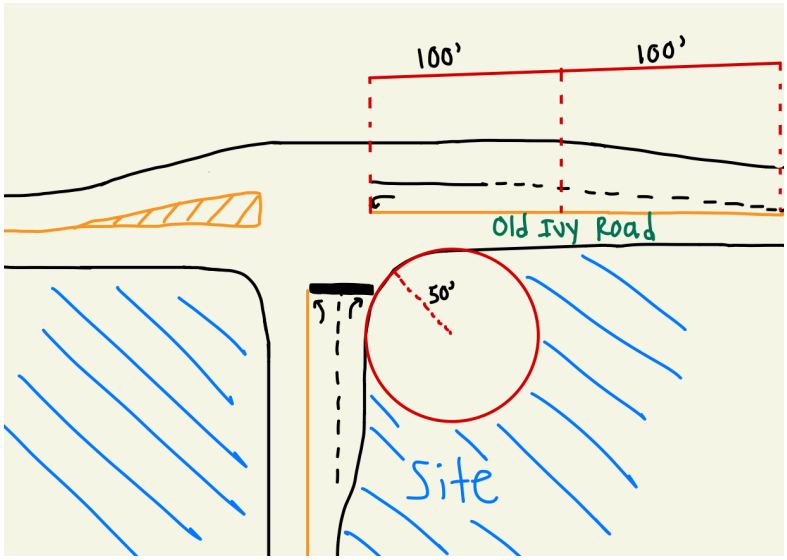

Figure 13. Proposed Intersection

Construction Plan

A construction plan for the site will help execution of building go more smoothly. To prepare for construction, our team developed a number of deliverables. These include a construction schedule Gantt chart, a list of subcontractors near Charlottesville that will be contracted to perform work, and a sample scoping document for landscaping.

To create the construction schedule, each labor step was divided into a category of preconstruction, sitework and structures, interiors, and inspection and closeout. From there, each division was structured to begin and end in a way that respected the necessary prerequisites of the construction process. For example, MEP work was scheduled to begin after completion of framing. Given the schematic nature of the design, exact timing and scheduling will fluctuate and a more detailed schedule will be able to be developed as the drawings progress. Figure 11 shows a simplified construction schedule, and a detailed schedule is available in Appendix D.

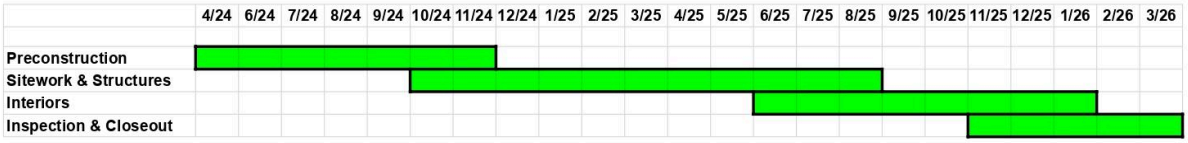

Figure 14. Simplified construction schedule

Selection of trade contractors is reliant on specialty, distance, pricing, and pre-existing relationships. Given the nature of this project, subcontractor specialization and proximity to the jobsite were the primary factors considered. Each trade has two options available as a shortlist in case one subcontractor is too busy to take the work or quotes a price that is unreasonable. In the selection process, companies based in Charlottesville were prioritized due to their knowledge of the community and their likelihood to bid on a local project. To find suitable contractors, a combination of internet searches and observational research was conducted. The divisions chosen follow MasterFormat CSI Division guidelines and are the most popular guidelines used on the construction of a neighborhood. Some divisions such as division 09 - finishes encompass different trades such as gypsum board, flooring, ceilings, and painting. In this case, multiple contractors were included in the list to cover these required parts of the building. A complete list of subcontractors can be found in Appendix D.

A detailed scoping document was created for the landscaping subcontractor. This was done using the format provided by Dewberry along with publicly available scoping documents on planting. The scoping document consists of three parts, a general overview section, information on the physical products, and the plan for executing for the subcontractor. While most projects only have a scorpion document for planting and a separate one for any other kind of hardscaping elements, both were combined into one for this project. Special considerations had to be taken in this scoping document for the plants as they are live organisms whose physical conditions are prone to change suddenly and drastically. These are also elements that require follow-up and constant maintenance post-project completion, further expanding the scope.

Design Constraints

Site Plan Constraints

The largest constraint facing the site plan was the learning curve regarding zoning, fire access requirements, specific Albemarle design requirements, and finding out new design manuals to base the design off of throughout the project. Due to how many design guidelines

that were followed to meet zoning and recommended design constraints, the site plan was changed multiple times in order to accommodate each new guideline added which caused subsequent changes throughout all other plans.

Grading Constraints

The largest design constraint facing the grading plan was the existing hilly conditions of the site combined with the generally low grades required for subdivision design roads. Additionally, the inclusion of street parking, while convenient for residents, meant that these particular roads were subject to an even lower grade of 2% to allow for ADA accessibility. These low grades lead to roads not being able to gain elevation at the same rate as the site, and resulting in large cut requirements. The overall favoring of low grades for development created challenges for grading the site while attempting to avoid large cut and fill sections.

Stormwater Constraints

Stormwater management planning was constrained by state stormwater code, outlined by the Virginia Stormwater Management Program (VSMP) Regulation. The BMPs that we selected needed to meet the total phosphorus removal requirements outlined in these standards. The potential BMPs available for use were those listed in the VRRM spreadsheet. Runoff coefficients that characterized land uses impacted the stormwater runoff quantity and quality. Managing these runoff coefficients constrained decisions regarding land use that were made during the design of the site plan.

Traffic constraints

Traffic constraints relate to the existing road infrastructure in place, particularly Old Ivy Road. There are only two points of entrance and exit on Old Ivy Road, with an extra exit point. This limits how both future residents and construction workers can access the site. In particular, the south entrance/exit point of Old Ivy Rd falls under an old railroad bridge which limits only one vehicle from entering/exiting at the same time and has a clearance of 11’1”, prohibiting larger vehicles like buses, or trucks from entering through there.

Construction Constraints

Construction related constraints relate to the reality of each job site being unique from the last. For sourcing subcontractors, qualified companies are limited to those physically nearby the Old Ivy Road site. In terms of scheduling, the unique variables associated with making a reliable schedule such as existing site conditions and material availability make defining success harder to accomplish. Lack of subcontractor critique and feedback on our scoping makes defining realistic scope more difficult.

Conclusion and discussion

There were a variety of complex decisions made throughout the design process. Some of these decisions were highly constrained by regulations and codes, while other aspects were

more flexible and allowed for creative problem-solving. As we progressed through the design process we had a number of iterations. Some changes were made after we received new information during weekly meetings with our industry mentors, while other changes were the result of new ideas from discussions held within the team. The various iterations can be found below in Appendix B: Site Plan Iterations.

One decision that we made early on was to have a roundabout near the entrance of the site versus a stoplight or a 4 way stop. A couple of factors went into this decision. The primary factor was safety. Compared to a signalized intersection or a 4 way stop, a roundabout has fewer points where crashes can happen. Another key factor was efficiency. Given the size of the neighborhood, we wanted to have the cars able to flow without causing backups. Since there's one main "artery" that connects all of the buildings, keeping it clear is important.

With the affordable housing shortage in not only Charlottesville but the greater Albemarle area, the most simple way to address it is through an increase in the supply of housing. Creating an additional 250-300 housing units not only takes a step towards that but shows that it can be a doable and sustainable way of building mixed-use residential developments within Charlottesville. The addition of community amenities such as parks, green spaces, and other recreational areas makes this a place that future residents will want to move into. Green ways of transportation, including walking, biking, and public transit through the additions of accessible sidewalks, walking trails, and bus stops to better connect the community with one another and the greater area.

Our project has met the needs of the developer by fulfilling the housing unit requirement with the requisite amenities and parking while going the extra step to thoughtfully address community concerns. While there will be an influx in traffic within the local area, carefully crafted road design, including innovative roundabouts, within the site regulates vehicular and foot traffic while the site entrance intersection was designed in a way that reduces queue times and car backup. These features ensure that traffic is efficiently regulated both within the site and throughout its connection to its surroundings. Careful coordination with local environmental groups has ensured that the Rivanna Trail's integrity is being kept and accessible to all. Town hall discussions with the local community and prospective residents have ensured that the commercial spaces on site are addressing their needs without being just a means of gentrifying the area through unwanted and expensive businesses. This project makes effective use of an unused parcel and is economically accessible to all socio-economic groups as it meets the Albemarle County requirement of a minimum of 20% of the total number of housing being provided as affordable housing due to its dense nature.

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cc10192023_PM.pdf

Appendix A - Detailed Schedule

GANTT CHART

* = an automatically calculated cell

TASK NAME	START DATE	END DATE	START ON DAY*	DURATION* (WORK DAYS)	TEAM MEMBER	PERCENT COMPLETE
Preliminary Site Plan						
Blocky Site Plan	9/22	9/29	0	7	Grey/Reese	100%
15% Site Plan	9/29	10/13	7	14	Grey/Matt	100%
30% Site Plan	10/13	11/10	21	28	Grey/Reese	100%
60% Site Plan	11/10	11/24	49	14	Grey/Reese	100%
90% Site Plan	11/24	12/1	63	7	Grey/Reese	100%
100% Site Plan	12/1	12/8	70	7	Grey/Reese	100%
Preliminary Traffic Plan						
Preliminary Traffic Plan V1	9/22	10/6	0	14	Subham/Matt	100%
30% Traffic Plan V2	10/13	11/17	21	35	Subham/Alex	100%
Preliminary Grading Plan						
Preliminary Grading V1	11/13	12/8	52	25	Matt/Reese	100%
Preliminary Rivanna Trail Plan						
Rivanna Trail Placement V1	10/6	10/13	14	7	Grey	100%
Preliminary Construction Timeline						
Preliminary Gantt Chart Framework	11/1	11/10	40	9	Subham/Alex	100%

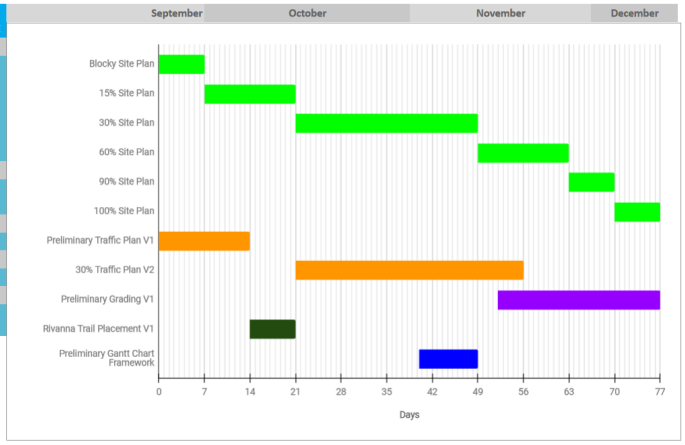


Figure A1. Fall 2023 Schedule

GANTT CHART

* = an automatically calculated cell

TASK NAME	START DATE	END DATE	START ON DAY*	DURATION* (WORK DAYS)	TEAM MEMBER	PERCENT COMPLETE
Traffic Plan						
60% Traffic Plan V3	1/17	1/26	0	9	Subham	100%
90% Traffic Plan V4	1/26	2/16	9	21	Subham	100%
100% Traffic Plan V5	2/16	3/8	30	21	Subham	25%
Grading Plan						
Grading V1	1/17	3/11	0	54	Matt/Reese	75%
Grading V2	3/11	4/1	54	21	Matt/Alex	0%
Stormwater Management						
Stormwater Plan V1	1/17	3/4	0	47	Matt	50%
Stormwater Plan V2	3/4	4/8	47	35	Matt	0%
Construction Information						
Construction timeline	1/22	3/18	5	56	Subham/Alex	50%
Trades Identified	2/2	2/19	16	17	Subham/Alex	100%
Subcontractors Identified	2/19	3/25	33	35	Subham/Alex	0%
Major Trade Estimate	3/4	3/25	47	21	Subham/Alex	0%
Sample Scoping Document	3/11	4/1	54	21	Subham/Alex	0%
Site Plan						
50% Site Plan	1/17	2/9	0	23	Grey/Reese	100%
70% Site Plan	2/9	2/26	23	17	Grey/Matt	100%
90% Site Plan	2/26	3/18	40	21	Grey/Reese	0%
Completed Site Plan	3/18	4/15	61	28	Grey/Reese	0%

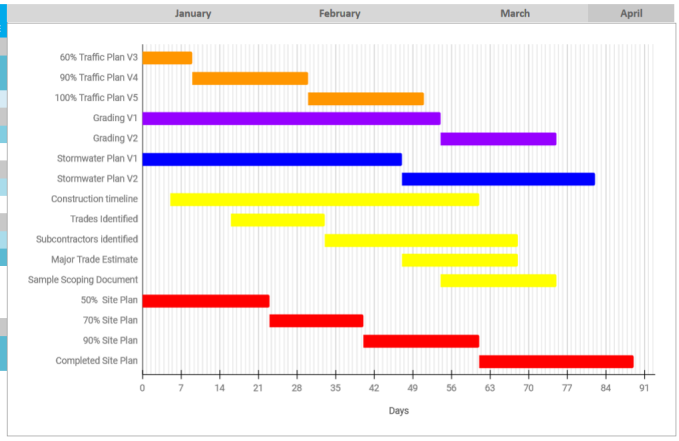


Figure A2. Spring 2024 Schedule

Appendix B - Design Evolution

Site Plan Evolution

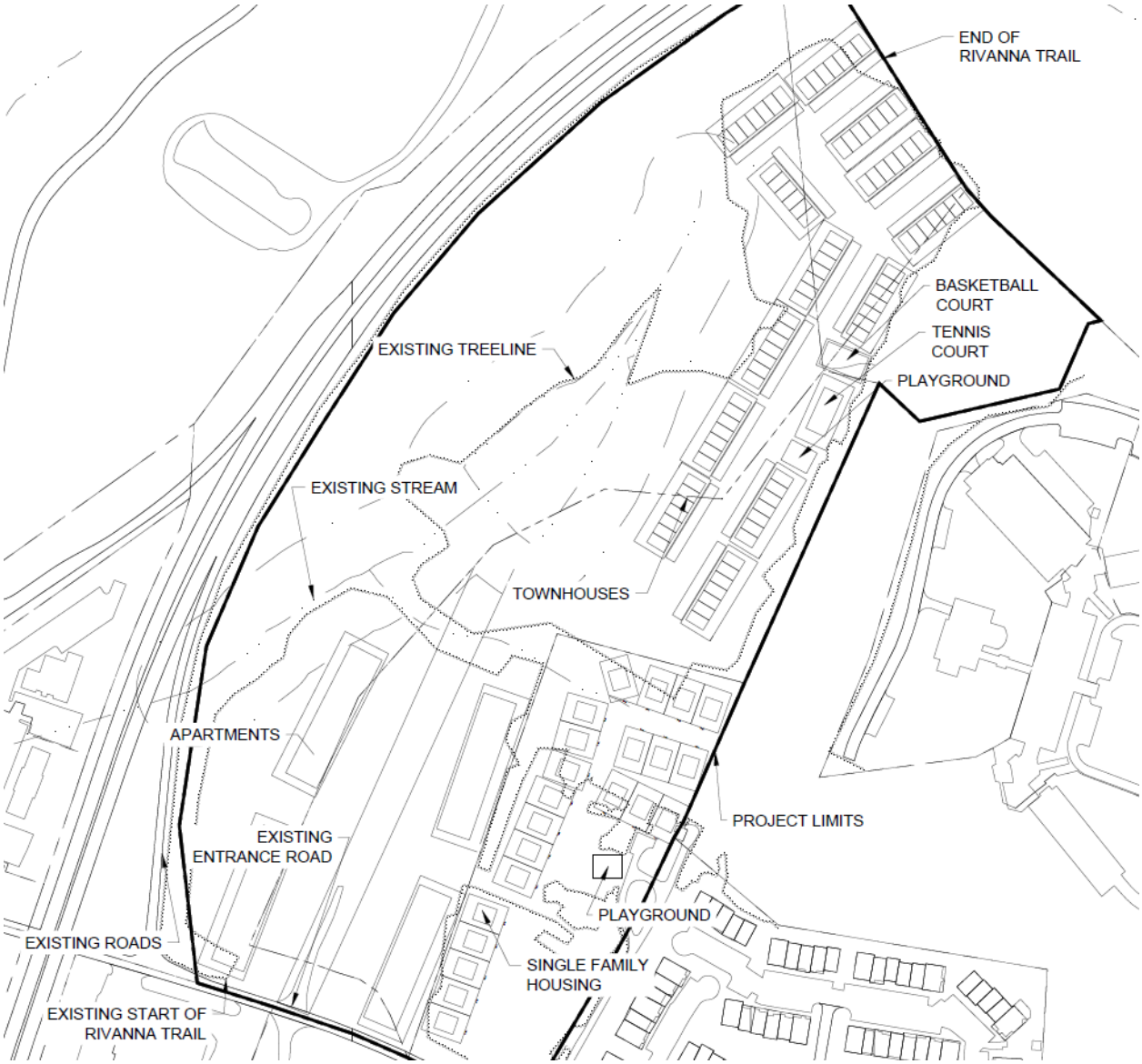


Figure B1. Preliminary Site Plan 10% Completion (October 5, 2023)

Key changes: Initial placement of residential units, recreational areas, and proposed main entrance.

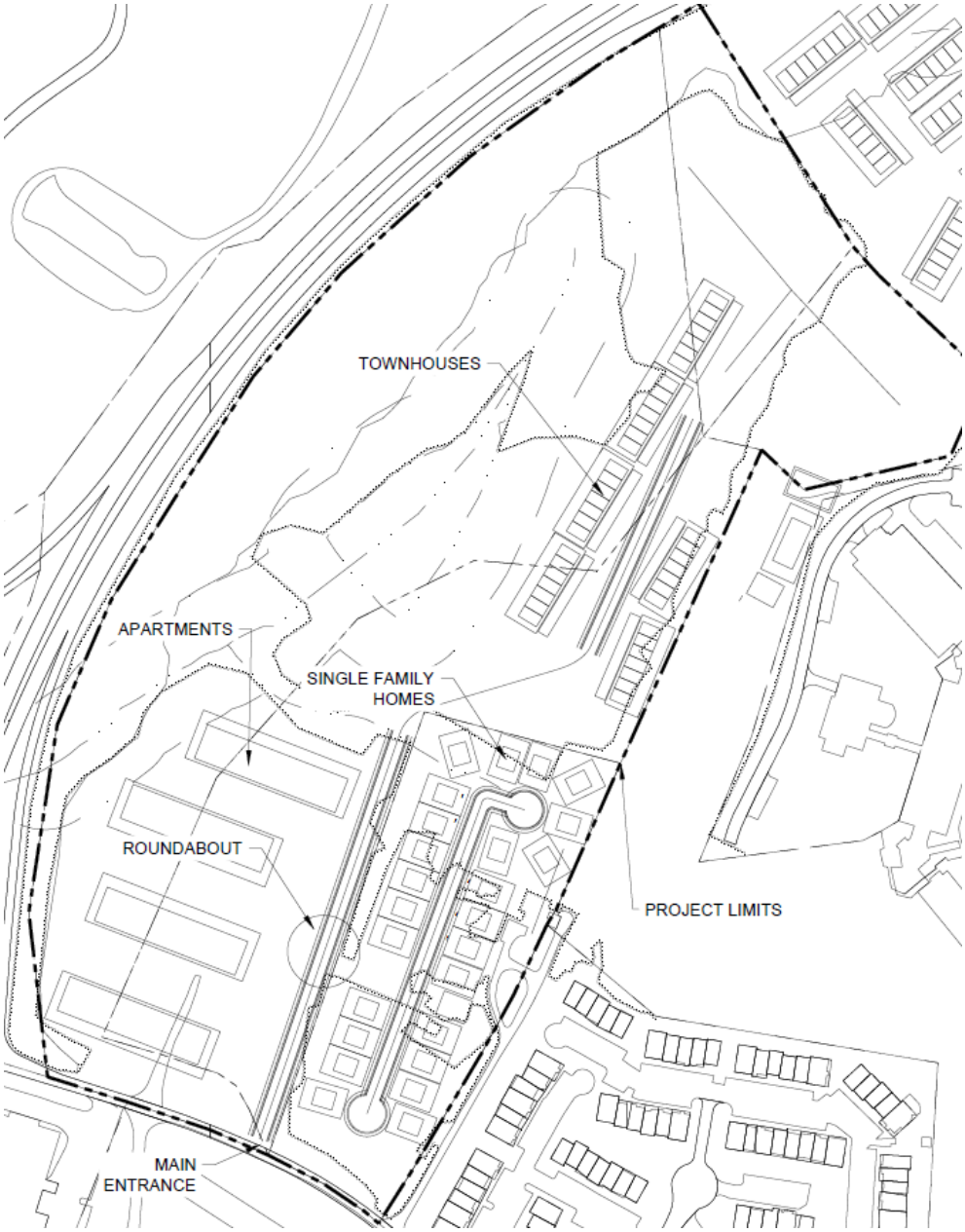


Figure B2. Preliminary Site Plan 25% Completion (October 11, 2023)

Key changes: More concrete layout of single family homes with cul-de-sac placement, placement of roundabout central to design, and placement of townhouses adjacent to Pond.

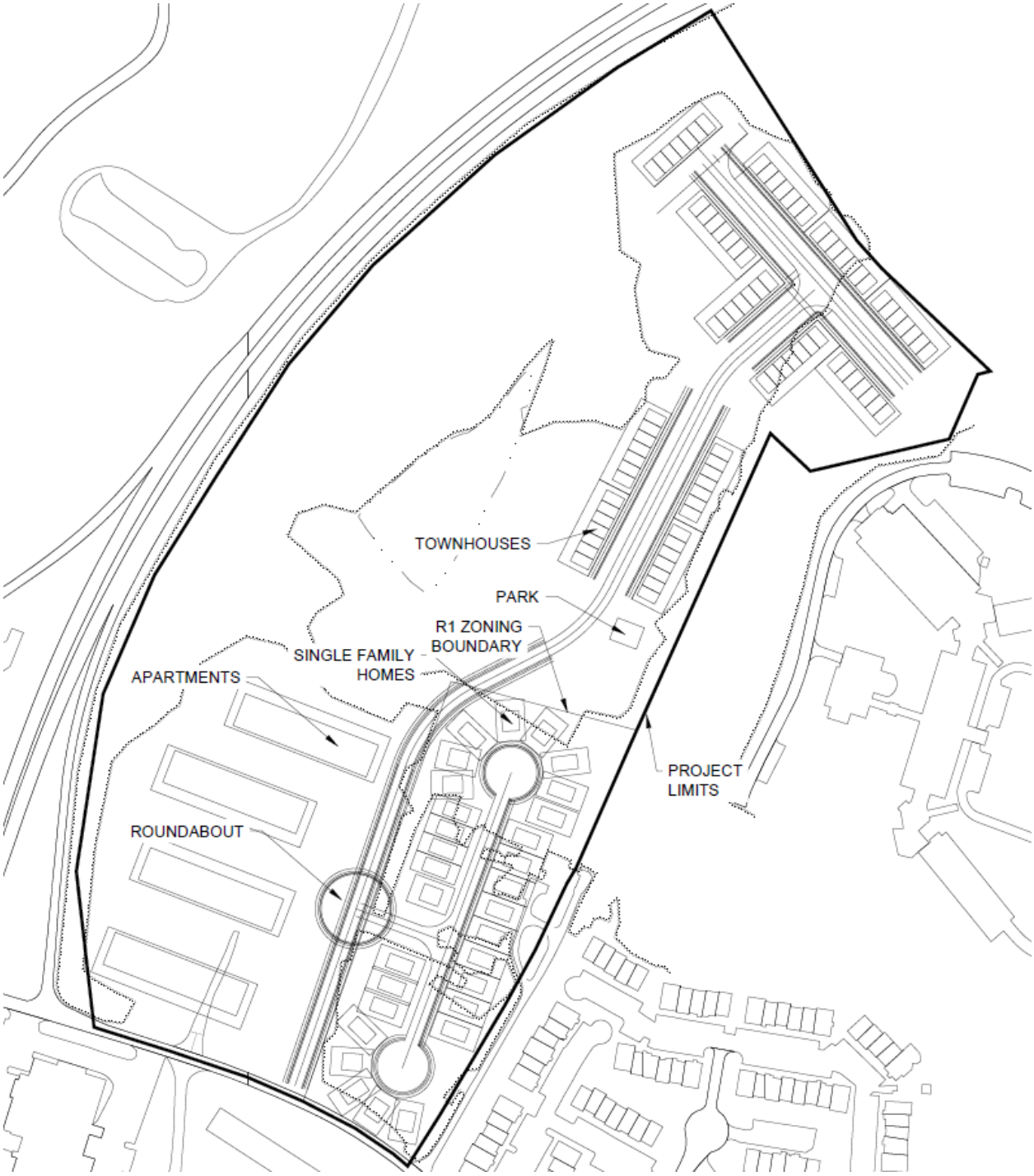


Figure B3. Preliminary Site Plan 35% Completion (October 16, 2023)

Key changes: More detail into single family home design and townhouse design.

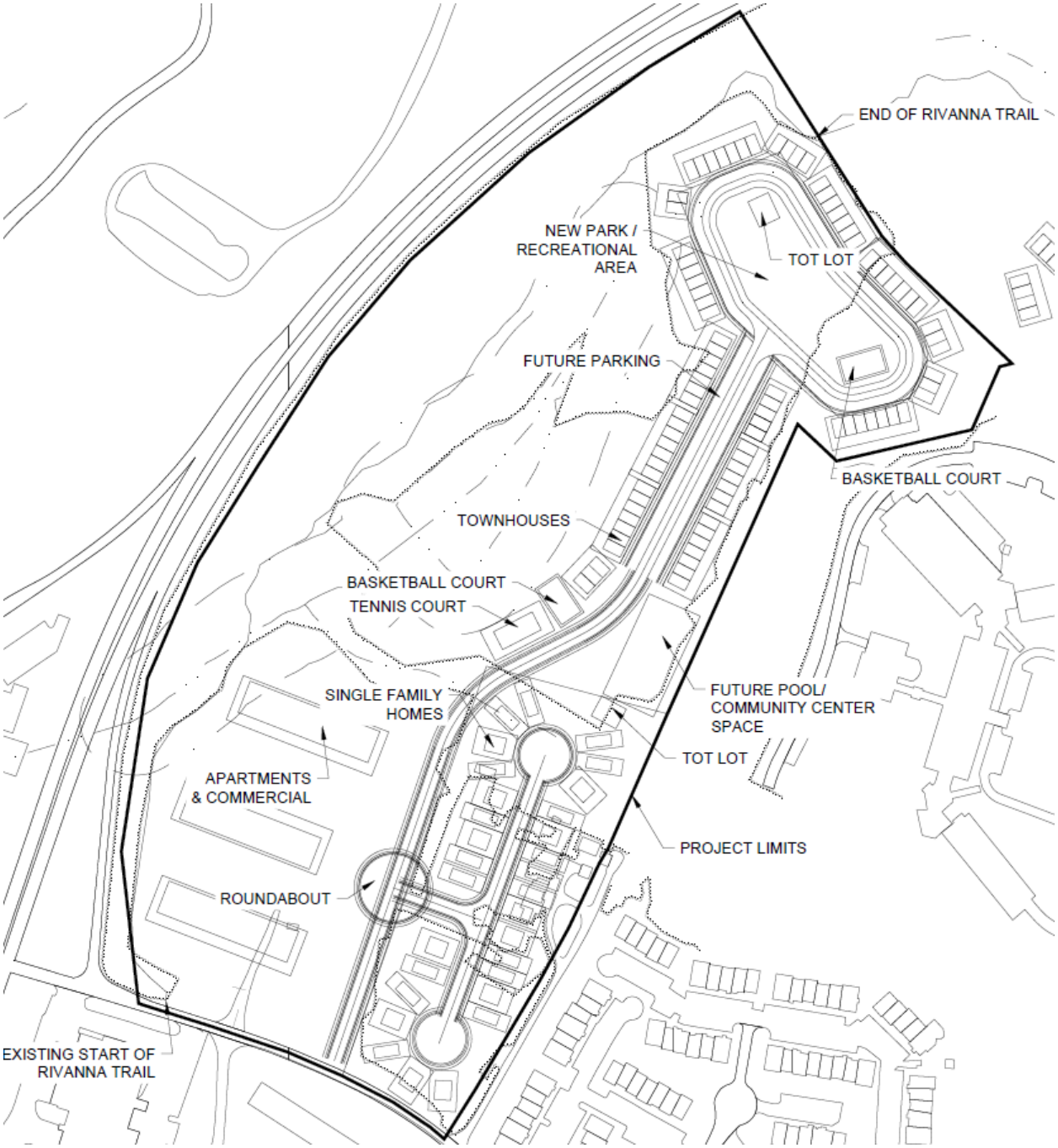


Figure B4. Preliminary Site Plan 50% Completion (October 27, 2023)

Key changes: New inclusion of large park area in townhouse development, recreational areas have moved around, and input of future pool area/community center. One apartment complex was removed.

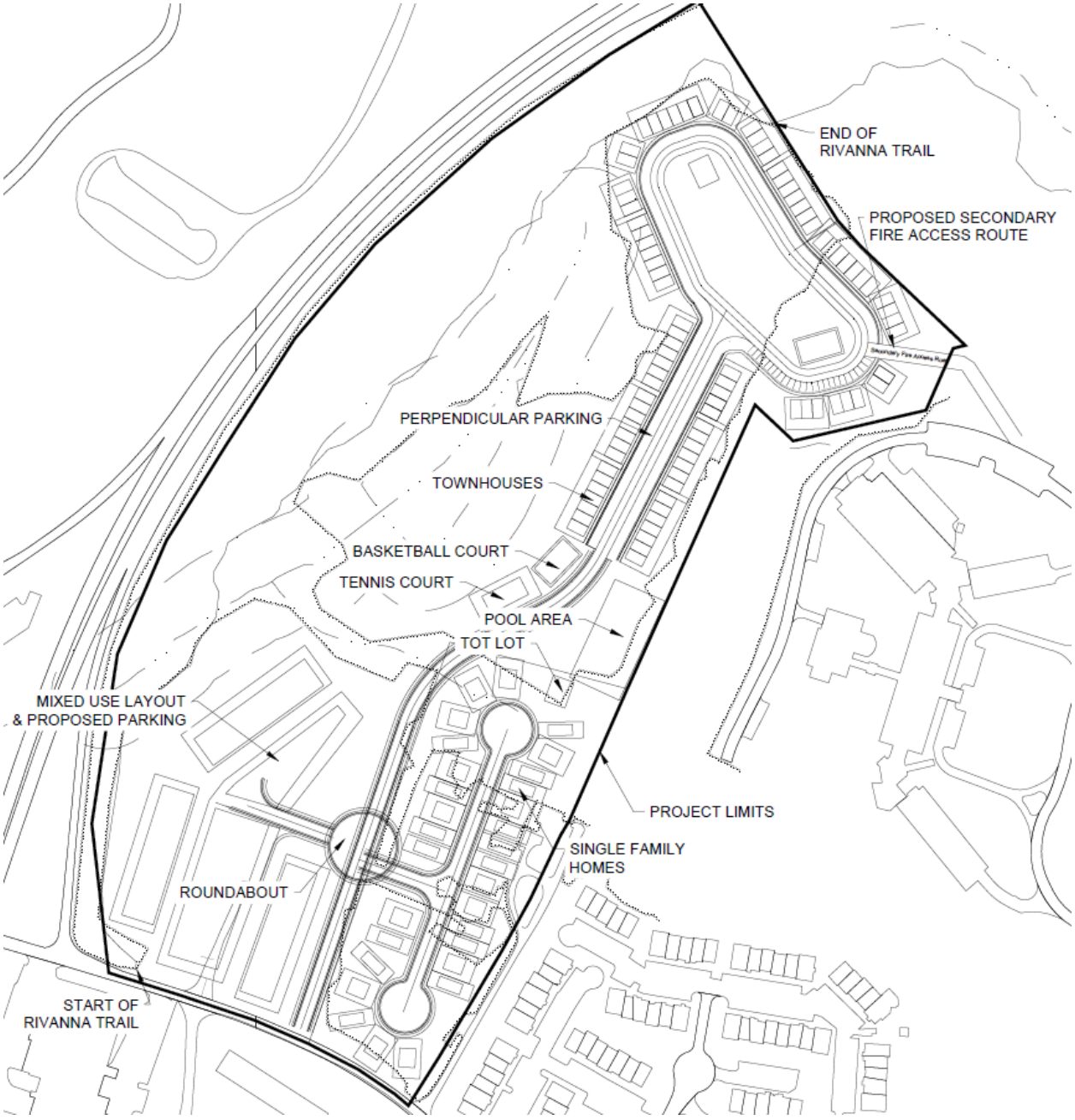


Figure B5. Preliminary Site Plan 55% (November 02, 2023)

Key changes: Proposed secondary fire access route from off-site was put in. Existing Rivanna trail placement into site, new mixed use parking layout off of Roundabout entrance.

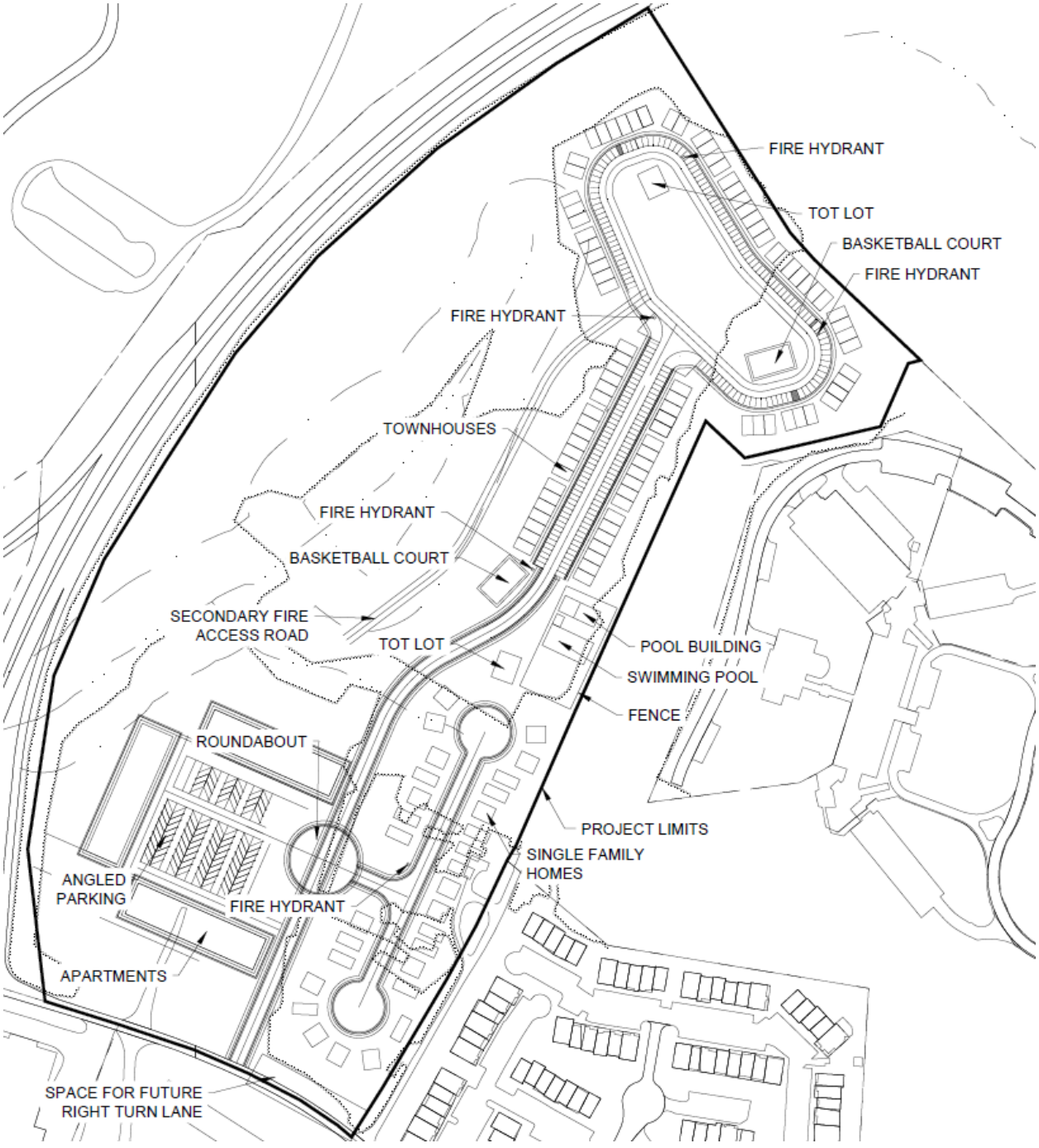


Figure B6. Preliminary Site Plan 75% (November 11, 2023)

Key changes: Space for a future right turn lane is put into site, new parking layout for the mixed use development apartment area is put in with angled parking. Parking along townhouses is put in as well. Secondary fire access route was moved so that route was not from off-site. Various fire hydrant placements were put in and the swimming pool area was designated with a fence.

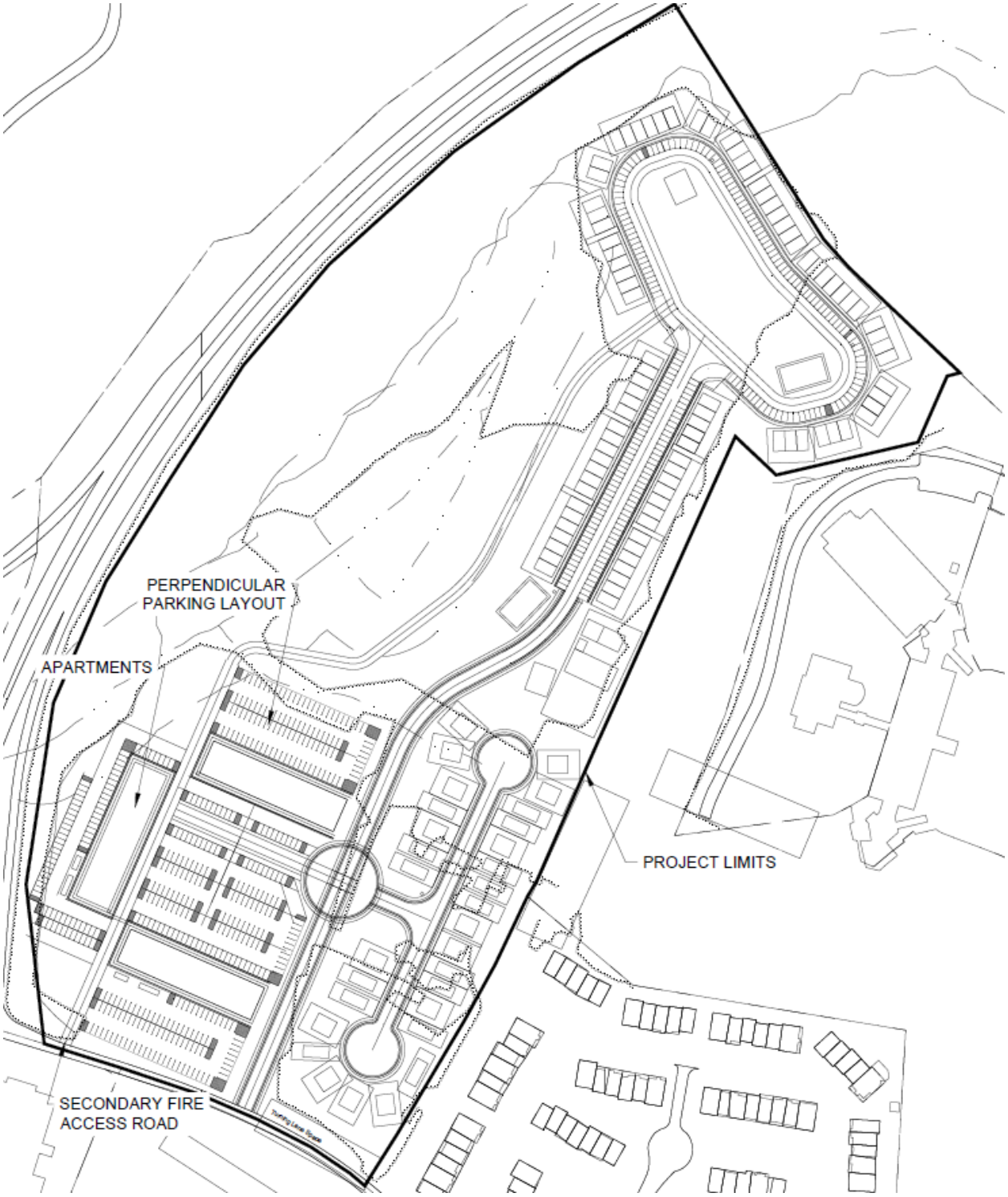


Figure B7. Preliminary Site Plan 95% (November 13, 2023)

Key changes: New perpendicular parking layout for mixed use residential/commercial area. Residential parking is put behind apartments while commercial parking is in front. Secondary fire access road is completely connected throughout the site.

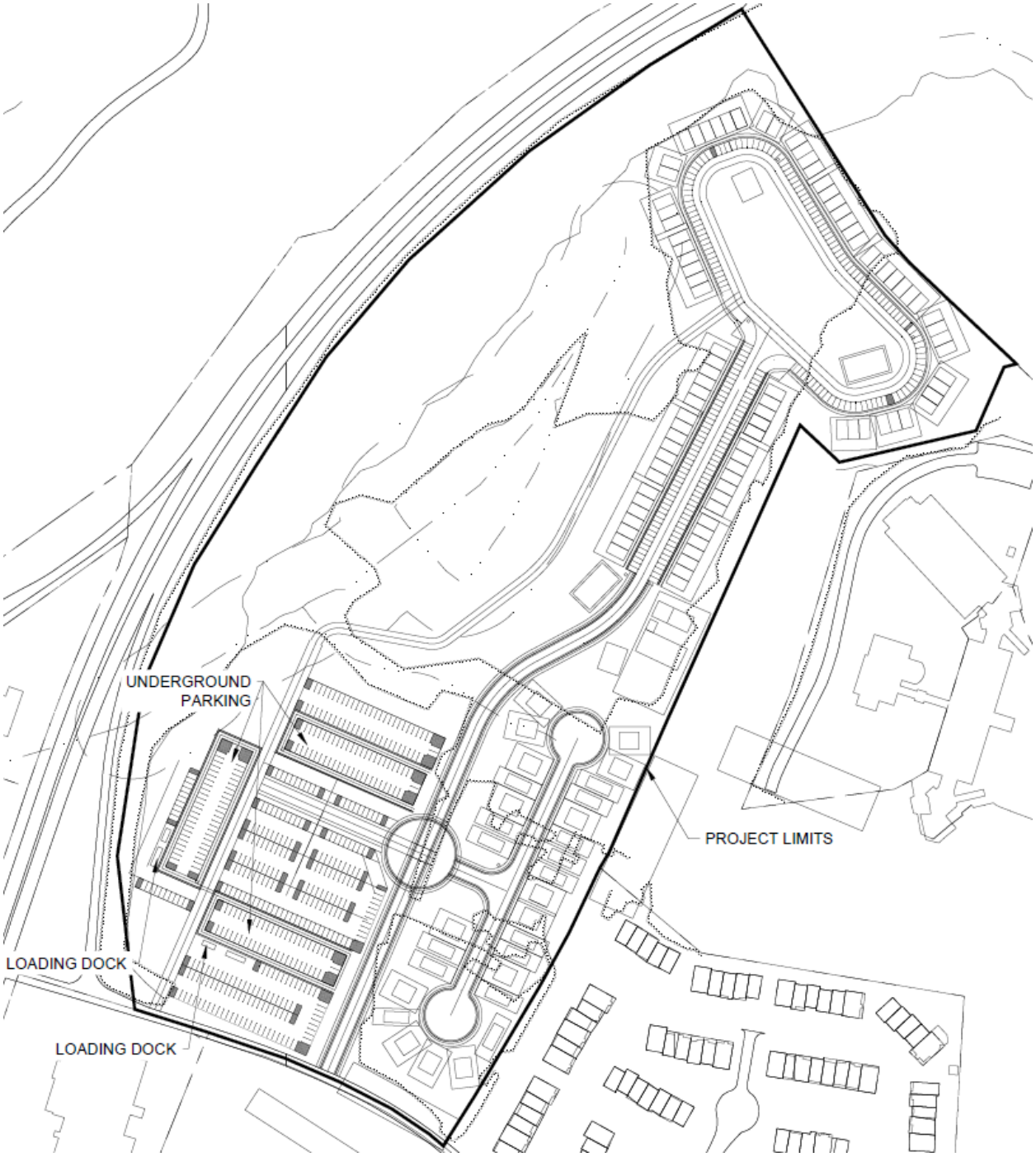


Figure B8. Preliminary Site Plan 100% (December 06, 2023)

Key changes: Residential Parking is separated between one layer of underground parking underneath the apartments and additional parking behind the building in order to conserve space. Loading docks that can accommodate the parking of 2-3 trucks are placed behind the 2 apartment buildings that have commercial areas on their first floors.

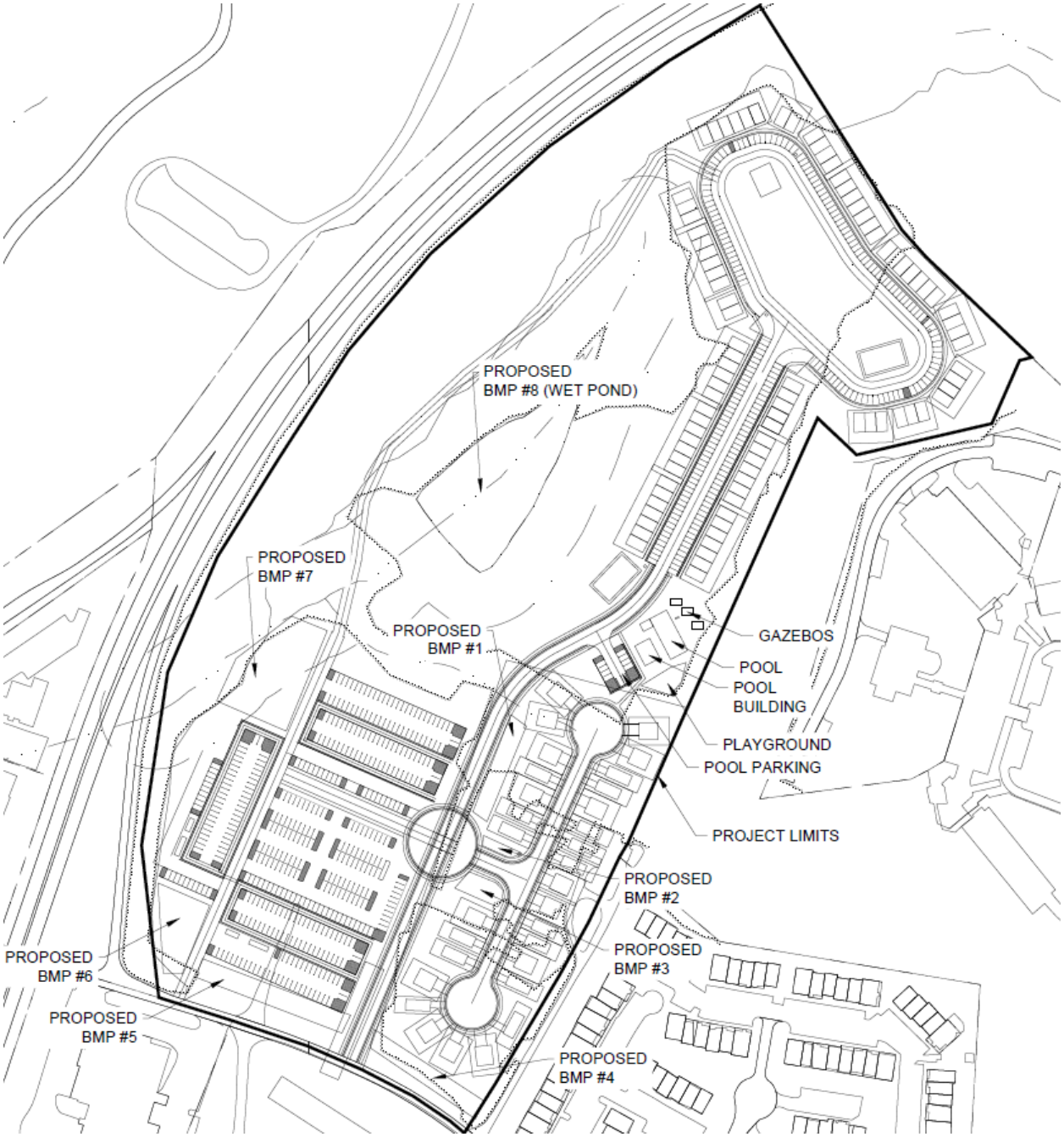


Figure B9. Final Site Plan 30% (February 26, 2024)

Key changes: Proposed BMPs (Bioretention areas and a wet pond) are put into the site plan for future proper sizing. More pool details and the pool parking lot were put in as well.

Stormwater Plan Evolution

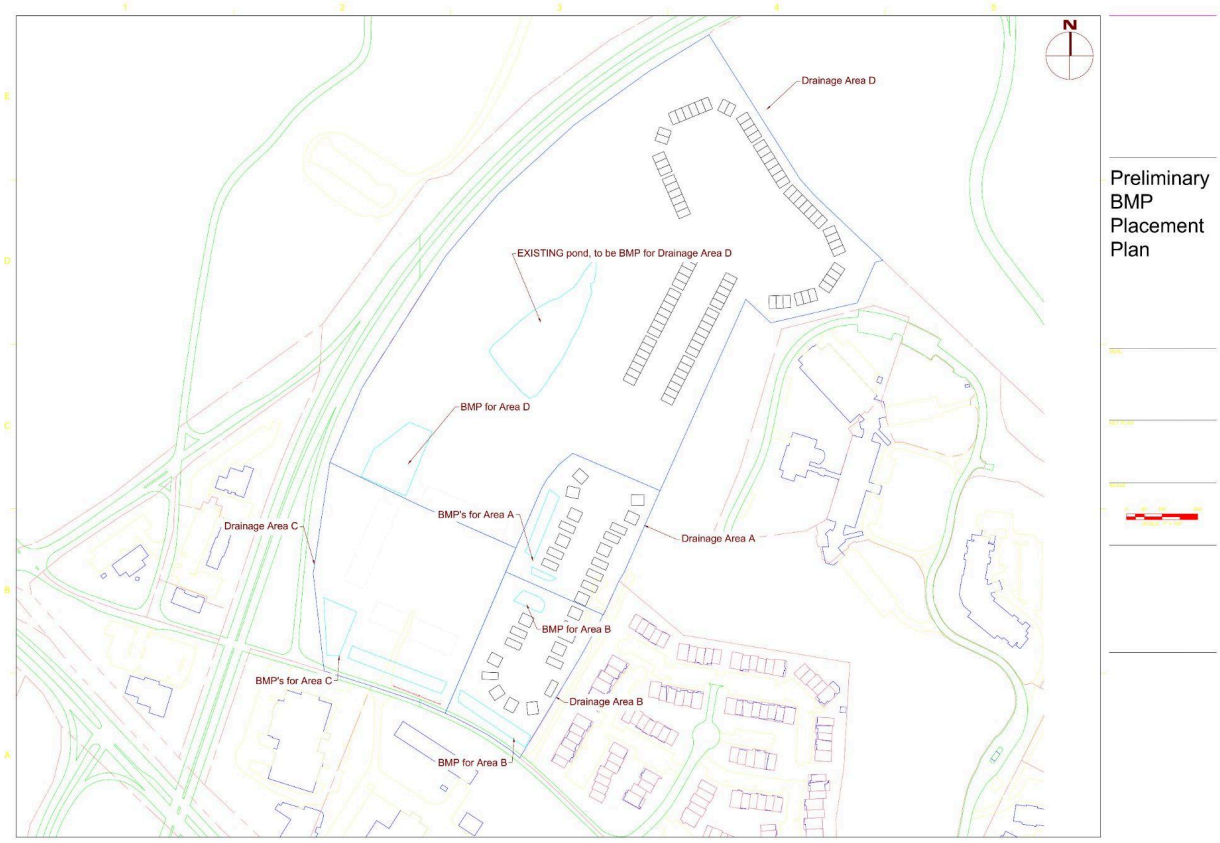


Figure B10. Preliminary Stormwater Plan

Process: The site was divided into drainage areas A through D which can be seen above in figure X. These boundaries were determined based on existing topography and Best Management Practices (BMP's) were placed at the lowest points within the drainage areas. The next steps will involve selecting specific BMPs and completing the VRRM spreadsheet.

Grading Plan Evolution

A preliminary grading plan was developed during the first semester of this project, but the physical CAD file contained many errors and issues. It was decided to start from scratch for the final semester of designing to ensure a clean and functioning file that will provide visually pleasing results. The previous flawed grading plan can be seen in Figure 20.

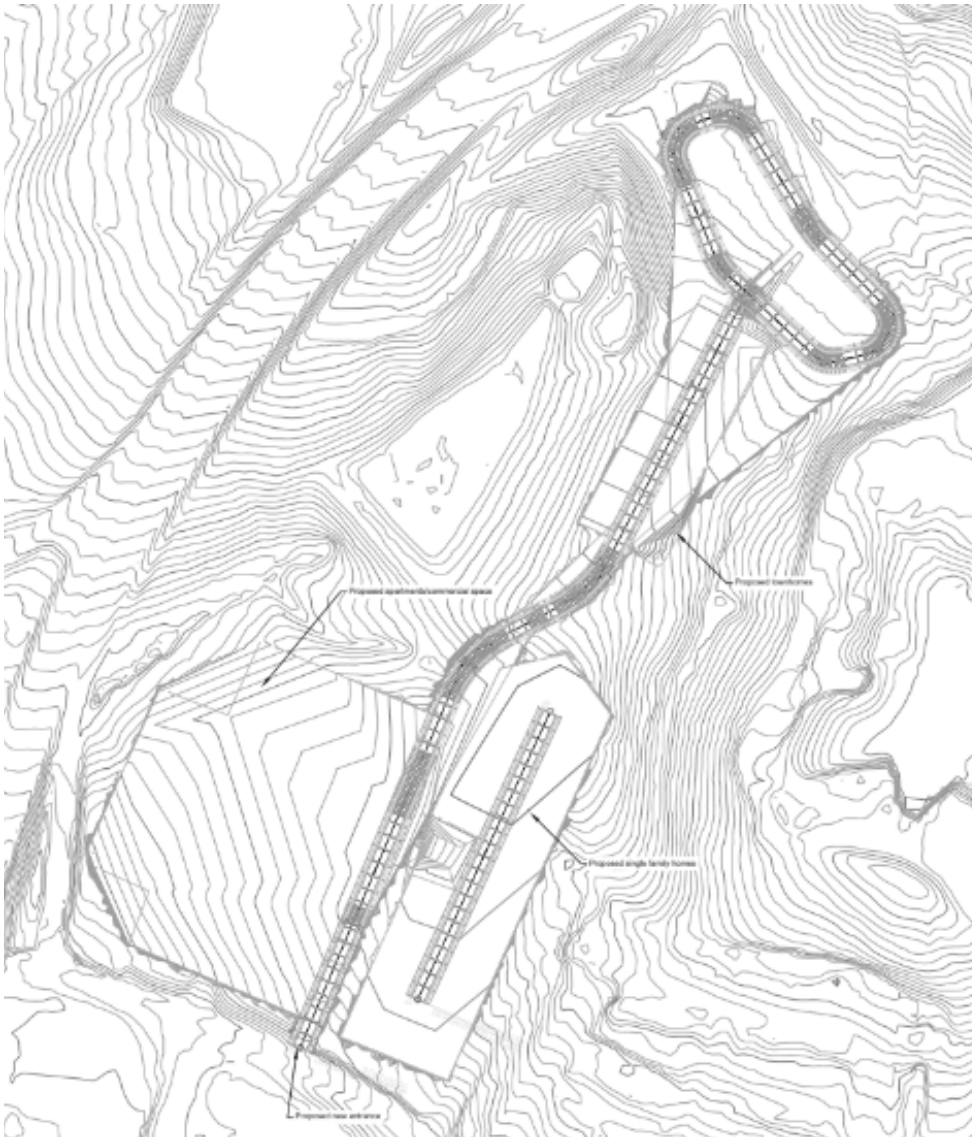


Figure B11. Version 1 grading plan

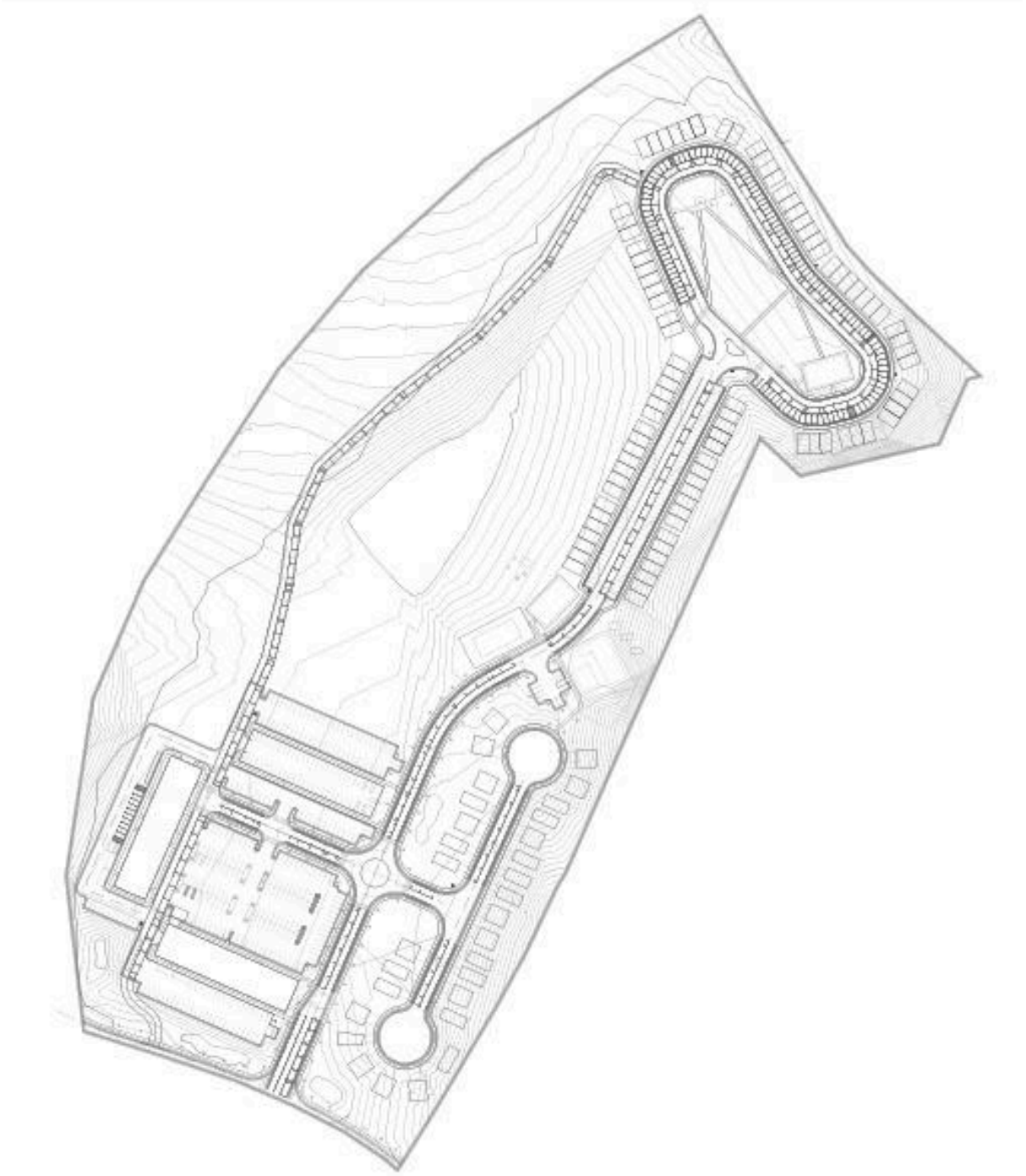


Figure B12. Grading Plan V2 overlaid on finalized site plan

Appendix C - Engineering Standards

Main Road and Entrances

1. Main Entrance Onto Site
   a. Entrance to site is more than 50’ away from other entrances allowing for proper spacing (no racing across to the other side).

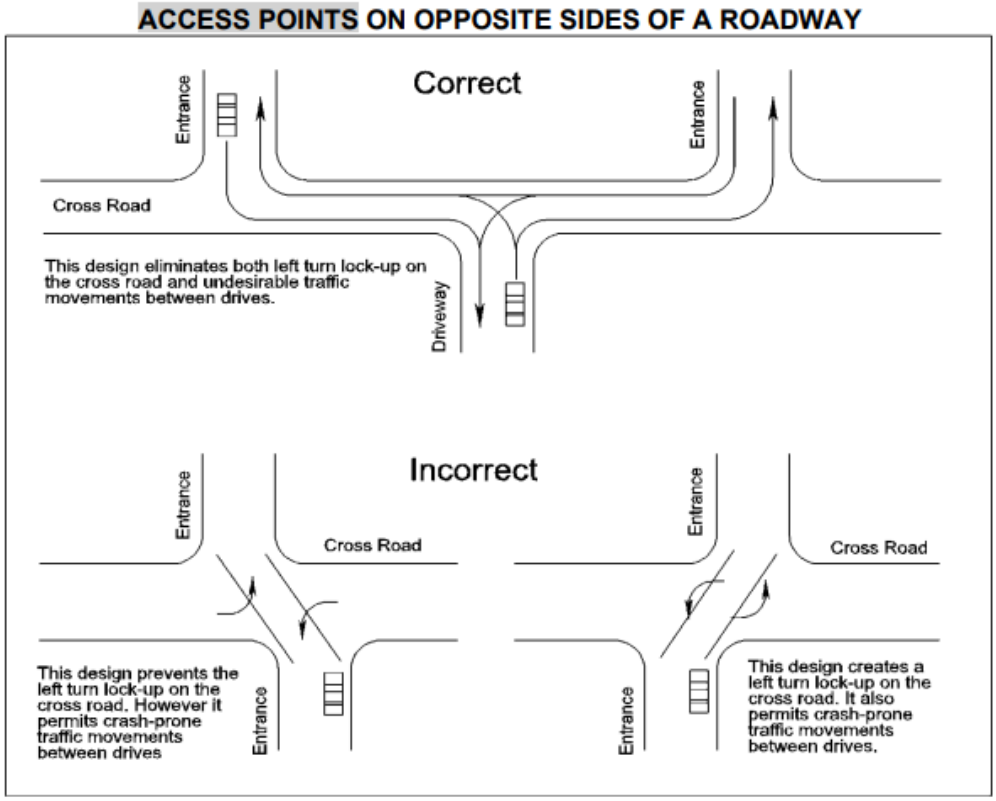


FIGURE 4-6 ACCESS POINTS ON OPPOSITE SIDES OF A ROADWAY

Source: Driveway Handbook, dated March 2005, Florida Dept. of Transportation.

Figure C1. (VDOT Appendix F, pg. F-112, Figure F 4-6)

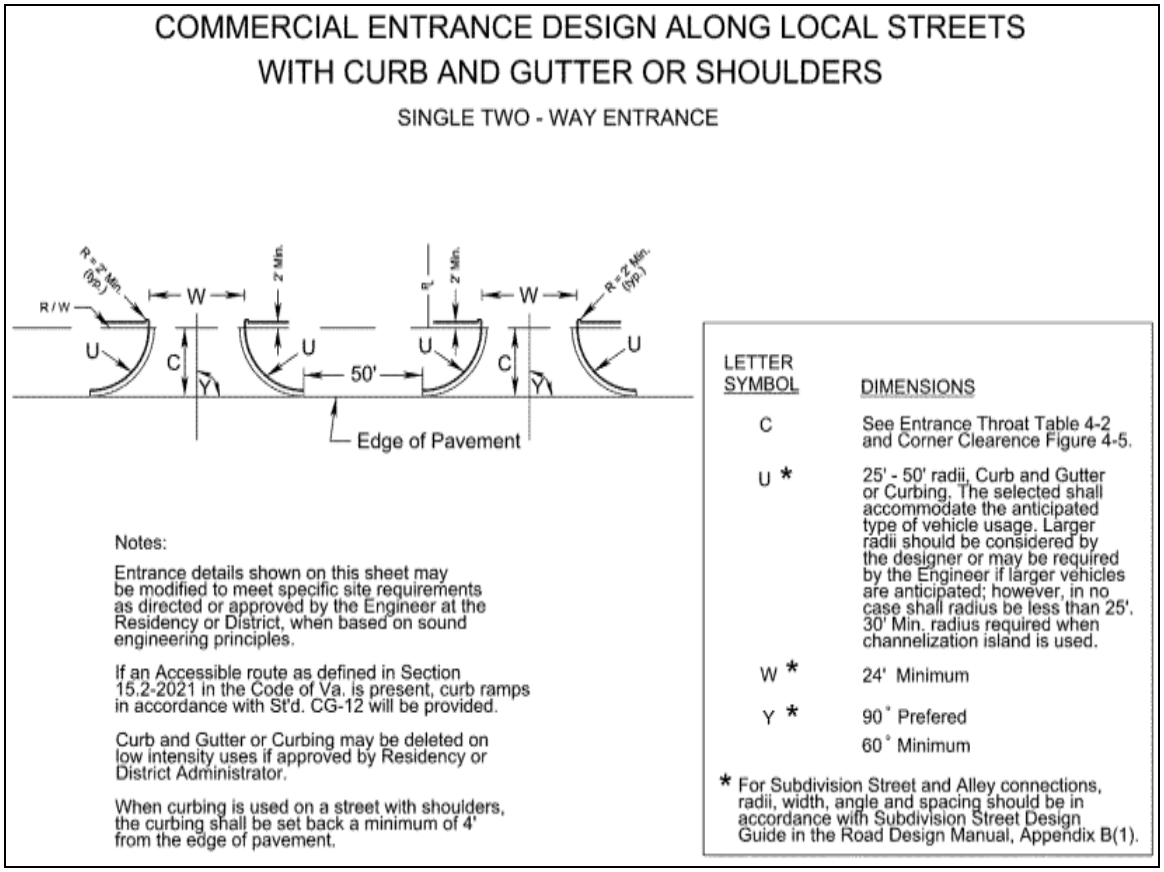


Figure C2. (VDOT Appendix F, Figure 4-11)

b. Main Entrance Specifications
   i. Turning Radius: 50' (For buses and trucks entering site)
   ii. Entrance Throat = 50'

Design Vehicle and Turning Radius by Land Use		
Land Use(s) Served by Access	**Design Vehicle**	**Radius (Minimum)**
Office with Separate Truck Access	Passenger Car/Pickup	25
Office without Truck Access	Single Unit Truck SU-30	45
Commercial / Retail with Separate Truck Access	Passenger Car/Pickup	25
Commercial / Retail without Separate Truck Access	WB-67 Truck	50
Industrial with Separate Truck Access	Passenger Car/Pickup	25
Industrial without Separate Truck Access	WB-67 Truck	50
Recreational without Watercraft Access or Camping	Passenger Car/Pickup	25
Recreational with Watercraft Access or Camping	Motor Home/Boat	50
Agricultural Field Access	Single Unit Truck SU-30	45
Municipal and County Roads	WB-67 Truck	50

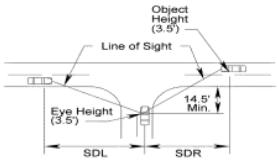
TABLE 4-3 DESIGN VEHICLE AND TURNING RADIUS BY LAND USE

Figure C3. (VDOT Appendix F, pg. F-104, Figure 4-3 Design Vehicle and Turning Radius by Land Use)

iii. Intersection Sight Distance: 390 ft, Sight Distance right and left

Intersection Sight Distance

The following table shows intersection sight distance requirements for various speeds along major roads:



SDR = Sight Distance Right (For a vehicle making a left turn)
SDL = Sight Distance Left (For a vehicle making a right or left turn)

Height of Eye 3.5'												**Height of Object 3.5'**
Design Speed (mph)**		**20**	**25**	**30**	**35**	**40**	**45**	**50**	**55**	**60**	**65**	**70**
SDL=SDR: 2 Lane Major Road	In Feet	225	280	335	390	445	500	555	610	665	720	775
SDR: 4 Lane Major Road (Undivided) or 3 Lane		250	315	375	440	500	565	625	690	750	815	875
SDL: 4 Lane Major Road (Undivided) or 3 Lane		240	295	355	415	475	530	590	650	710	765	825
SDR: 4 Lane Major Road (Divided – 18' Median)		275	340	410	480	545	615	680	750	820	885	955
SDL: 4 Lane Major Road (Divided – 18' Median)		240	295	355	415	475	530	590	650	710	765	825
SDR: 5 Lane Major Road (continuous two-way turn-lane)		265	335	400	465	530	600	665	730	800	860	930
SDL: 5 Lane Major Road (continuous two-way turn-lane)		250	315	375	440	500	565	625	690	750	815	875
SDR: 6 Lane Major Road (Divided – 18' Median)		290	360	430	505	575	645	720	790	860	935	1005
SDL: 6 Lane Major Road (Divided – 18' Median)		250	315	375	440	500	565	625	690	750	815	875
SDL: (Where left turns are physically restricted)		210	260	310	365	415	465	515	566	620	670	725

TABLE 2-5 INTERSECTION SIGHT DISTANCE

Source: 2018 AASHTO Green Book, Chapter 9, Section 9.5.3

Figure C4. (VDOT Appendix F, pg. F-50, Table 2-5 Intersection Sight Distance)

2. Single Family Residential Entrance
    a. Road Width = 24'
    b. Radius = 45' to accommodate school busses
3. Secondary Fire Access Route Entrance
    a. Entrance Dimensions: 24' width, R = 45' (dirt road, able to drive over sidewalk with lower curb)

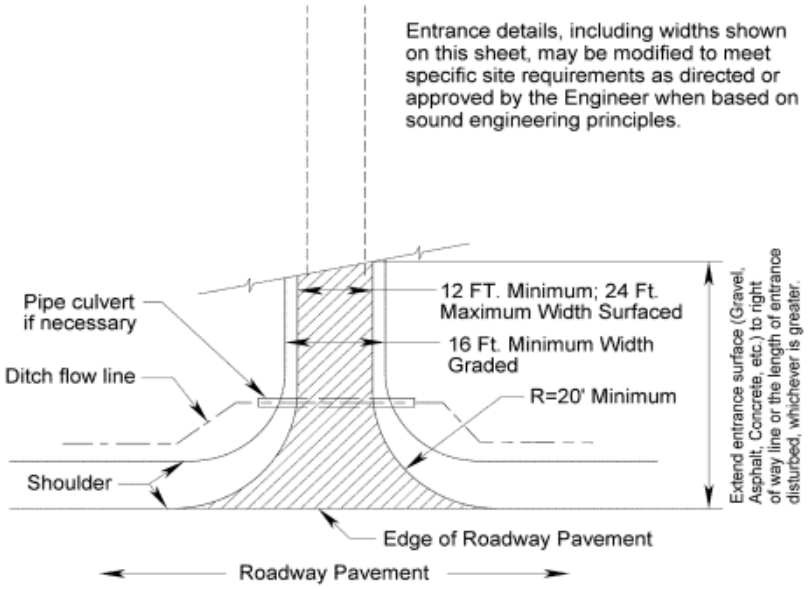


FIGURE 4-1 PRIVATE ENTRANCE AND LOW VOLUME COMMERCIAL ENTRANCE DETAIL

Figure C5. (VDOT Appendix F, Figure 4-1)

4. Townhouse Entrance
    a. Road Median Design (Manual on Uniform Traffic Control Devices MUTCD Sec. 3I.06)
    b. 18’ road widths maintained with median, 7’ median minimum side lengths maintained, R = 5’ on corners.

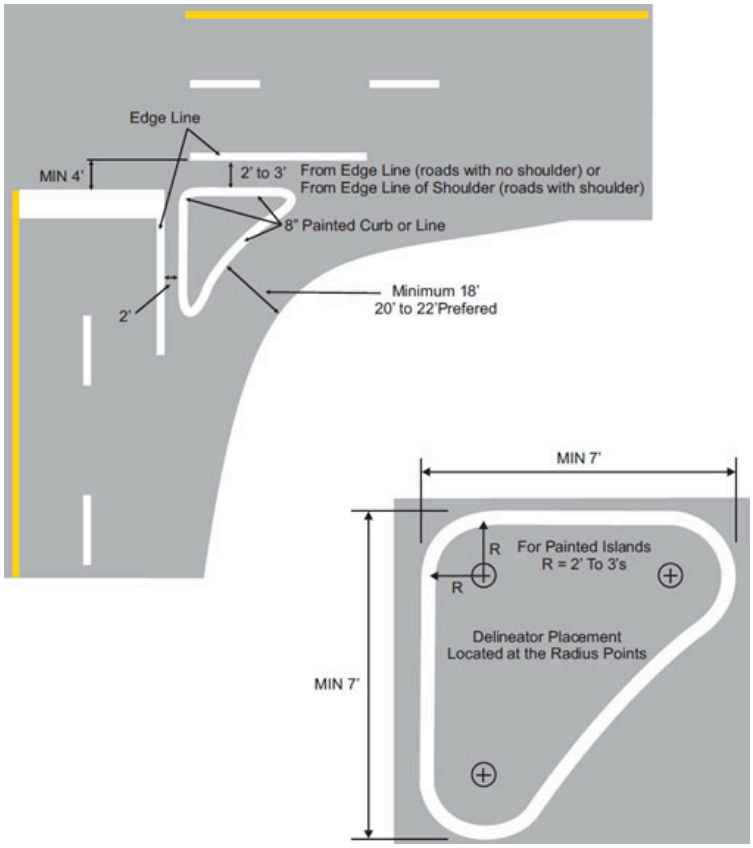


Figure C6. Median/Island Design Guidelines

5. Roundabout
    a. The Federal Highway Administration Roundabout Standards for a mini roundabout were followed.
    b. Our daily traffic volume to the site = 4,326 AADT
    c. Roundabout Center Island Radius = 25 feet
    d. Roundabout Design Radius = 80 feet
    e. Circular Roadway Width = 15 feet
    f. Design Speed (per FHWA manual) = 15 mph
    g. Priorities: accommodates pedestrians and semi trucks for commercial area
    h. Only necessary to have a single lane in the roundabout.
    i. Mini Roundabout Geometric Guidelines
        i. Central Island Diameter = 50 ft, fully mountable
        ii. Central island and splitter island curb height is less than 2 inches high and is flush (traversable) and painted when frequently used by buses
        iii. Central islands that are raised should be domed using 5-6% cross slope, max height of 5 inches
        iv. Circular roadway width = 15 ft
        v. Approach Lanes = 10 -11 ft to reduce speeds
    j. Mini Roundabouts are recommended for intersections where ADT is no more than 15,000 vehicles
    k. Mini Roundabout Specifications
        i. Entry path radius (Outer Turn Radius) = 55 ft
        ii. Stopping Sight Distance (FHWA 6.3.9) >= 100 ft

iii. Inscribed Circle Diameter = 80 ft
iv. Final roundabout design is seen in Figure 5

Design Element	Mini-Roundabout	Single-Lane Roundabout	Multi-lane Roundabout
Desirable maximum entry design speed	15 to 20 mph	20 to 25 mph	25 mph to 30 mph
Maximum number of entering lanes per approach	1	1	2+
Typical inscribed circle diameter	45 to 90 ft.	90 to 180 ft.	150 to 220 ft. (two-lanes)
Central island treatment	Fully traversable	Raised (w/ traversable apron)	Raised (w/ traversable apron)
Typical daily service volumes on 4-leg roundabout below which may be expected to operate without requiring a detailed capacity analysis (veh/day)*	Up to approximately 15,000	Up to Approximately 25,000	Up to Approximately 45,000 for two-lane roundabout

Figure C7. (VDOT Appendix A, pg. A-56 Roundabout Design Comparison Chart)

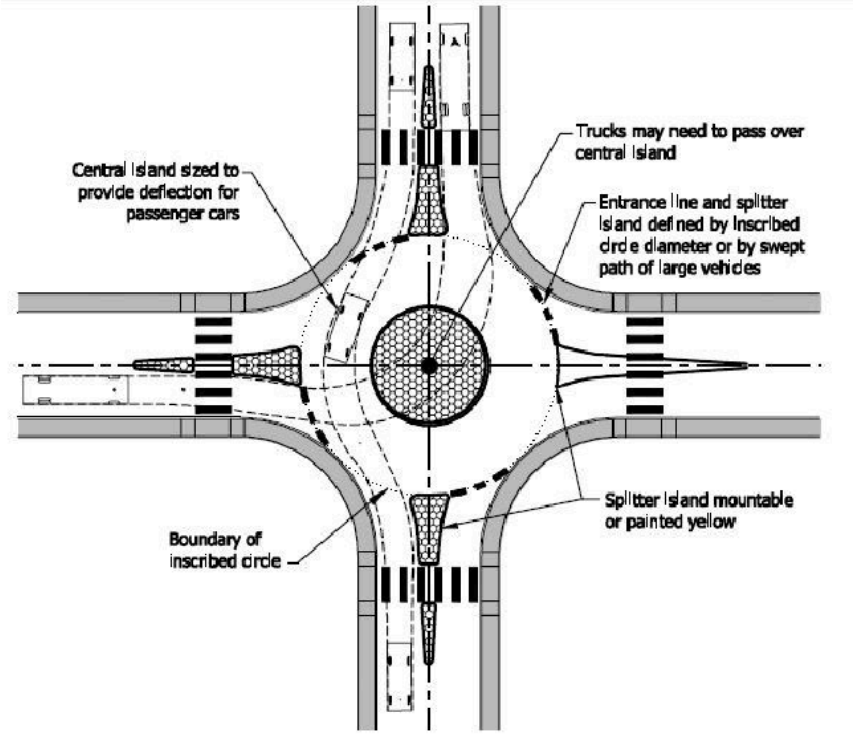


FIGURE A3-9 FEATURES OF TYPICAL MINI-ROUNDABOUT

Figure C8. (VDOT Appendix A, pg. A-51 Features of a Typical Mini Roundabout)

6. Main Road (VDOT Appendix B, Subdivision Street Design Guide)
   a. 24’ minimum road width
   b. 0.5’ curb and 2’ gutter (CG-6)

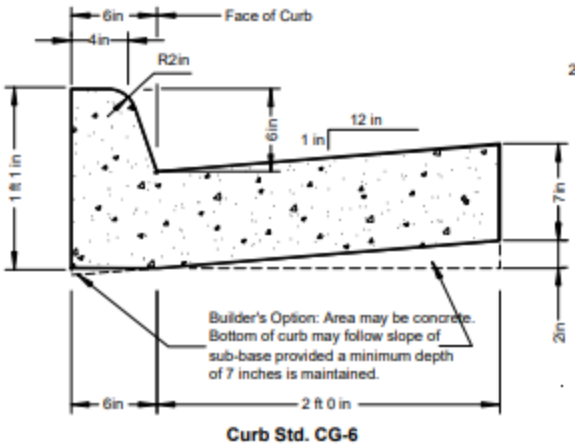
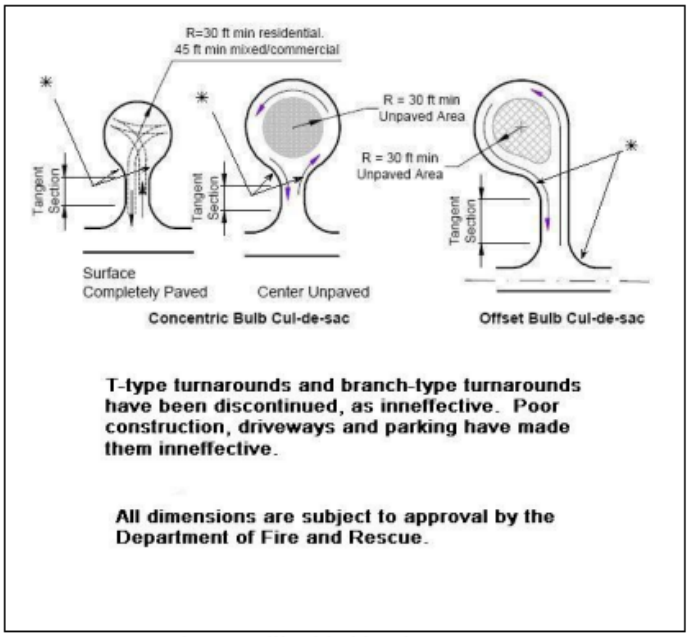


Figure C9. Standard Road Gutter Diagram

c. 3’ plant buffer strip
d. 5’ sidewalks
e. Radius going into single family home area is 45’ to accommodate school buses
f. Turn radius on main road is 251’ (VDOT Geometric Design Standards Appendix A1 page 2)
g. Cul-de-sac design will follow adapted Albemarle County Design Manual



* 25’ radii added by the County

Figure C10. Cul-de-Sac Design Standard

7. Fire Access
    a. Secondary Access Road
        i. Road Design
            1. Fire apparatus access roads do not exceed 10% in grade.
            2. Fire apparatus access roads are 24 feet in width

ii. Commercial areas will have 2 fire access routes (Fire Code D104.1)
    1. Buildings or facilities exceeding 30 feet or three stories in height shall have not fewer than two means of fire apparatus access for each structure.
    2. Where two fire apparatus access roads are required, they shall be placed a distance apart equal to not less than one half of the length of the maximum overall diagonal dimension of the lot or area to be served, measured in a straight line between accesses.
    3. Aerial fire apparatus access roads shall have a minimum unobstructed width of 26 feet, exclusive of shoulders, in the immediate vicinity of the building or portion thereof (our fire access lanes/roads are 26 feet with 2' curb)(Fire Code D105.2)
iii. Residential Townhouses will have 2 fire access routes (Fire Code D106.1)
    1. Multiple-family residential projects having more than 100 dwelling units shall be provided with two separate and approved fire apparatus access roads regardless of whether they are equipped with an approved automatic sprinkler system.
    2. Where two fire apparatus access roads are required, they shall be placed a distance apart equal to not less than one-half of the length of the maximum overall diagonal dimension of the property or area to be served, measured in a straight line between accesses.

b. Fire Hydrant Placement (VA Fire Code Appendix C)
    i. Spacing between each hydrant = 500 ft
    ii. Max distance from any point on street/road frontage to hydrant = 250 ft.
        1. Reduce by 50 feet for dead-end streets or roads
        2. Exception: The average spacing shall be permitted to be increased by 10 percent where existing fire hydrants provide all or a portion of the required number of fire hydrants.

Housing Standards

Apartment Buildings

Apartment Buildings (180 units total)

1. Design of Buildings
    a. Each building is a maximum of 250 x 60 ft (*Project Requirements, Appendix D*)
        i. 1st Building: 1st floor commercial + 4 additional stories with 15 units each [60 units total]
        ii. 2nd Building: 1st floor commercial (75%) + 1st floor units (25%, 3 units) + 4 additional stories with 15 units each [48 units total]
        iii. 3rd Building: 5 stories with 1st floor having 12, and each floor after having 15 units each [72 units total]
    b. Setback Requirements (*Albemarle County Code Sec. 4.19*)
        i. Front: 5'
        ii. Back: 20'
        iii. Side: 10'
2. Design of Parking Lots, Docks, and Dumpster Pads
    a. All apartments have underground parking
    b. Parking Minimums
        i. Residential = 1.35(180) = 243 spaces total (*Project Requirements, Appendix D*)

1. 1st Building = 81 spaces + 4 ADA (*2010 ADA Standards*)
2. 2nd Building = 65 spaces + 3 ADA (*2010 ADA Standards*)
3. 3rd Building = 98 spaces + 4 ADA (*2010 ADA Standards*)
4. 1 of every 6 ADA is van accessible (*2010 ADA Standards*)

ii. Commercial parking requirements were based off square footage of retail space. There is a total of 26,250 sq. ft. from 2 of the apartment buildings having commercial as their ground floor areas. Commercial parking spaces were calculated by using square footage for the use and using parking space minimum calculations from Albemarle's County Code Sec. 4.12.6.

1. Laundromat (3600 sq. ft.) = 13 spaces
2. Daycare (assumed 30 kids, 7 employees) = 10 spaces minimum
    a. Dropoff Area has no minimum, but we designed 10 spaces
3. YMCA/Gym (7200 sq. ft.) = 58 spaces
4. Smaller Grocery Store (Trader Joe's/Aldi) (11,000 sq. ft.) = 61
5. ADA requires 5 passenger vehicle accessible spots and 1 van accessible spot for the 159 space lot (2010 ADA Standards)

c. Perpendicular Parking Lot Space Design (Sec 4.12.16)
    i. Aisle widths are 24'
    ii. Parking dimensions are 9' x 18'
d. ADA Parking Lot Spaces Design (2010 ADA Standards) (Sec 4.12.16)
    i. ADA guidelines require accessible spaces with access aisles for every parking lot designed with the number of spaces required varying by the number of spaces inside the lot.
    ii. Van Accessible Parking Space dimensions: 11'W x 18'L with 5' wide accessible aisle on 1 side
    iii. Normal Accessible Parking Space dimensions: 9'W x 18'L with 5' wide accessible aisle on 1 side
e. Loading Dock Design (Sec. 4.12.13)
    i. Each commercial building will have 2 loading dock spaces each
    ii. Loading spaces are provided on the same lot and adjacent to the structure it serves.
    iii. Loading spaces are designed so as not to impede any required parking spaces, or any pedestrian or vehicular circulation.
    iv. Loading spaces are provided in addition to and exclusive of any parking requirement on the basis of: (1) one space for the first 8,000 square feet of retail gross leasable area, plus one space for each additional 20,000 square feet of retail gross leasable area
    v. Loading spaces shall be a minimum of 12 feet in width, 14½ feet in clearance height and a length sufficient to accommodate the largest delivery trucks serving the establishment, but in no case will such length be less than 25 feet.
    vi. Loading Pad dimensions are as follows: 12' x 30'
f. Dumpster Pads (Sec. 4.12.13)(Sec. 4.12.14)
    i. Each site plan that depicts a commercial or industrial building of 4,000 gross square feet or more shall provide a dumpster pad that does not impede any required parking or loading spaces, nor any pedestrian or vehicular circulation aisles (necessitating a dumpster pad location for each commercial building)

ii. The pad shall extend beyond the front of each dumpster and its length can't be less than eight feet beyond the front of the dumpster. The site shall be designed so that stormwater does not run through, and drains away from, areas where dumpsters are located in order to minimize the potential for contaminating stormwater runoff due to contact with solid waste

iii. Dumpster pad dimensions are as follows: 19' length, 22' wide enclosing 2, 8 cubic yard commercial dumpsters (which measure 6' x 6')(general standards are 14'W x 19'L)

Townhouses

Townhouses (90 units total)

1. Design of Buildings
    a. Blocks of townhomes are 7 maximum (*Project Requirements, Appendix D*)
    b. Setback Requirements (*Albemarle County Code Sec. 4.19*)
        i. Front: 5'
        ii. Back: 20'
        iii. Side: 10' from each 7 unit block (if it's in a block, can have shared walls)
2. Design of Curvilinear Parking
    a. 1.6(90) = 144 spaces total (*Project Requirements, Appendix D*)
    b. Curvilinear Parking Dimensions = 9' x 18'
    c. Width of the parking space measured at the narrowest point along the length of the space
    d. For curvilinear parking, a 100-foot sight distance must be maintained, and shall be measured as provided in Section 602.1 (Figure 6-5) of the Albemarle County Design Standards Manual.
        i. For parking on the inside of a curved travelway, a minimum centerline radius of 120' is required to maintain sight distance (*Albemarle County Design Standards Manual*)
        iv. Parking Graphically (current design along townhouse sidewalks)

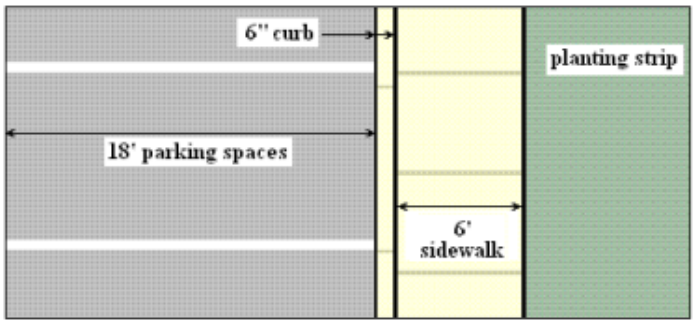


Figure C11. Parking Guidelines (*Albemarle County Design Standards Manual*)

Single Family Homes

Residential R1 Single Family Homes (30 units total)

1. Design of Buildings
    a. 30 homes that are either 30' x 30' or 25' x 45' (*Project Requirements, Appendix D*)
    b. Setback Requirements (*Sec. 4.19*)
        i. Front: 18' (garages)

        ii. Back: 20’
        iii. Side: 10’
2. Design of Parking
    a. 20’ width by 18’ length driveways on all homes (*Project Requirements, Appendix D*)

Recreational Area Design

1. Recreational Requirements (County Code Sec. 4.16)
    a. Minimum/Open Area (Sec 4.16.1)
        i. Developed recreational areas shall be provided for every development of 30 units or more equal to or exceeding 4 dwelling units per acre, except for single-family and two-family dwellings developed on conventional lots.
        ii. A minimum of 200 square feet per unit of recreational area shall be provided in common area or open space on the site, this requirement not to exceed five percent of the gross site area
        iii. The current park area is 59,900+ sq. ft. (3.84% of gross site area)
        iv. Total site area is 1,557,945 sq. ft.
    b. 2 Tot lot (Sec. 4.16.2.1)
        i. One tot lot shall be provided for the first 30 units and for each additional 50 units (5 tot lots required - 3 are being substituted)
        ii. 1 tot lot is in the Park Area
        iii. 1 tot lot is in the Pool Area
    c. 2 Basketball Courts (Sec 4.16.2.2)
        i. There is a minimum half court per 100 units
        ii. 3 half courts are required, providing 4 half courts (2 full courts)
        iii. 1 half court is substituting 1 tot lot
        iv. 1 basketball court is in the Park Area
        v. 1 basketball court is in the Pool Area
    d. 1 Swimming Pool Area
        i. Substituting for 2 tot lot
2. Parking for Recreational Areas (Sec. 4.12.6)
    a. The minimum number of parking spaces required for a residential recreational facility within a subdivision shall be reduced by the percentage of dwelling units within the subdivision within one-quarter mile of the facility (within 1,320 feet)
    b. Basketball = 2 per court, not necessary due to provision above
    c. Swimming pool = 1 per 125 sq. ft. water surface, 9 spots included
    d. Tot lots = none, due to above

Grading Standards

1. Grading of Roads and Sidewalks
    a. VDOT Subdivision Street Design Guide
        i. All roads are below a 10% grade (Section B-3)(Virginia Department of Transportation [VDOT], 2007)
        ii. All sidewalks are below a 5% grade and 5 feet wide (Section B-4 I.)
    b. Albemarle County Design Standards Manual – Engineering
        i. All K values of sag curves exceed 5 and all K values of crest curves exceed 15
        ii. All parking lots are below a 2% grade

Traffic Plan

Table 1-1: Trip Generation Comparison

LAND USE	ITE CODE	AMOUNT	UNITS	WEEKDAY ADT	AM PEAK HOUR IN	AM PEAK HOUR OUT	AM PEAK HOUR TOTAL	PM PEAK HOUR IN	PM PEAK HOUR OUT	PM PEAK HOUR TOTAL
Single-Family Detached Housing	210	80	Dwelling Units	847	15	47	62	52	30	82
Single-Family Detached Housing - Duets	210	60	Dwelling Units	650	12	35	47	39	23	62
Multi-Family Housing (Low-Rise) - Apartments	220	335	Dwelling Units	2,492	35	116	150	109	64	173
Multi-Family Housing (Low-Rise) - Townhomes	220	50	Dwelling Units	337	6	19	25	20	12	32
TOTAL		**525**	**Dwelling Units**	4,326	67	217	284	220	129	349

SOURCE: Institute of Transportation Engineers' *Trip Generation Manual* 10th Edition (2017)

Figure C12. Trip Generation Comparison

Timmons Group. (2022). *Old Ivy Residence: Traffic Impact Analysis*. https://lfweb.albemarle.org/WebLink/DocView.aspx?id=1423952&dbid=0&repo=CountyofAlbemarle&cr=1

Land Use	Average Trips Generated	Amount of Units	ADT
Single-Family Detached Housing	10.6	30	318
Apartments	7.4	180	1,332
Townhomes	6.7	90	603
Total			2,253

Figure C13. Trip Generation Calculations

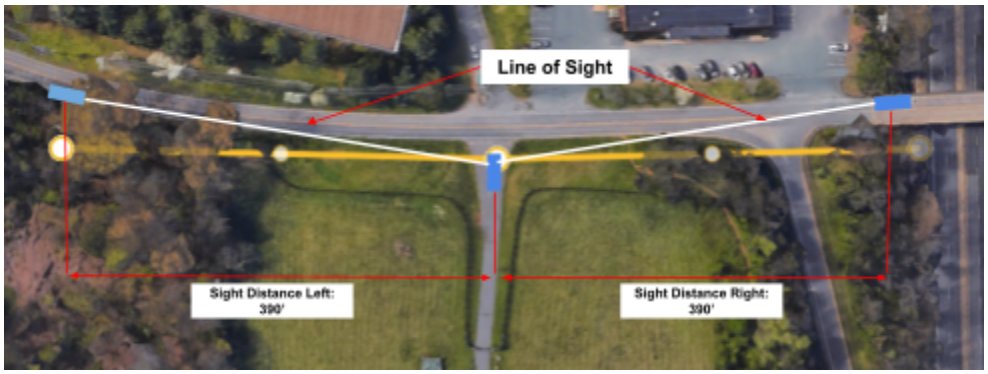


Figure C14. Intersection Line of Sight

Appendix D - Technical Deliverables

- Project Requirements
- Final Site

- Final Grade
- VRRM Stormwater Spreadsheet
- Construction Subcontractor Short List
- Landscaping Scoping Document
- Construction Phasing and Timeline

Dewberry

UVA CAPSTONE PROJECT DETAILS – 2023/2024

Project Description

This project will include a mix of residential area development including single family homes, townhomes and apartment buildings as well as commercial building requirements. As well as roadway improvements, modification of an existing pond, and the relocation of the Rivanna river trail around the site. See below for specific requests from the client

Site Address: 2441 Old Ivy Road, Albemarle County, VA 22903

- 250 to 300 units, prefer 300
  - Single family homes:
    - 30ft x 35ft or 20ft x45ft
    - Optional – can design a sample layout for the houses
    - Counts as 1 unit
    - 10 to 15% of all housing on site
    - Needs to include a driveway
    - Otherwise – 2 parking spaces per unit
  - Townhomes:
    - 20ft x 35ft
    - Counts as 1 unit
    - Can have up to 7 in one block of townhomes
    - 20 to 30 % of all housing on site
    - Parking requirement: 1.6 per unit
  - Apartment buildings:
    - 250ft by 60ft
    - 1st floor has 12 units
    - Any floor above 1st has 15 units
    - Max 5 stories but prefer 4
    - Optional – can design sample floor plan of apartments
    - 60 to 70% of all housing on site
    - You can explore having commercial on the bottom floor
    - Parking requirement: 1.35 per unit
- Parking options
  - Can explore various options including street parking, under ground parking, garage parking, etc.
- Commercial Buildings
  - Minimum of 2 commercial buildings
  - Ideas include
    - Whole foods – average 40,000 sqft
    - Trader joes – average 10,000 to 15,000 sqft
    - Restaurants – research will need to be done to figure out how much space is required
    - Small shops
    - CVS/ Walgreens
  - At minimum we would like 2 different commercial options, however to make the area more attractive to residents, more would be ideal. Some average square footages will need to be researched
  - An example of a mixed residental/commercial area:

        - https://www.westbroadvillage.com/
    - Parking will be required for this areas, but is dependent on what the buildings are – further discussion later on
- Amenities
    - We are open to suggestions on what you think would make the property more appealing. Ideas included below
        - Pool
        - Club house/leasing office – required
        - Mail rooms - required
        - Dog park
        - Daycare center
        - Sport options (i.e. tennis courts, volleyball etc)
        - Walking trails/Playgrounds
- Transportation
    - We would like sidewalk throughout the site so that commercial spaces are easily accessible by our residents
        - ADA compliance – optional extra requirement
        - Generally, avoid anything steeper than 5% for sidewalk accessibility and consider ramps when doing parking layouts
    - Also considering connectivity to Charlottesville bus system
    - Ideally one main corridor through the site to access everything. Only one access point required to the whole development though.
        - Hint: we did not use the existing location for our entrance, so explore your options/make some consideration for 250 bypass right next to site

Expected next steps

- Scoping document/complexity document/list of constraints
- Buildable area map
- Site layout - will need to happen before anything else
- Grading, Stormwater design, ESC, etc. Can discuss more on Friday what these steps are/timeline
- Construction schedule, estimate of cost, etc – can also discuss more in the future

Helpful Links

- Albemarle County Code
    - https://library.municode.com/va/albemarle_county/codes/code_of_ordinances?nodeId=COALCOVI
- ADA Accessibility
    - https://www.ada.gov/law-and-regs/design-standards/
- VA DEQ
    - https://www.deq.virginia.gov/our-programs/water/stormwater/stormwater-construction/handbooks

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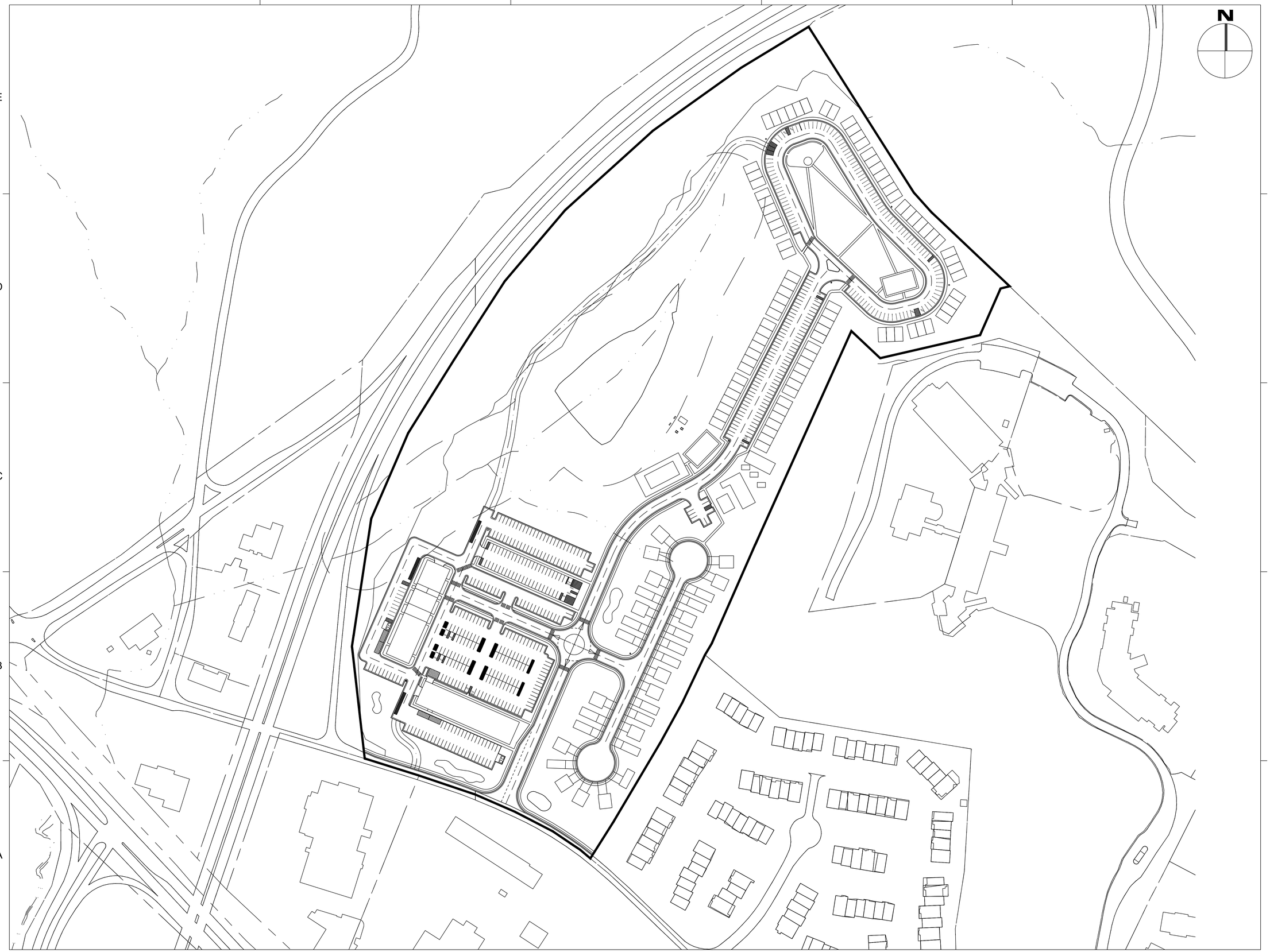


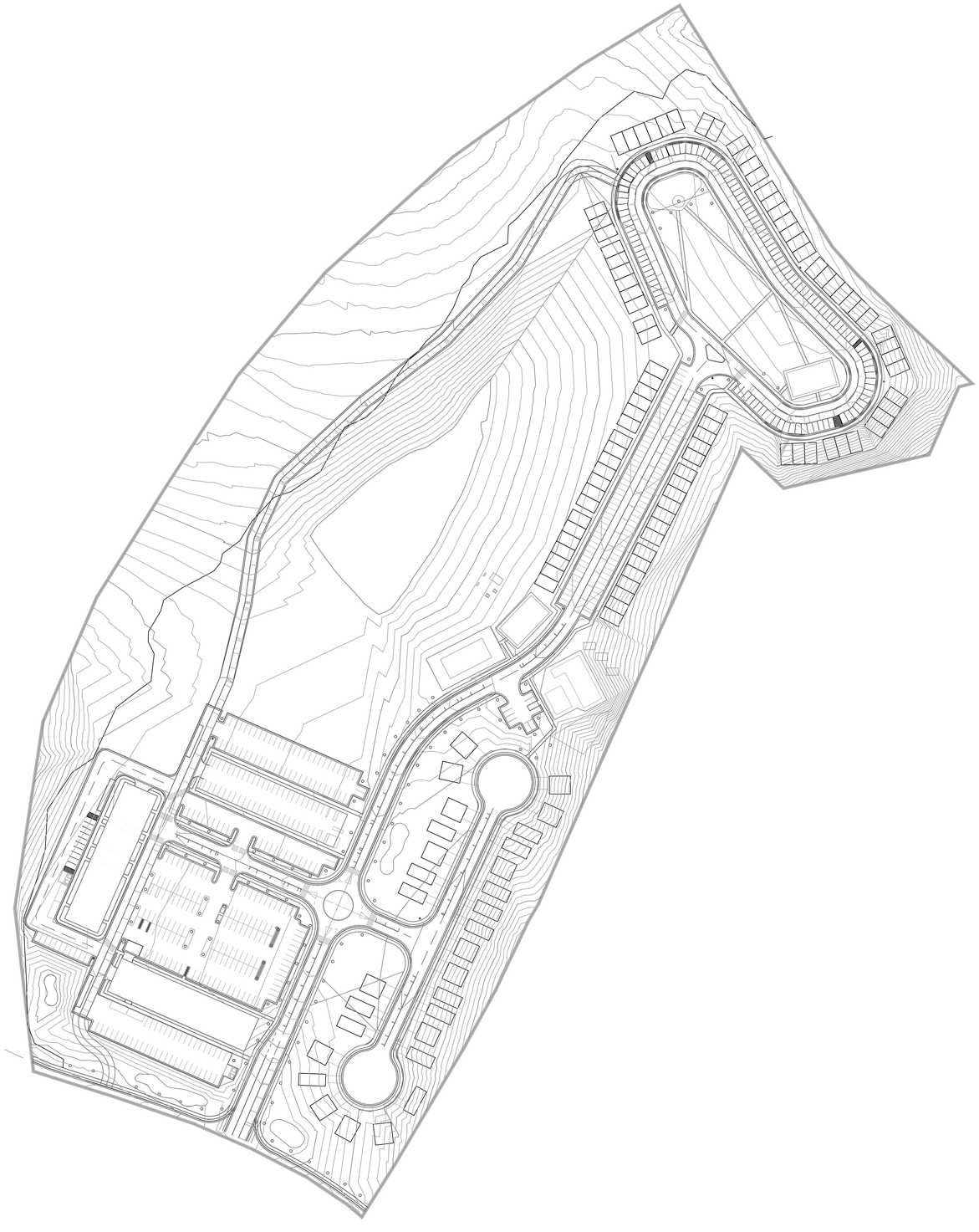
SEAL

KEY PLAN

SCALE

0' 50' 100' 200'

SCALE: 1" = 100'



SEAL

KEY PLAN

SCALE

0' 50' 100' 200'

SCALE: 1" = 100'

Virginia Runoff Reduction Method Worksheet

DEQ Virginia Runoff Reduction Method New Development Compliance Spreadsheet - Version 3.0

○ 2011 BMP Standards and Specifications ◉ 2013 Draft BMP Standards and Specifications

Project Name: Old Ivy Road Mixed-Use Development
Date: April 11, 2024

CLEAR ALL (Ctrl+Shift+R)

data input cells
constant values
calculation cells
final results

BMP Design Specifications List: 2013 Draft Stds & Specs

Site Information

Post-Development Project (Treatment Volume and Loads)

Land Cover (acres)

	A Soils	B Soils	C Soils	D Soils	Totals
Forest/Open Space (acres) -- undisturbed, protected forest/open space or reforested land	0.00	5.04	3.15	0.00	8.19 *
Managed Turf (acres) -- disturbed, graded for yards or other turf to be mowed/managed	0.00	6.34	8.80	0.00	15.14
Impervious Cover (acres)	0.00	10.61	1.86	0.00	12.47
					35.80

Total

** Forest/Open Space areas must be protected in accordance with the Virginia Runoff Reduction Method*

Constants

Annual Rainfall (inches)	43
Target Rainfall Event (inches)	1.00
Total Phosphorus (TP) EMC (mg/L)	0.26
Total Nitrogen (TN) EMC (mg/L)	1.86
Target TP Load (lb/acre/yr)	0.41
Pj (unitless correction factor)	0.90

Runoff Coefficients (Rv)

	A Soils	B Soils	C Soils	D Soils
Forest/Open Space	0.02	0.03	0.04	0.05
Managed Turf	0.15	0.20	0.22	0.25
Impervious Cover	0.95	0.95	0.95	0.95

Post-Development Requirement for Site Area

TP Load Reduction Required (lb/yr)	20.28

LAND COVER SUMMARY -- POST DEVELOPMENT

Land Cover Summary

Forest/Open Space Cover (acres)	8.19
Weighted Rv (forest)	0.03
% Forest	23%
Managed Turf Cover (acres)	15.14
Weighted Rv (turf)	0.21
% Managed Turf	42%
Impervious Cover (acres)	12.47
Rv (impervious)	0.95
% Impervious	35%
Site Area (acres)	35.80
Site Rv	0.43

Treatment Volume and Nutrient Loads

Treatment Volume (acre-ft)	1.2773
Treatment Volume (cubic feet)	55,641
TP Load (lb/yr)	34.96
TN Load (lb/yr) (Informational Purposes Only)	250.09

Summary Print

Virginia Runoff Reduction Method Worksheet

Drainage Area A

Northern half of single family homes

*SA of bioretention calculated assuming dept

CLEAR BMP AREAS

Drainage Area A Land Cover (acres)

	A Soils	B Soils	C Soils	D Soils	Totals	Land Cover Rv
Forest/Open Space (acres)	0.00	0.00	0.00	0.00	0.00	0.00
Managed Turf (acres)	0.00	0.64	0.60	0.00	1.24	0.21
Impervious Cover (acres)	0.00	0.78	0.60	0.00	1.38	0.95
				Total	2.62	

Total Phosphorus Available for Removal in D.A. A (lb/yr)	3.59
Post Development Treatment Volume in D.A. A (ft3)	5,706

Stormwater Best Management Practices (RR = Runoff Reduction)

--Select from dropdown lists--

Practice	Runoff Reduction Credit (%)	Managed Turf Credit Area (acres)	Impervious Cover Credit Area (acres)	Volume from Upstream Practice (ft3)	Runoff Reduction (ft3)	Remaining Runoff Volume (ft3)	Total BMP Treatment Volume (ft3)	Phosphorus Removal Efficiency (%)	Phosphorus Load from Upstream Practices (lb)	Untreated Phosphorus Load to Practice (lb)	Phosphorus Removed By Practice (lb)	Remaining Phosphorus Load (lb)	Downstream Practice to be Employed
1. Vegetated Roof (RR)													
1.a. Vegetated Roof #1 (Spec #5)	45				0	0	0	0		0.00	0.00	0.00	
1.b. Vegetated Roof #2 (Spec #5)	60				0	0	0	0		0.00	0.00	0.00	
2. Rooftop Disconnection (RR)													
2.a. Simple Disconnection to A/B Soils (Spec #1)	50			0	0	0	0	0	0.00	0.00	0.00	0.00	
2.b. Simple Disconnection to C/D Soils (Spec #1)	25			0	0	0	0	0	0.00	0.00	0.00	0.00	
2.c. To Soil Amended Filter Path as per specifications (existing C/D soils) (Spec #4)	50			0	0	0	0	0	0.00	0.00	0.00	0.00	
2.d. To Dry Well or French Drain #1, Micro-Infiltration #1 (Spec #8)	50			0	0	0	0	25	0.00	0.00	0.00	0.00	
2.e. To Dry Well or French Drain #2, Micro-Infiltration #2 (Spec #8)	90			0	0	0	0	25	0.00	0.00	0.00	0.00	
2.f. To Rain Garden #1, Micro-Bioretention #1 (Spec #9)	40			0	0	0	0	25	0.00	0.00	0.00	0.00	
2.g. To Rain Garden #2, Micro-Bioretention #2 (Spec #9)	80			0	0	0	0	50	0.00	0.00	0.00	0.00	
2.h. To Rainwater Harvesting (Spec #6)	0			0	0	0	0	0	0.00	0.00	0.00	0.00	
2.i. To Stormwater Planter, Urban Bioretention (Spec #9, Appendix A)	40			0	0	0	0	25	0.00	0.00	0.00	0.00	
3. Permeable Pavement (RR)													
3.a. Permeable Pavement #1 (Spec #7)	45			0	0	0	0	25	0.00	0.00	0.00	0.00	
3.b. Permeable Pavement #2 (Spec #7)	75				0	0	0	25		0.00	0.00	0.00	
4. Grass Channel (RR)													
4.a. Grass Channel A/B Soils (Spec #3)	20			0	0	0	0	15	0.00	0.00	0.00	0.00	
4.b. Grass Channel C/D Soils (Spec #3)	10			0	0	0	0	15	0.00	0.00	0.00	0.00	
4.c. Grass Channel with Compost Amended Soils as per specs (see Spec #4)	20			0	0	0	0	15	0.00	0.00	0.00	0.00	
5. Dry Swale (RR)													
5.a. Dry Swale #1 (Spec #10)	40			0	0	0	0	20	0.00	0.00	0.00	0.00	
5.b. Dry Swale #2 (Spec #10)	60			0	0	0	0	40	0.00	0.00	0.00	0.00	
6. Bioretention (RR)													
6.a. Bioretention #1 or Micro-Bioretention #1 or Urban Bioretention (Spec #9)	40			0	0	0	0	25	0.00	0.00	0.00	0.00	
6.b. Bioretention #2 or Micro-Bioretention #2 (Spec #9)	80	1.24	1.38	0	4,562	1,141	5,703	50	0.00	3.58	3.22	0.36	
7. Infiltration (RR)													
7.a. Infiltration #1 (Spec #8)	50			0	0	0	0	25	0.00	0.00	0.00	0.00	
7.b. Infiltration #2 (Spec #8)	90			0	0	0	0	25	0.00	0.00	0.00	0.00	
8. Extended Detention Pond (RR)													
8.a. ED #1 (Spec #15)	0			0	0	0	0	15	0.00	0.00	0.00	0.00	
8.b. ED #2 (Spec #15)	15			0	0	0	0	15	0.00	0.00	0.00	0.00	
9. Sheetflow to Filter/Open Space (RR)													
9.a. Sheetflow to Conservation Area, A/B Soils (Spec #2)	75			0	0	0	0	0	0.00	0.00	0.00	0.00	
9.b. Sheetflow to Conservation Area, C/D Soils (Spec #2)	50			0	0	0	0	0	0.00	0.00	0.00	0.00	
9.c. Sheetflow to Vegetated Filter Strip, A Soils or Compost Amended B/C/D Soils (Spec #2 & #4)	50			0	0	0	0	0	0.00	0.00	0.00	0.00	
10. Wet Swale (no RR)													
10.a. Wet Swale #1 (Spec #11)	0			0	0	0	0	20	0.00	0.00	0.00	0.00	
10.b. Wet Swale #2 (Spec #11)	0			0	0	0	0	40	0.00	0.00	0.00	0.00	
11. Filtering Practices (no RR)													

Nitrogen Removal Efficiency (%)	Nitrogen Load from Upstream Practices (lbs)	Untreated Nitrogen Load to Practice (lbs)	Nitrogen Removed By Practice (lbs)	Remaining Nitrogen Load (lbs)
1. Vegetated Roof (RR)				
0		0.00	0.00	0.00
0		0.00	0.00	0.00
2. Rooftop Disconnection (RR)				
0	0.00	0.00	0.00	0.00
0	0.00	0.00	0.00	0.00
0	0.00	0.00	0.00	0.00
15	0.00	0.00	0.00	0.00
15	0.00	0.00	0.00	0.00
40	0.00	0.00	0.00	0.00
60	0.00	0.00	0.00	0.00
0	0.00	0.00	0.00	0.00
40	0.00	0.00	0.00	0.00
3. Permeable Pavement (RR)				
25	0.00	0.00	0.00	0.00
25		0.00	0.00	0.00
4. Grass Channel (RR)				
20	0.00	0.00	0.00	0.00
20	0.00	0.00	0.00	0.00
20	0.00	0.00	0.00	0.00
5. Dry Swale (RR)				
25	0.00	0.00	0.00	0.00
35	0.00	0.00	0.00	0.00
6. Bioretention (RR)				
40	0.00	0.00	0.00	0.00
60	0.00	25.60	23.56	2.05
7. Infiltration (RR)				
15	0.00	0.00	0.00	0.00
15	0.00	0.00	0.00	0.00
8. Extended Detention Pond (RR)				
10	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00
9. Sheetflow to Filter/Open Space (RR)				
0	0.00	0.00	0.00	0.00
0	0.00	0.00	0.00	0.00
0	0.00	0.00	0.00	0.00
10. Wet Swale (Coastal Plain) (no RR)				
25	0.00	0.00	0.00	0.00
35	0.00	0.00	0.00	0.00
11. Filtering Practices (no RR)				

TOTAL IMPERVIOUS COVER TREATED (ac)	1.38	AREA CHECK: OK.
TOTAL MANAGED TURF AREA TREATED (ac)	1.24	AREA CHECK: OK.
TOTAL RUNOFF REDUCTION IN D.A. A (ft3)	4,562	
TOTAL PHOSPHORUS AVAILABLE FOR REMOVAL IN D.A. A (lb/yr)	3.59	
TOTAL PHOSPHORUS REMOVED WITH RUNOFF REDUCTION PRACTICES IN D.A. A (lb/yr)	3.22	
TOTAL PHOSPHORUS REMAINING AFTER APPLYING RUNOFF REDUCTION PRACTICES IN D.A. A (lb/yr)	0.36	

SEE WATER QUALITY COMPLIANCE TAB FOR SITE COMPLIANCE CALCULATIONS

TOTAL RUNOFF REDUCTION IN D.A. A (ft3)	4,562
NITROGEN REMOVED WITH RUNOFF REDUCTION PRACTICES IN D.A. A (lb/yr)	23.56

SEE WATER QUALITY COMPLIANCE TAB FOR SITE CALCULATIONS (Information Only)

Summary Print

Virginia Runoff Reduction Method Worksheet

Drainage Area A

Northern half of single family homes *SA of bioretention calculated assuming dept

CLEAR BMP AREAS

Drainage Area A Land Cover (acres)

	A Soils	B Soils	C Soils	D Soils	Totals	Land Cover Rv
Forest/Open Space (acres)	0.00	0.00	0.00	0.00	0.00	0.00
Managed Turf (acres)	0.00	0.64	0.60	0.00	1.24	0.21
Impervious Cover (acres)	0.00	0.78	0.60	0.00	1.38	0.95
				Total	2.62	

Total Phosphorus Available for Removal in D.A. A (lb/yr): 3.59

Post Development Treatment Volume in D.A. A (ft3): 5,706

Stormwater Best Management Practices (RR = Runoff Reduction)

--Select from dropdown lists--

Practice	Runoff Reduction Credit (%)	Managed Turf Credit Area (acres)	Impervious Cover Credit Area (acres)	Volume from Upstream Practice (ft3)	Runoff Reduction (ft3)	Remaining Runoff Volume (ft3)	Total BMP Treatment Volume (ft3)	Phosphorus Removal Efficiency (%)	Phosphorus Load from Upstream Practices (lb)	Untreated Phosphorus Load to Practice (lb)	Phosphorus Removed By Practice (lb)	Remaining Phosphorus Load (lb)	Downstream Practice to be Employed
11.a.Filtering Practice #1 (Spec #12)	0			0	0	0	0	60	0.00	0.00	0.00	0.00	
11.b. Filtering Practice #2 (Spec #12)	0			0	0	0	0	65	0.00	0.00	0.00	0.00	
12. Constructed Wetland (no RR)													
12.a.Constructed Wetland #1 (Spec #13)	0			0	0	0	0	50	0.00	0.00	0.00	0.00	
12.b. Constructed Wetland #2 (Spec #13)	0			0	0	0	0	75	0.00	0.00	0.00	0.00	
13. Wet Ponds (no RR)													
13.a. Wet Pond #1 (Spec #14)	0			0	0	0	0	50	0.00	0.00	0.00	0.00	
13.b. Wet Pond #1 (Coastal Plain) (Spec #14)	0			0	0	0	0	45	0.00	0.00	0.00	0.00	
13.c. Wet Pond #2 (Spec #14)	0			0	0	0	0	75	0.00	0.00	0.00	0.00	
13.d. Wet Pond #2 (Coastal Plain) (Spec #14)	0			0	0	0	0	65	0.00	0.00	0.00	0.00	
14. Manufactured Treatment Devices (no RR)													
14.a. Manufactured Treatment Device-Hydrodynamic	0			0	0	0	0	20	0.00	0.00	0.00	0.00	
14.b. Manufactured Treatment Device-Filtering	0			0	0	0	0	65	0.00	0.00	0.00	0.00	
14.c. Manufactured Treatment Device-Generic	0			0	0	0	0	20	0.00	0.00	0.00	0.00	

Nitrogen Removal Efficiency (%)	Nitrogen Load from Upstream Practices (lbs)	Untreated Nitrogen Load to Practice (lbs)	Nitrogen Removed By Practice (lbs)	Remaining Nitrogen Load (lbs)
30	0.00	0.00	0.00	0.00
45	0.00	0.00	0.00	0.00
12. Constructed Wetland (no RR)				
25	0.00	0.00	0.00	0.00
55	0.00	0.00	0.00	0.00
13. Wet Ponds (no RR)				
30	0.00	0.00	0.00	0.00
20	0.00	0.00	0.00	0.00
40	0.00	0.00	0.00	0.00
30	0.00	0.00	0.00	0.00
14. Manufactured BMP (no RR)				
0	0.00	0.00	0.00	0.00
0	0.00	0.00	0.00	0.00
0	0.00	0.00	0.00	0.00

TOTAL IMPERVIOUS COVER TREATED (ac): 1.38 — AREA CHECK: OK.

TOTAL MANAGED TURF AREA TREATED (ac): 1.24 — AREA CHECK: OK.

TOTAL PHOSPHORUS REMOVAL REQUIRED ON SITE (lb/yr): 20.28

TOTAL PHOSPHORUS AVAILABLE FOR REMOVAL IN D.A. A (lb/yr): 3.59

TOTAL PHOSPHORUS REMOVED WITHOUT RUNOFF REDUCTION PRACTICES IN D.A. A (lb/yr): 0.00

TOTAL PHOSPHORUS REMOVED WITH RUNOFF REDUCTION PRACTICES IN D.A. A (lb/yr): 3.22

TOTAL PHOSPHORUS LOAD REDUCTION ACHIEVED IN D.A. A (lb/yr): 3.22

TOTAL PHOSPHORUS REMAINING AFTER APPLYING BMP LOAD REDUCTIONS IN D.A. A (lb/yr): 0.36

SEE WATER QUALITY COMPLIANCE TAB FOR SITE COMPLIANCE CALCULATIONS

NITROGEN REMOVED WITH RUNOFF REDUCTION PRACTICES IN D.A. A (lb/yr): 23.56

NITROGEN REMOVED WITHOUT RUNOFF REDUCTION PRACTICES IN D.A. A (lb/yr): 0.00

TOTAL NITROGEN REMOVED IN D.A. A (lb/yr): 23.56

Summary Print

Virginia Runoff Reduction Method Worksheet

Drainage Area B Southern half of single family homes

Drainage Area A Land Cover (acres)

	A Soils	B Soils	C Soils	D Soils	Totals	Land Cover Rv
Forest/Open Space (acres)	0.00	0.00	0.00	0.00	0.00	0.00
Managed Turf (acres)	0.00	1.66	0.00	0.00	1.66	0.20
Impervious Cover (acres)	0.00	1.11	0.00	0.00	1.11	0.95
				Total	2.77	

CLEAR BMP AREAS

Total Phosphorus Available for Removal in D.A. B (lb/yr)	3.16
Post Development Treatment Volume in D.A. B (ft3)	5,028

Stormwater Best Management Practices (RR = Runoff Reduction)

--Select from dropdown lists--

Practice	Runoff Reduction Credit (%)	Managed Turf Credit Area (acres)	Impervious Cover Credit Area (acres)	Volume from Upstream Practice (ft3)	Runoff Reduction (ft3)	Remaining Runoff Volume (ft3)	Total BMP Treatment Volume (ft3)	Phosphorus Removal Efficiency (%)	Phosphorus Load from Upstream Practices (lb)	Untreated Phosphorus Load to Practice (lb)	Phosphorus Removed By Practice (lb)	Remaining Phosphorus Load (lb)	Downstream Practice to be Employed
1. Vegetated Roof (RR)													
1.a. Vegetated Roof #1 (Spec #5)	45				0	0	0	0		0.00	0.00	0.00	
1.b. Vegetated Roof #2 (Spec #5)	60				0	0	0	0		0.00	0.00	0.00	
2. Rooftop Disconnection (RR)													
2.a. Simple Disconnection to A/B Soils (Spec #1)	50			0	0	0	0	0	0.00	0.00	0.00	0.00	
2.b. Simple Disconnection to C/D Soils (Spec #1)	25			0	0	0	0	0	0.00	0.00	0.00	0.00	
2.c. To Soil Amended Filter Path as per specifications (existing C/D soils) (Spec #4)	50			0	0	0	0	0	0.00	0.00	0.00	0.00	
2.d. To Dry Well or French Drain #1, Micro-Infiltration #1 (Spec #8)	50			0	0	0	0	25	0.00	0.00	0.00	0.00	
2.e. To Dry Well or French Drain #2, Micro-Infiltration #2 (Spec #8)	90			0	0	0	0	25	0.00	0.00	0.00	0.00	
2.f. To Rain Garden #1, Micro-Bioretention #1 (Spec #9)	40			0	0	0	0	25	0.00	0.00	0.00	0.00	
2.g. To Rain Garden #2, Micro-Bioretention #2 (Spec #9)	80			0	0	0	0	50	0.00	0.00	0.00	0.00	
2.h. To Rainwater Harvesting (Spec #6)	0			0	0	0	0	0	0.00	0.00	0.00	0.00	
2.i. To Stormwater Planter, Urban Bioretention (Spec #9, Appendix A)	40			0	0	0	0	25	0.00	0.00	0.00	0.00	
3. Permeable Pavement (RR)													
3.a. Permeable Pavement #1 (Spec #7)	45			0	0	0	0	25	0.00	0.00	0.00	0.00	
3.b. Permeable Pavement #2 (Spec #7)	75				0	0	0	25		0.00	0.00	0.00	
4. Grass Channel (RR)													
4.a. Grass Channel A/B Soils (Spec #3)	20			0	0	0	0	15	0.00	0.00	0.00	0.00	
4.b. Grass Channel C/D Soils (Spec #3)	10			0	0	0	0	15	0.00	0.00	0.00	0.00	
4.c. Grass Channel with Compost Amended Soils as per specs (see Spec #4)	20			0	0	0	0	15	0.00	0.00	0.00	0.00	
5. Dry Swale (RR)													
5.a. Dry Swale #1 (Spec #10)	40			0	0	0	0	20	0.00	0.00	0.00	0.00	
5.b. Dry Swale #2 (Spec #10)	60			0	0	0	0	40	0.00	0.00	0.00	0.00	
6. Bioretention (RR)													
6.a. Bioretention #1 or Micro-Bioretention #1 or Urban Bioretention (Spec #9)	40			0	0	0	0	25	0.00	0.00	0.00	0.00	
6.b. Bioretention #2 or Micro-Bioretention #2 (Spec #9)	80	1.66	1.11	0	4,026	1,007	5,033	50	0.00	3.16	2.84	0.32	
7. Infiltration (RR)													
7.a. Infiltration #1 (Spec #8)	50			0	0	0	0	25	0.00	0.00	0.00	0.00	
7.b. Infiltration #2 (Spec #8)	90			0	0	0	0	25	0.00	0.00	0.00	0.00	
8. Extended Detention Pond (RR)													
8.a. ED #1 (Spec #15)	0			0	0	0	0	15	0.00	0.00	0.00	0.00	
8.b. ED #2 (Spec #15)	15			0	0	0	0	15	0.00	0.00	0.00	0.00	
9. Sheetflow to Filter/Open Space (RR)													
9.a. Sheetflow to Conservation Area, A/B Soils (Spec #2)	75			0	0	0	0	0	0.00	0.00	0.00	0.00	
9.b. Sheetflow to Conservation Area, C/D Soils (Spec #2)	50			0	0	0	0	0	0.00	0.00	0.00	0.00	
9.c. Sheetflow to Vegetated Filter Strip, A Soils or Compost Amended B/C/D Soils (Spec #2 & #4)	50			0	0	0	0	0	0.00	0.00	0.00	0.00	

TOTAL IMPERVIOUS COVER TREATED (ac)	1.11	AREA CHECK: AREA EXCEEDED!
TOTAL MANAGED TURF AREA TREATED (ac)	1.66	AREA CHECK: OK.
TOTAL RUNOFF REDUCTION IN D.A. B (ft3)	4,026	
TOTAL PHOSPHORUS AVAILABLE FOR REMOVAL IN D.A. B (lb/yr)	3.16	
TOTAL PHOSPHORUS REMOVED WITH RUNOFF REDUCTION PRACTICES IN D.A. B (lb/yr)	2.84	
TOTAL PHOSPHORUS REMAINING AFTER APPLYING RUNOFF REDUCTION PRACTICES IN D.A. B (lb/yr)	0.32	

SEE WATER QUALITY COMPLIANCE TAB FOR SITE COMPLIANCE CALCULATIONS

Practice	Nitrogen Removal Efficiency (%)	Nitrogen Load from Upstream Practices (lbs)	Untreated Nitrogen Load to Practice (lbs)	Nitrogen Removed By Practice (lbs)	Remaining Nitrogen Load (lbs)
1. Vegetated Roof (RR)					
1.a. Vegetated Roof #1 (Spec #5)	0		0.00	0.00	0.00
1.b. Vegetated Roof #2 (Spec #5)	0		0.00	0.00	0.00
2. Rooftop Disconnection (RR)					
2.a. Simple Disconnection to A/B Soils (Spec #1)	0	0.00	0.00	0.00	0.00
2.b. Simple Disconnection to C/D Soils (Spec #1)	0	0.00	0.00	0.00	0.00
2.c. To Soil Amended Filter Path as per specifications (existing C/D soils) (Spec #4)	0	0.00	0.00	0.00	0.00
2.d. To Dry Well or French Drain #1, Micro-Infiltration #1 (Spec #8)	15	0.00	0.00	0.00	0.00
2.e. To Dry Well or French Drain #2, Micro-Infiltration #2 (Spec #8)	15	0.00	0.00	0.00	0.00
2.f. To Rain Garden #1, Micro-Bioretention #1 (Spec #9)	40	0.00	0.00	0.00	0.00
2.g. To Rain Garden #2, Micro-Bioretention #2 (Spec #9)	60	0.00	0.00	0.00	0.00
2.h. To Rainwater Harvesting (Spec #6)	0	0.00	0.00	0.00	0.00
2.i. To Stormwater Planter, Urban Bioretention (Spec #9, Appendix A)	40	0.00	0.00	0.00	0.00
3. Permeable Pavement (RR)					
3.a. Permeable Pavement #1 (Spec #7)	25	0.00	0.00	0.00	0.00
3.b. Permeable Pavement #2 (Spec #7)	25		0.00	0.00	0.00
4. Grass Channel (RR)					
4.a. Grass Channel A/B Soils (Spec #3)	20	0.00	0.00	0.00	0.00
4.b. Grass Channel C/D Soils (Spec #3)	20	0.00	0.00	0.00	0.00
4.c. Grass Channel with Compost Amended Soils as per specs (see Spec #4)	20	0.00	0.00	0.00	0.00
5. Dry Swale (RR)					
5.a. Dry Swale #1 (Spec #10)	25	0.00	0.00	0.00	0.00
5.b. Dry Swale #2 (Spec #10)	35	0.00	0.00	0.00	0.00
6. Bioretention (RR)					
6.a. Bioretention #1 or Micro-Bioretention #1 or Urban Bioretention (Spec #9)	40	0.00	0.00	0.00	0.00
6.b. Bioretention #2 or Micro-Bioretention #2 (Spec #9)	60	0.00	22.60	20.79	1.81
7. Infiltration (RR)					
7.a. Infiltration #1 (Spec #8)	15	0.00	0.00	0.00	0.00
7.b. Infiltration #2 (Spec #8)	15	0.00	0.00	0.00	0.00
8. Extended Detention Pond (RR)					
8.a. ED #1 (Spec #15)	10	0.00	0.00	0.00	0.00
8.b. ED #2 (Spec #15)	10	0.00	0.00	0.00	0.00
9. Sheetflow to Filter/Open Space (RR)					
9.a. Sheetflow to Conservation Area, A/B Soils (Spec #2)	0	0.00	0.00	0.00	0.00
9.b. Sheetflow to Conservation Area, C/D Soils (Spec #2)	0	0.00	0.00	0.00	0.00
9.c. Sheetflow to Vegetated Filter Strip, A Soils or Compost Amended B/C/D Soils (Spec #2 & #4)	0	0.00	0.00	0.00	0.00

TOTAL RUNOFF REDUCTION IN D.A. B (ft3)	4,026
NITROGEN REMOVED WITH RUNOFF REDUCTION PRACTICES IN D.A. B (lb/yr)	20.79

SEE WATER QUALITY COMPLIANCE TAB FOR SITE CALCULATIONS (Information Only)

10. Wet Swale (no RR)													
10.a. Wet Swale #1 (Spec #11)	0			0	0	0	0	20	0.00	0.00	0.00	0.00	
10.b. Wet Swale #2 (Spec #11)	0			0	0	0	0	40	0.00	0.00	0.00	0.00	
11. Filtering Practices (no RR)													

10. Wet Swale (Coastal Plain) (no RR)					
	25	0.00	0.00	0.00	0.00
	35	0.00	0.00	0.00	0.00
11. Filtering Practices (no RR)					

Summary Print

Virginia Runoff Reduction Method Worksheet

Drainage Area B

Southern half of single family homes

Drainage Area A Land Cover (acres)

	A Soils	B Soils	C Soils	D Soils	Totals	Land Cover Rv
Forest/Open Space (acres)	0.00	0.00	0.00	0.00	0.00	0.00
Managed Turf (acres)	0.00	1.66	0.00	0.00	1.66	0.20
Impervious Cover (acres)	0.00	1.11	0.00	0.00	1.11	0.95
				Total	2.77	

CLEAR BMP AREAS

Total Phosphorus Available for Removal in D.A. B (lb/yr)	3.16
Post Development Treatment Volume in D.A. B (ft3)	5,028

Stormwater Best Management Practices (RR = Runoff Reduction)

--Select from dropdown lists--

Practice	Runoff Reduction Credit (%)	Managed Turf Credit Area (acres)	Impervious Cover Credit Area (acres)	Volume from Upstream Practice (ft3)	Runoff Reduction (ft3)	Remaining Runoff Volume (ft3)	Total BMP Treatment Volume (ft3)	Phosphorus Removal Efficiency (%)	Phosphorus Load from Upstream Practices (lb)	Untreated Phosphorus Load to Practice (lb)	Phosphorus Removed By Practice (lb)	Remaining Phosphorus Load (lb)	Downstream Practice to be Employed
11.a.Filtering Practice #1 (Spec #12)	0			0	0	0	0	60	0.00	0.00	0.00	0.00	
11.b. Filtering Practice #2 (Spec #12)	0			0	0	0	0	65	0.00	0.00	0.00	0.00	
12. Constructed Wetland (no RR)													
12.a.Constructed Wetland #1 (Spec #13)	0			0	0	0	0	50	0.00	0.00	0.00	0.00	
12.b. Constructed Wetland #2 (Spec #13)	0			0	0	0	0	75	0.00	0.00	0.00	0.00	
13. Wet Ponds (no RR)													
13.a. Wet Pond #1 (Spec #14)	0			0	0	0	0	50	0.00	0.00	0.00	0.00	
13.b. Wet Pond #1 (Coastal Plain) (Spec #14)	0			0	0	0	0	45	0.00	0.00	0.00	0.00	
13.c. Wet Pond #2 (Spec #14)	0			0	0	0	0	75	0.00	0.00	0.00	0.00	
13.d. Wet Pond #2 (Coastal Plain) (Spec #14)	0			0	0	0	0	65	0.00	0.00	0.00	0.00	
14. Manufactured Treatment Devices (no RR)													
14.a. Manufactured Treatment Device-Hydrodynamic	0			0	0	0	0	20	0.00	0.00	0.00	0.00	
14.b. Manufactured Treatment Device-Filtering	0			0	0	0	0	20	0.00	0.00	0.00	0.00	
14.c. Manufactured Treatment Device-Generic	0			0	0	0	0	20	0.00	0.00	0.00	0.00	

Nitrogen Removal Efficiency (%)	Nitrogen Load from Upstream Practices (lbs)	Untreated Nitrogen Load to Practice (lbs)	Nitrogen Removed By Practice (lbs)	Remaining Nitrogen Load (lbs)
30	0.00	0.00	0.00	0.00
45	0.00	0.00	0.00	0.00
12. Constructed Wetland (no RR)				
25	0.00	0.00	0.00	0.00
55	0.00	0.00	0.00	0.00
13. Wet Ponds (no RR)				
30	0.00	0.00	0.00	0.00
20	0.00	0.00	0.00	0.00
40	0.00	0.00	0.00	0.00
30	0.00	0.00	0.00	0.00
14. Manufactured BMP (no RR)				
0	0.00	0.00	0.00	0.00
0	0.00	0.00	0.00	0.00
0	0.00	0.00	0.00	0.00

TOTAL IMPERVIOUS COVER TREATED (ac)	1.11	AREA CHECK: AREA EXCEEDED!
TOTAL MANAGED TURF AREA TREATED (ac)	1.66	AREA CHECK: OK.
TOTAL PHOSPHORUS REMOVAL REQUIRED ON SITE (lb/yr)	20.28	
TOTAL PHOSPHORUS AVAILABLE FOR REMOVAL IN D.A. B (lb/yr)	3.16	
TOTAL PHOSPHORUS REMOVED WITHOUT RUNOFF REDUCTION PRACTICES IN D.A. B (lb/yr)	0.00	
TOTAL PHOSPHORUS REMOVED WITH RUNOFF REDUCTION PRACTICES IN D.A. B (lb/yr)	2.84	
TOTAL PHOSPHORUS LOAD REDUCTION ACHIEVED IN D.A. B (lb/yr)	2.84	
TOTAL PHOSPHORUS REMAINING AFTER APPLYING BMP LOAD REDUCTIONS IN D.A. B (lb/yr)	0.32	

SEE WATER QUALITY COMPLIANCE TAB FOR SITE COMPLIANCE CALCULATIONS

NITROGEN REMOVED WITH RUNOFF REDUCTION PRACTICES IN D.A. B (lb/yr)	20.79
NITROGEN REMOVED WITHOUT RUNOFF REDUCTION PRACTICES IN D.A. B (lb/yr)	0.00
TOTAL NITROGEN REMOVED IN D.A. B (lb/yr)	20.79

Summary Print

Virginia Runoff Reduction Method Worksheet

Drainage Area C

Southern half of apartment parking lot and Westernmost building

Total area: 5.15 acres

*Ask about requirement to be less than 50% impervious

Drainage Area A Land Cover (acres)

	A Soils	B Soils	C Soils	D Soils	Totals	Land Cover Rv
Forest/Open Space (acres)	0.00	0.00	0.00	0.00	0.00	0.00
Managed Turf (acres)	0.00	1.52	0.00	0.00	1.52	0.20
Impervious Cover (acres)	0.00	3.68	0.00	0.00	3.68	0.95
				Total	5.20	

CLEAR BMP AREAS

Total Phosphorus Available for Removal in D.A. C (lb/yr)	8.67
Post Development Treatment Volume in D.A. C (ft3)	13,794

Stormwater Best Management Practices (RR = Runoff Reduction)

--Select from dropdown lists--

Practice	Runoff Reduction Credit (%)	Managed Turf Credit Area (acres)	Impervious Cover Credit Area (acres)	Volume from Upstream Practice (ft3)	Runoff Reduction (ft3)	Remaining Runoff Volume (ft3)	Total BMP Treatment Volume (ft3)	Phosphorus Removal Efficiency (%)	Phosphorus Load from Upstream Practices (lb)	Untreated Phosphorus Load to Practice (lb)	Phosphorus Removed By Practice (lb)	Remaining Phosphorus Load (lb)	Downstream Practice to be Employed
1. Vegetated Roof (RR)													
1.a. Vegetated Roof #1 (Spec #5)	45				0	0	0	0		0.00	0.00	0.00	
1.b. Vegetated Roof #2 (Spec #5)	60				0	0	0	0		0.00	0.00	0.00	
2. Rooftop Disconnection (RR)													
2.a. Simple Disconnection to A/B Soils (Spec #1)	50			0	0	0	0	0	0.00	0.00	0.00	0.00	
2.b. Simple Disconnection to C/D Soils (Spec #1)	25			0	0	0	0	0	0.00	0.00	0.00	0.00	
2.c. To Soil Amended Filter Path as per specifications (existing C/D soils) (Spec #4)	50			0	0	0	0	0	0.00	0.00	0.00	0.00	
2.d. To Dry Well or French Drain #1, Micro-Infiltration #1 (Spec #8)	50			0	0	0	0	25	0.00	0.00	0.00	0.00	
2.e. To Dry Well or French Drain #2, Micro-Infiltration #2 (Spec #8)	90			0	0	0	0	25	0.00	0.00	0.00	0.00	
2.f. To Rain Garden #1, Micro-Bioretention #1 (Spec #9)	40			0	0	0	0	25	0.00	0.00	0.00	0.00	
2.g. To Rain Garden #2, Micro-Bioretention #2 (Spec #9)	80			0	0	0	0	50	0.00	0.00	0.00	0.00	
2.h. To Rainwater Harvesting (Spec #6)	0			0	0	0	0	0	0.00	0.00	0.00	0.00	
2.i. To Stormwater Planter, Urban Bioretention (Spec #9, Appendix A)	40			0	0	0	0	25	0.00	0.00	0.00	0.00	
3. Permeable Pavement (RR)													
3.a. Permeable Pavement #1 (Spec #7)	45			0	0	0	0	25	0.00	0.00	0.00	0.00	
3.b. Permeable Pavement #2 (Spec #7)	75				0	0	0	25		0.00	0.00	0.00	
4. Grass Channel (RR)													
4.a. Grass Channel A/B Soils (Spec #3)	20			0	0	0	0	15	0.00	0.00	0.00	0.00	
4.b. Grass Channel C/D Soils (Spec #3)	10			0	0	0	0	15	0.00	0.00	0.00	0.00	
4.c. Grass Channel with Compost Amended Soils as per specs (see Spec #4)	20			0	0	0	0	15	0.00	0.00	0.00	0.00	
5. Dry Swale (RR)													
5.a. Dry Swale #1 (Spec #10)	40			0	0	0	0	20	0.00	0.00	0.00	0.00	
5.b. Dry Swale #2 (Spec #10)	60			0	0	0	0	40	0.00	0.00	0.00	0.00	
6. Bioretention (RR)													
6.a. Bioretention #1 or Micro-Bioretention #1 or Urban Bioretention (Spec #9)	40			0	0	0	0	25	0.00	0.00	0.00	0.00	
6.b. Bioretention #2 or Micro-Bioretention #2 (Spec #9)	80	1.52	2.58	0	8,001	2,000	10,001	50	0.00	6.28	5.65	0.63	
7. Infiltration (RR)													
7.a. Infiltration #1 (Spec #8)	50			0	0	0	0	25	0.00	0.00	0.00	0.00	
7.b. Infiltration #2 (Spec #8)	90			0	0	0	0	25	0.00	0.00	0.00	0.00	
8. Extended Detention Pond (RR)													
8.a. ED #1 (Spec #15)	0			0	0	0	0	15	0.00	0.00	0.00	0.00	
8.b. ED #2 (Spec #15)	15			0	0	0	0	15	0.00	0.00	0.00	0.00	
9. Sheetflow to Filter/Open Space (RR)													
9.a. Sheetflow to Conservation Area, A/B Soils (Spec #2)	75			0	0	0	0	0	0.00	0.00	0.00	0.00	
9.b. Sheetflow to Conservation Area, C/D Soils (Spec #2)	50			0	0	0	0	0	0.00	0.00	0.00	0.00	
9.c. Sheetflow to Vegetated Filter Strip, A Soils or Compost Amended B/C/D Soils (Spec #2 & #4)	50			0	0	0	0	0	0.00	0.00	0.00	0.00	

Practice	Nitrogen Removal Efficiency (%)	Nitrogen Load from Upstream Practices (lbs)	Untreated Nitrogen Load to Practice (lbs)	Nitrogen Removed By Practice (lbs)	Remaining Nitrogen Load (lbs)
1. Vegetated Roof (RR)					
1.a. Vegetated Roof #1 (Spec #5)	0		0.00	0.00	0.00
1.b. Vegetated Roof #2 (Spec #5)	0		0.00	0.00	0.00
2. Rooftop Disconnection (RR)					
2.a. Simple Disconnection to A/B Soils (Spec #1)	0	0.00	0.00	0.00	0.00
2.b. Simple Disconnection to C/D Soils (Spec #1)	0	0.00	0.00	0.00	0.00
2.c. To Soil Amended Filter Path as per specifications (existing C/D soils) (Spec #4)	0	0.00	0.00	0.00	0.00
2.d. To Dry Well or French Drain #1, Micro-Infiltration #1 (Spec #8)	15	0.00	0.00	0.00	0.00
2.e. To Dry Well or French Drain #2, Micro-Infiltration #2 (Spec #8)	15	0.00	0.00	0.00	0.00
2.f. To Rain Garden #1, Micro-Bioretention #1 (Spec #9)	40	0.00	0.00	0.00	0.00
2.g. To Rain Garden #2, Micro-Bioretention #2 (Spec #9)	60	0.00	0.00	0.00	0.00
2.h. To Rainwater Harvesting (Spec #6)	0	0.00	0.00	0.00	0.00
2.i. To Stormwater Planter, Urban Bioretention (Spec #9, Appendix A)	40	0.00	0.00	0.00	0.00
3. Permeable Pavement (RR)					
3.a. Permeable Pavement #1 (Spec #7)	25	0.00	0.00	0.00	0.00
3.b. Permeable Pavement #2 (Spec #7)	25		0.00	0.00	0.00
4. Grass Channel (RR)					
4.a. Grass Channel A/B Soils (Spec #3)	20	0.00	0.00	0.00	0.00
4.b. Grass Channel C/D Soils (Spec #3)	20	0.00	0.00	0.00	0.00
4.c. Grass Channel with Compost Amended Soils as per specs (see Spec #4)	20	0.00	0.00	0.00	0.00
5. Dry Swale (RR)					
5.a. Dry Swale #1 (Spec #10)	25	0.00	0.00	0.00	0.00
5.b. Dry Swale #2 (Spec #10)	35	0.00	0.00	0.00	0.00
6. Bioretention (RR)					
6.a. Bioretention #1 or Micro-Bioretention #1 or Urban Bioretention (Spec #9)	40	0.00	0.00	0.00	0.00
6.b. Bioretention #2 or Micro-Bioretention #2 (Spec #9)	60	0.00	44.90	41.31	3.59
7. Infiltration (RR)					
7.a. Infiltration #1 (Spec #8)	15	0.00	0.00	0.00	0.00
7.b. Infiltration #2 (Spec #8)	15	0.00	0.00	0.00	0.00
8. Extended Detention Pond (RR)					
8.a. ED #1 (Spec #15)	10	0.00	0.00	0.00	0.00
8.b. ED #2 (Spec #15)	10	0.00	0.00	0.00	0.00
9. Sheetflow to Filter/Open Space (RR)					
9.a. Sheetflow to Conservation Area, A/B Soils (Spec #2)	0	0.00	0.00	0.00	0.00
9.b. Sheetflow to Conservation Area, C/D Soils (Spec #2)	0	0.00	0.00	0.00	0.00
9.c. Sheetflow to Vegetated Filter Strip, A Soils or Compost Amended B/C/D Soils (Spec #2 & #4)	0	0.00	0.00	0.00	0.00

TOTAL IMPERVIOUS COVER TREATED (ac)	2.58	AREA CHECK: OK.
TOTAL MANAGED TURF AREA TREATED (ac)	1.52	AREA CHECK: OK.
TOTAL RUNOFF REDUCTION IN D.A. C (ft3)	8,001	
TOTAL PHOSPHORUS AVAILABLE FOR REMOVAL IN D.A. C (lb/yr)	8.67	
TOTAL PHOSPHORUS REMOVED WITH RUNOFF REDUCTION PRACTICES IN D.A. C (lb/yr)	5.65	
TOTAL PHOSPHORUS REMAINING AFTER APPLYING RUNOFF REDUCTION PRACTICES IN D.A. C (lb/yr)	3.02	

SEE WATER QUALITY COMPLIANCE TAB FOR SITE COMPLIANCE CALCULATIONS

TOTAL RUNOFF REDUCTION IN D.A. C (ft3)	8,001
NITROGEN REMOVED WITH RUNOFF REDUCTION PRACTICES IN D.A. C (lb/yr)	41.31

SEE WATER QUALITY COMPLIANCE TAB FOR SITE CALCULATIONS (Information Only)

10. Wet Swale (no RR)													
10.a. Wet Swale #1 (Spec #11)	0			0	0	0	0	20	0.00	0.00	0.00	0.00	
10.b. Wet Swale #2 (Spec #11)	0			0	0	0	0	40	0.00	0.00	0.00	0.00	

10. Wet Swale (Coastal Plain) (no RR)					
	25	0.00	0.00	0.00	0.00
	35	0.00	0.00	0.00	0.00

Summary Print

Virginia Runoff Reduction Method Worksheet

Drainage Area C

Southern half of apartment parking lot and Westernmost building

Total area: 5.15 acres

*Ask about requirement to be less than 50% impervious

Drainage Area A Land Cover (acres)

	A Soils	B Soils	C Soils	D Soils	Totals	Land Cover Rv
Forest/Open Space (acres)	0.00	0.00	0.00	0.00	0.00	0.00
Managed Turf (acres)	0.00	1.52	0.00	0.00	1.52	0.20
Impervious Cover (acres)	0.00	3.68	0.00	0.00	3.68	0.95
				Total	5.20	

CLEAR BMP AREAS

Total Phosphorus Available for Removal in D.A. C (lb/yr)	8.67
Post Development Treatment Volume in D.A. C (ft3)	13,794

Stormwater Best Management Practices (RR = Runoff Reduction)

--Select from dropdown lists--

Practice	Runoff Reduction Credit (%)	Managed Turf Credit Area (acres)	Impervious Cover Credit Area (acres)	Volume from Upstream Practice (ft3)	Runoff Reduction (ft3)	Remaining Runoff Volume (ft3)	Total BMP Treatment Volume (ft3)	Phosphorus Removal Efficiency (%)	Phosphorus Load from Upstream Practices (lb)	Untreated Phosphorus Load to Practice (lb)	Phosphorus Removed By Practice (lb)	Remaining Phosphorus Load (lb)	Downstream Practice to be Employed
11. Filtering Practices (no RR)													
11.a.Filtering Practice #1 (Spec #12)	0			0	0	0	0	60	0.00	0.00	0.00	0.00	
11.b. Filtering Practice #2 (Spec #12)	0			0	0	0	0	65	0.00	0.00	0.00	0.00	
12. Constructed Wetland (no RR)													
12.a.Constructed Wetland #1 (Spec #13)	0			0	0	0	0	50	0.00	0.00	0.00	0.00	
12.b. Constructed Wetland #2 (Spec #13)	0			0	0	0	0	75	0.00	0.00	0.00	0.00	
13. Wet Ponds (no RR)													
13.a. Wet Pond #1 (Spec #14)	0			0	0	0	0	50	0.00	0.00	0.00	0.00	
13.b. Wet Pond #1 (Coastal Plain) (Spec #14)	0			0	0	0	0	45	0.00	0.00	0.00	0.00	
13.c. Wet Pond #2 (Spec #14)	0			0	0	0	0	75	0.00	0.00	0.00	0.00	
13.d. Wet Pond #2 (Coastal Plain) (Spec #14)	0			0	0	0	0	65	0.00	0.00	0.00	0.00	
14. Manufactured Treatment Devices (no RR)													
14.a. Manufactured Treatment Device-Hydrodynamic	0			0	0	0	0	20	0.00	0.00	0.00	0.00	
14.b. Manufactured Treatment Device-Filtering	0		1.10	0	0	3,793	3,793	20	0.00	2.38	0.48	1.90	
14.c. Manufactured Treatment Device-Generic	0			0	0	0	0	20	0.00	0.00	0.00	0.00	

Practice	Nitrogen Removal Efficiency (%)	Nitrogen Load from Upstream Practices (lbs)	Untreated Nitrogen Load to Practice (lbs)	Nitrogen Removed By Practice (lbs)	Remaining Nitrogen Load (lbs)
11. Filtering Practices (no RR)					
11.a.Filtering Practice #1 (Spec #12)	30	0.00	0.00	0.00	0.00
11.b. Filtering Practice #2 (Spec #12)	45	0.00	0.00	0.00	0.00
12. Constructed Wetland (no RR)					
12.a.Constructed Wetland #1 (Spec #13)	25	0.00	0.00	0.00	0.00
12.b. Constructed Wetland #2 (Spec #13)	55	0.00	0.00	0.00	0.00
13. Wet Ponds (no RR)					
13.a. Wet Pond #1 (Spec #14)	30	0.00	0.00	0.00	0.00
13.b. Wet Pond #1 (Coastal Plain) (Spec #14)	20	0.00	0.00	0.00	0.00
13.c. Wet Pond #2 (Spec #14)	40	0.00	0.00	0.00	0.00
13.d. Wet Pond #2 (Coastal Plain) (Spec #14)	30	0.00	0.00	0.00	0.00
14. Manufactured BMP (no RR)					
14.a. Manufactured Treatment Device-Hydrodynamic	0	0.00	0.00	0.00	0.00
14.b. Manufactured Treatment Device-Filtering	0	0.00	17.03	0.00	17.03
14.c. Manufactured Treatment Device-Generic	0	0.00	0.00	0.00	0.00

TOTAL IMPERVIOUS COVER TREATED (ac)	3.68	AREA CHECK: OK.
TOTAL MANAGED TURF AREA TREATED (ac)	1.52	AREA CHECK: OK.
TOTAL PHOSPHORUS REMOVAL REQUIRED ON SITE (lb/yr)	20.28	
TOTAL PHOSPHORUS AVAILABLE FOR REMOVAL IN D.A. C (lb/yr)	8.67	
TOTAL PHOSPHORUS REMOVED WITHOUT RUNOFF REDUCTION PRACTICES IN D.A. C (lb/yr)	0.48	
TOTAL PHOSPHORUS REMOVED WITH RUNOFF REDUCTION PRACTICES IN D.A. C (lb/yr)	5.65	
TOTAL PHOSPHORUS LOAD REDUCTION ACHIEVED IN D.A. C (lb/yr)	6.12	
TOTAL PHOSPHORUS REMAINING AFTER APPLYING BMP LOAD REDUCTIONS IN D.A. C (lb/yr)	2.54	

SEE WATER QUALITY COMPLIANCE TAB FOR SITE COMPLIANCE CALCULATIONS

NITROGEN REMOVED WITH RUNOFF REDUCTION PRACTICES IN D.A. C (lb/yr)	41.31
NITROGEN REMOVED WITHOUT RUNOFF REDUCTION PRACTICES IN D.A. C (lb/yr)	0.00
TOTAL NITROGEN REMOVED IN D.A. C (lb/yr)	41.31

Summary Print

Virginia Runoff Reduction Method Worksheet

Drainage Area D

Northern half of site (draining to wet pond)

Drainage Area A Land Cover (acres)

	A Soils	B Soils	C Soils	D Soils	Totals	Land Cover Rv
Forest/Open Space (acres)	0.00	5.04	3.15	0.00	8.19	0.03
Managed Turf (acres)	0.00	2.52	8.20	0.00	10.72	0.26
Impervious Cover (acres)	0.00	5.04	1.26	0.00	6.30	0.95
				Total	25.21	

CLEAR BMP AREAS

Total Phosphorus Available for Removal in D.A. D (lb/yr): 20.07

Post Development Treatment Volume in D.A. D (ft3): 31,937

Stormwater Best Management Practices (RR = Runoff Reduction)

--Select from dropdown lists--

Practice	Runoff Reduction Credit (%)	Managed Turf Credit Area (acres)	Impervious Cover Credit Area (acres)	Volume from Upstream Practice (ft3)	Runoff Reduction (ft3)	Remaining Runoff Volume (ft3)	Total BMP Treatment Volume (ft3)	Phosphorus Removal Efficiency (%)	Phosphorus Load from Upstream Practices (lb)	Untreated Phosphorus Load to Practice (lb)	Phosphorus Removed By Practice (lb)	Remaining Phosphorus Load (lb)	Downstream Practice to be Employed
1. Vegetated Roof (RR)													
1.a. Vegetated Roof #1 (Spec #5)	45				0	0	0	0		0.00	0.00	0.00	
1.b. Vegetated Roof #2 (Spec #5)	60				0	0	0	0		0.00	0.00	0.00	
2. Rooftop Disconnection (RR)													
2.a. Simple Disconnection to A/B Soils (Spec #1)	50			0	0	0	0	0	0.00	0.00	0.00	0.00	
2.b. Simple Disconnection to C/D Soils (Spec #1)	25			0	0	0	0	0	0.00	0.00	0.00	0.00	
2.c. To Soil Amended Filter Path as per specifications (existing C/D soils) (Spec #4)	50			0	0	0	0	0	0.00	0.00	0.00	0.00	
2.d. To Dry Well or French Drain #1, Micro-Infiltration #1 (Spec #8)	50			0	0	0	0	25	0.00	0.00	0.00	0.00	
2.e. To Dry Well or French Drain #2, Micro-Infiltration #2 (Spec #8)	90			0	0	0	0	25	0.00	0.00	0.00	0.00	
2.f. To Rain Garden #1, Micro-Bioretention #1 (Spec #9)	40			0	0	0	0	25	0.00	0.00	0.00	0.00	
2.g. To Rain Garden #2, Micro-Bioretention #2 (Spec #9)	80			0	0	0	0	50	0.00	0.00	0.00	0.00	
2.h. To Rainwater Harvesting (Spec #6)	0			0	0	0	0	0	0.00	0.00	0.00	0.00	
2.i. To Stormwater Planter, Urban Bioretention (Spec #9, Appendix A)	40			0	0	0	0	25	0.00	0.00	0.00	0.00	
3. Permeable Pavement (RR)													
3.a. Permeable Pavement #1 (Spec #7)	45			0	0	0	0	25	0.00	0.00	0.00	0.00	
3.b. Permeable Pavement #2 (Spec #7)	75				0	0	0	25		0.00	0.00	0.00	
4. Grass Channel (RR)													
4.a. Grass Channel A/B Soils (Spec #3)	20			0	0	0	0	15	0.00	0.00	0.00	0.00	
4.b. Grass Channel C/D Soils (Spec #3)	10			0	0	0	0	15	0.00	0.00	0.00	0.00	
4.c. Grass Channel with Compost Amended Soils as per specs (see Spec #4)	20			0	0	0	0	15	0.00	0.00	0.00	0.00	
5. Dry Swale (RR)													
5.a. Dry Swale #1 (Spec #10)	40			0	0	0	0	20	0.00	0.00	0.00	0.00	
5.b. Dry Swale #2 (Spec #10)	60			0	0	0	0	40	0.00	0.00	0.00	0.00	
6. Bioretention (RR)													
6.a. Bioretention #1 or Micro-Bioretention #1 or Urban Bioretention (Spec #9)	40			0	0	0	0	25	0.00	0.00	0.00	0.00	
6.b. Bioretention #2 or Micro-Bioretention #2 (Spec #9)	80			0				50	0.00		0.00	0.00	
7. Infiltration (RR)													
7.a. Infiltration #1 (Spec #8)	50			0	0	0	0	25	0.00	0.00	0.00	0.00	
7.b. Infiltration #2 (Spec #8)	90			0	0	0	0	25	0.00	0.00	0.00	0.00	
8. Extended Detention Pond (RR)													
8.a. ED #1 (Spec #15)	0			0	0	0	0	15	0.00	0.00	0.00	0.00	
8.b. ED #2 (Spec #15)	15			0	0	0	0	15	0.00	0.00	0.00	0.00	
9. Sheetflow to Filter/Open Space (RR)													
9.a. Sheetflow to Conservation Area, A/B Soils (Spec #2)	75			0	0	0	0	0	0.00	0.00	0.00	0.00	
9.b. Sheetflow to Conservation Area, C/D Soils (Spec #2)	50			0	0	0	0	0	0.00	0.00	0.00	0.00	
9.c. Sheetflow to Vegetated Filter Strip, A Soils or Compost Amended B/C/D Soils (Spec #2 & #4)	50			0	0	0	0	0	0.00	0.00	0.00	0.00	

Practice	Nitrogen Removal Efficiency (%)	Nitrogen Load from Upstream Practices (lbs)	Untreated Nitrogen Load to Practice (lbs)	Nitrogen Removed By Practice (lbs)	Remaining Nitrogen Load (lbs)
1. Vegetated Roof (RR)					
1.a. Vegetated Roof #1 (Spec #5)	0		0.00	0.00	0.00
1.b. Vegetated Roof #2 (Spec #5)	0		0.00	0.00	0.00
2. Rooftop Disconnection (RR)					
2.a. Simple Disconnection to A/B Soils (Spec #1)	0	0.00	0.00	0.00	0.00
2.b. Simple Disconnection to C/D Soils (Spec #1)	0	0.00	0.00	0.00	0.00
2.c. To Soil Amended Filter Path as per specifications (existing C/D soils) (Spec #4)	0	0.00	0.00	0.00	0.00
2.d. To Dry Well or French Drain #1, Micro-Infiltration #1 (Spec #8)	15	0.00	0.00	0.00	0.00
2.e. To Dry Well or French Drain #2, Micro-Infiltration #2 (Spec #8)	15	0.00	0.00	0.00	0.00
2.f. To Rain Garden #1, Micro-Bioretention #1 (Spec #9)	40	0.00	0.00	0.00	0.00
2.g. To Rain Garden #2, Micro-Bioretention #2 (Spec #9)	60	0.00	0.00	0.00	0.00
2.h. To Rainwater Harvesting (Spec #6)	0	0.00	0.00	0.00	0.00
2.i. To Stormwater Planter, Urban Bioretention (Spec #9, Appendix A)	40	0.00	0.00	0.00	0.00
3. Permeable Pavement (RR)					
3.a. Permeable Pavement #1 (Spec #7)	25	0.00	0.00	0.00	0.00
3.b. Permeable Pavement #2 (Spec #7)	25		0.00	0.00	0.00
4. Grass Channel (RR)					
4.a. Grass Channel A/B Soils (Spec #3)	20	0.00	0.00	0.00	0.00
4.b. Grass Channel C/D Soils (Spec #3)	20	0.00	0.00	0.00	0.00
4.c. Grass Channel with Compost Amended Soils as per specs (see Spec #4)	20	0.00	0.00	0.00	0.00
5. Dry Swale (RR)					
5.a. Dry Swale #1 (Spec #10)	25	0.00	0.00	0.00	0.00
5.b. Dry Swale #2 (Spec #10)	35	0.00	0.00	0.00	0.00
6. Bioretention (RR)					
6.a. Bioretention #1 or Micro-Bioretention #1 or Urban Bioretention (Spec #9)	40	0.00	0.00	0.00	0.00
6.b. Bioretention #2 or Micro-Bioretention #2 (Spec #9)	60	0.00	143.37	0.00	143.37
7. Infiltration (RR)					
7.a. Infiltration #1 (Spec #8)	15	0.00	0.00	0.00	0.00
7.b. Infiltration #2 (Spec #8)	15	0.00	0.00	0.00	0.00
8. Extended Detention Pond (RR)					
8.a. ED #1 (Spec #15)	10	0.00	0.00	0.00	0.00
8.b. ED #2 (Spec #15)	10	0.00	0.00	0.00	0.00
9. Sheetflow to Filter/Open Space (RR)					
9.a. Sheetflow to Conservation Area, A/B Soils (Spec #2)	0	0.00	0.00	0.00	0.00
9.b. Sheetflow to Conservation Area, C/D Soils (Spec #2)	0	0.00	0.00	0.00	0.00
9.c. Sheetflow to Vegetated Filter Strip, A Soils or Compost Amended B/C/D Soils (Spec #2 & #4)	0	0.00	0.00	0.00	0.00

TOTAL IMPERVIOUS COVER TREATED (ac): 0.00 — AREA CHECK: OK.

TOTAL MANAGED TURF AREA TREATED (ac): 0.00 — AREA CHECK: OK.

TOTAL RUNOFF REDUCTION IN D.A. D (ft3): 0

TOTAL PHOSPHORUS AVAILABLE FOR REMOVAL IN D.A. D (lb/yr): 20.07

TOTAL PHOSPHORUS REMOVED WITH RUNOFF REDUCTION PRACTICES IN D.A. D (lb/yr): 0.00

TOTAL PHOSPHORUS REMAINING AFTER APPLYING RUNOFF REDUCTION PRACTICES IN D.A. D (lb/yr): 20.07

SEE WATER QUALITY COMPLIANCE TAB FOR SITE COMPLIANCE CALCULATIONS

TOTAL RUNOFF REDUCTION IN D.A. D (ft3): 0

NITROGEN REMOVED WITH RUNOFF REDUCTION PRACTICES IN D.A. D (lb/yr): 0.00

SEE WATER QUALITY COMPLIANCE TAB FOR SITE CALCULATIONS (Information Only)

10. Wet Swale (no RR)													
10.a. Wet Swale #1 (Spec #11)	0			0	0	0	0	20	0.00	0.00	0.00	0.00	
10.b. Wet Swale #2 (Spec #11)	0			0	0	0	0	40	0.00	0.00	0.00	0.00	
11. Filtering Practices (no RR)													
11.a.Filtering Practice #1 (Spec #12)	0			0	0	0	0	60	0.00	0.00	0.00	0.00	

10. Wet Swale (Coastal Plain) (no RR)					
10.a. Wet Swale #1 (Spec #11)	25	0.00	0.00	0.00	0.00
10.b. Wet Swale #2 (Spec #11)	35	0.00	0.00	0.00	0.00
11. Filtering Practices (no RR)					
11.a.Filtering Practice #1 (Spec #12)	30	0.00	0.00	0.00	0.00

Summary Print

Virginia Runoff Reduction Method Worksheet

Drainage Area D

Northern half of site (draining to wet pond)

Drainage Area A Land Cover (acres)

	A Soils	B Soils	C Soils	D Soils	Totals	Land Cover Rv
Forest/Open Space (acres)	0.00	5.04	3.15	0.00	8.19	0.03
Managed Turf (acres)	0.00	2.52	8.20	0.00	10.72	0.26
Impervious Cover (acres)	0.00	5.04	1.26	0.00	6.30	0.95
				Total	25.21	

CLEAR BMP AREAS

Total Phosphorus Available for Removal in D.A. D (lb/yr)	20.07
Post Development Treatment Volume in D.A. D (ft3)	31,937

Stormwater Best Management Practices (RR = Runoff Reduction)

--Select from dropdown lists--

Practice	Runoff Reduction Credit (%)	Managed Turf Credit Area (acres)	Impervious Cover Credit Area (acres)	Volume from Upstream Practice (ft3)	Runoff Reduction (ft3)	Remaining Runoff Volume (ft3)	Total BMP Treatment Volume (ft3)	Phosphorus Removal Efficiency (%)	Phosphorus Load from Upstream Practices (lb)	Untreated Phosphorus Load to Practice (lb)	Phosphorus Removed By Practice (lb)	Remaining Phosphorus Load (lb)	Downstream Practice to be Employed
11.b. Filtering Practice #2 (Spec #12)	0			0	0	0	0	65	0.00	0.00	0.00	0.00	
12. Constructed Wetland (no RR)													
12.a.Constructed Wetland #1 (Spec #13)	0			0	0	0	0	50	0.00	0.00	0.00	0.00	
12.b. Constructed Wetland #2 (Spec #13)	0			0	0	0	0	75	0.00	0.00	0.00	0.00	
13. Wet Ponds (no RR)													
13.a. Wet Pond #1 (Spec #14)	0			0	0	0	0	50	0.00	0.00	0.00	0.00	
13.b. Wet Pond #1 (Coastal Plain) (Spec #14)	0			0	0	0	0	45	0.00	0.00	0.00	0.00	
13.c. Wet Pond #2 (Spec #14)	0	10.72	6.30	0	0	31,933	31,933	75	0.00	20.04	15.03	5.01	
13.d. Wet Pond #2 (Coastal Plain) (Spec #14)	0			0	0	0	0	65	0.00	0.00	0.00	0.00	
14. Manufactured Treatment Devices (no RR)													
14.a. Manufactured Treatment Device-Hydrodynamic	0			0	0	0	0	20	0.00	0.00	0.00	0.00	
14.b. Manufactured Treatment Device-Filtering	0			0	0	0	0	20	0.00	0.00	0.00	0.00	
14.c. Manufactured Treatment Device-Generic	0			0	0	0	0	20	0.00	0.00	0.00	0.00	

Nitrogen Removal Efficiency (%)	Nitrogen Load from Upstream Practices (lbs)	Untreated Nitrogen Load to Practice (lbs)	Nitrogen Removed By Practice (lbs)	Remaining Nitrogen Load (lbs)
45	0.00	0.00	0.00	0.00
12. Constructed Wetland (no RR)				
25	0.00	0.00	0.00	0.00
55	0.00	0.00	0.00	0.00
13. Wet Ponds (no RR)				
30	0.00	0.00	0.00	0.00
20	0.00	0.00	0.00	0.00
40	0.00	143.37	57.35	86.02
30	0.00	0.00	0.00	0.00
14. Manufactured BMP (no RR)				
0	0.00	0.00	0.00	0.00
0	0.00	0.00	0.00	0.00
0	0.00	0.00	0.00	0.00

TOTAL IMPERVIOUS COVER TREATED (ac)	6.30	AREA CHECK: OK.
TOTAL MANAGED TURF AREA TREATED (ac)	10.72	AREA CHECK: OK.
TOTAL PHOSPHORUS REMOVAL REQUIRED ON SITE (lb/yr)	20.28	
TOTAL PHOSPHORUS AVAILABLE FOR REMOVAL IN D.A. D (lb/yr)	20.07	
TOTAL PHOSPHORUS REMOVED WITHOUT RUNOFF REDUCTION PRACTICES IN D.A. D (lb/yr)	15.03	
TOTAL PHOSPHORUS REMOVED WITH RUNOFF REDUCTION PRACTICES IN D.A. D (lb/yr)	0.00	
TOTAL PHOSPHORUS LOAD REDUCTION ACHIEVED IN D.A. D (lb/yr)	15.03	
TOTAL PHOSPHORUS REMAINING AFTER APPLYING BMP LOAD REDUCTIONS IN D.A. D (lb/yr)	5.04	

SEE WATER QUALITY COMPLIANCE TAB FOR SITE COMPLIANCE CALCULATIONS

NITROGEN REMOVED WITH RUNOFF REDUCTION PRACTICES IN D.A. D (lb/yr)	0.00
NITROGEN REMOVED WITHOUT RUNOFF REDUCTION PRACTICES IN D.A. D (lb/yr)	57.35
TOTAL NITROGEN REMOVED IN D.A. D (lb/yr)	57.35

Summary Print

Virginia Runoff Reduction Method Worksheet

Site Results (Water Quality Compliance)

Area Checks	D.A. A	D.A. B	D.A. C	D.A. D	D.A. E	AREA CHECK
FOREST/OPEN SPACE (ac)	0.00	0.00	0.00	8.19	#REF!	#REF!
IMPERVIOUS COVER (ac)	0.00	1.11	3.68	6.30	#REF!	#REF!
IMPERVIOUS COVER TREATED (ac)	4.99	1.11	3.68	6.30	#REF!	#REF!
MANAGED TURF AREA (ac)	0.00	1.66	1.52	10.72	#REF!	#REF!
MANAGED TURF AREA TREATED (ac)	0.46	1.66	1.52	10.72	#REF!	#REF!
AREA CHECK	AREA EXCEEDED!	AREA EXCEEDED!	OK.	OK.	#REF!	

Site Treatment Volume (ft3)	55,641

Runoff Reduction Volume and TP By Drainage Area

	D.A. A	D.A. B	D.A. C	D.A. D	D.A. E	TOTAL
RUNOFF REDUCTION VOLUME ACHIEVED (ft3)	0	4,026	8,001	0	#REF!	#REF!
TP LOAD AVAILABLE FOR REMOVAL (lb/yr)	0.00	3.16	8.67	20.07	#REF!	#REF!
TP LOAD REDUCTION ACHIEVED (lb/yr)	0.00	2.84	6.12	15.03	#REF!	#REF!
TP LOAD REMAINING (lb/yr)	0.00	0.32	2.54	5.04	#REF!	#REF!
NITROGEN LOAD REDUCTION ACHIEVED (lb/yr)	0.00	20.79	41.31	57.35	#REF!	#REF!

Total Phosphorus

FINAL POST-DEVELOPMENT TP LOAD (lb/yr)	34.96	
TP LOAD REDUCTION REQUIRED (lb/yr)	20.28	
TP LOAD REDUCTION ACHIEVED (lb/yr)	#REF!	
TP LOAD REMAINING (lb/yr):	#REF!	
REMAINING TP LOAD REDUCTION REQUIRED (lb/yr):	#REF!	#REF!
	#REF!	

Total Nitrogen (For Information Purposes)

POST-DEVELOPMENT LOAD (lb/yr)	250.09
NITROGEN LOAD REDUCTION ACHIEVED (lb/yr)	#REF!
REMAINING POST-DEVELOPMENT NITROGEN LOAD (lb/yr)	#REF!

Summary Print

Virginia Runoff Reduction Method Worksheet

Runoff Volume and Curve Number Calculations

Enter design storm rainfall depths (in):

1-year storm	2-year storm	10-year storm
0.00	0.00	0.00

Use NOAA Atlas 14 (http://hdsc.nws.noaa.gov/hdsc/pfds/)

***Notes (see below):**

[1] The curve numbers and runoff volumes computed in this spreadsheet for each drainage area are limited in their applicability for determining and demonstrating compliance with water quantity requirements. See VRRM User's Guide and Documentation for additional information.

[2] Runoff Volume (RV) for pre- and post-development drainage areas must be in volumetric units (e.g., acre-feet or cubic feet) when using the Energy Balance Equation. Runoff measured in watershed-inches and shown in the spreadsheet as RV(watershed-inch) can only be used in the Energy Balance Equation when the pre- and post-development drainage areas are equal. Otherwise RV(watershed-inch) must be multiplied by the drainage area.

[3] Adjusted CNs are based on runoff reduction volumes as calculated in D.A. tabs. An alternative CN adjustment calculation for Vegetated Roofs is included in BMP specification No. 5.

Drainage Area Curve Numbers and Runoff Depths*

Curve numbers (CN, CNadj) and runoff depths (RVDeveloped) are computed with and without reduction practices.

Drainage Area A		A Soils	B Soils	C Soils	D Soils	
Forest/Open Space -- undisturbed, protected forest/open space or reforested land	Area (acres)	0.00			0.00	Total Area (acres): 0.00
	CN	30	55	70	77	Runoff Reduction Volume (ft3): 0
Managed Turf -- disturbed, graded for yards or other turf to be mowed/managed	Area (acres)	0.00			0.00	
	CN	39	61	74	80	
Impervious Cover	Area (acres)	0.00			0.00	
	CN	98	98	98	98	
					CN(D.A. A)	
					0	

	1-year storm	2-year storm	10-year storm
RVDeveloped *(watershed-inch)* with no Runoff Reduction*	0.00	0.00	0.00
RVDeveloped *(watershed-inch)* with Runoff Reduction*	0.00	0.00	0.00
Adjusted CN*	0	0	0

**See Notes above*

Drainage Area B		A Soils	B Soils	C Soils	D Soils	
Forest/Open Space -- undisturbed, protected forest/open space or reforested land	Area (acres)	0.00	0.00	0.00	0.00	Total Area (acres): 2.77
	CN	30	55	70	77	Runoff Reduction Volume (ft3): 4,026
Managed Turf -- disturbed, graded for yards or other turf to be mowed/managed	Area (acres)	0.00	1.66	0.00	0.00	
	CN	39	61	74	80	
Impervious Cover	Area (acres)	0.00	1.11	0.00	0.00	
	CN	98	98	98	98	
					CN(D.A. B)	
					76	

	1-year storm	2-year storm	10-year storm
RVDeveloped *(watershed-inch)* with no Runoff Reduction*	0.00	0.00	0.00
RVDeveloped *(watershed-inch)* with Runoff Reduction*	0.00	0.00	0.00
Adjusted CN*	100	100	100

**See Notes above*

Drainage Area C		A Soils	B Soils	C Soils	D Soils	
Forest/Open Space -- undisturbed, protected forest/open space or reforested land	Area (acres)	0.00	0.00	0.00	0.00	Total Area (acres): 5.20
	CN	30	55	70	77	Runoff Reduction Volume (ft3): 8,001
Managed Turf -- disturbed, graded for yards or other turf to be mowed/managed	Area (acres)	0.00	1.52	0.00	0.00	
	CN	39	61	74	80	
Impervious Cover	Area (acres)	0.00	3.68	0.00	0.00	
	CN	98	98	98	98	
					CN(D.A. C)	
					87	

	1-year storm	2-year storm	10-year storm
RVDeveloped *(watershed-inch)* with no Runoff Reduction*	0.00	0.00	0.00
RVDeveloped *(watershed-inch)* with Runoff Reduction*	0.00	0.00	0.00
Adjusted CN*	100	100	100

**See Notes above*

Drainage Area D		A Soils	B Soils	C Soils	D Soils	
Forest/Open Space -- undisturbed, protected forest/open space or reforested land	Area (acres)	0.00	5.04	3.15	0.00	Total Area (acres): 25.21
	CN	30	55	70	77	Runoff Reduction Volume (ft3): 0
Managed Turf -- disturbed, graded for yards or other turf to be mowed/managed	Area (acres)	0.00	5.04	8.20	0.00	
	CN	39	61	74	80	

Virginia Runoff Reduction Method Worksheet

Impervious Cover	Area (acres)	0.00	#REF!	1.26	0.00
	CN	98	98	98	98

CN(D.A. D)
#REF!

	1-year storm	2-year storm	10-year storm
RVDeveloped *(watershed-inch)* with no Runoff Reduction*	#REF!	#REF!	#REF!
RVDeveloped *(watershed-inch)* with Runoff Reduction*	#REF!	#REF!	#REF!
Adjusted CN*	**#REF!**	**#REF!**	**#REF!**

See Notes above

Drainage Area E		**A Soils**	**B Soils**	**C Soils**	**D Soils**
Forest/Open Space -- undisturbed, protected forest/open space or reforested land	Area (acres)	#REF!	#REF!	#REF!	#REF!
	CN	30	55	70	77
Managed Turf -- disturbed, graded for yards or other turf to be mowed/managed	Area (acres)	#REF!	#REF!	#REF!	#REF!
	CN	39	61	74	80
Impervious Cover	Area (acres)	#REF!	#REF!	#REF!	#REF!
	CN	98	98	98	98

CN(D.A. E)
#REF!

	1-year storm	2-year storm	10-year storm
RVDeveloped *(watershed-inch)* with no Runoff Reduction*	#REF!	#REF!	#REF!
RVDeveloped *(watershed-inch)* with Runoff Reduction*	#REF!	#REF!	#REF!
Adjusted CN*	**#REF!**	**#REF!**	**#REF!**

See Notes above

Total Area (acres):	#REF!
Runoff Reduction Volume (ft3):	#REF!

Summary Print

Virginia Runoff Reduction Method Worksheet

DEQ Virginia Runoff Reduction Method New Development Compliance Spreadsheet - Version 3.0

BMP Design Specifications List: **2013 Draft Stds & Specs**

Site Summary

Project Title: Old Ivy Road Mixed-Use Development

Date: 45393

Total Rainfall = 43 inches

Site Land Cover Summary

	A soils	B Soils	C Soils	D Soils	Totals	% of Total
Forest/Open (acres)	0.00	5.04	3.15	0.00	8.19	23
Managed Turf (acres)	0.00	6.34	8.80	0.00	15.14	42
Impervious Cover (acres)	0.00	10.61	1.86	0.00	12.47	35
					35.80	100

Site Tv and Land Cover Nutrient Loads

Site Rv	0.43
Treatment Volume (ft3)	55,641
TP Load (lb/yr)	34.96
TN Load (lb/yr)	250.09

Total TP Load Reduction Required (lb/yr)	20.28

Site Compliance Summary

Total Runoff Volume Reduction (ft3)	#REF!
Total TP Load Reduction Achieved (lb/yr)	#REF!
Total TN Load Reduction Achieved (lb/yr)	#REF!
Remaining Post Development TP Load (lb/yr)	0.00
Remaining TP Load Reduction (lb/yr) Required	**#REF!**

#REF!

#REF!
#REF! ***Errors on D.A. tab(s)***

Drainage Area Summary

	D.A. A	D.A. B	D.A. C	D.A. D	D.A. E	Total	
Forest/Open (acres)	0.00	0.00	0.00	8.19	#REF!	#REF!	***#REF!***
Managed Turf (acres)	0.00	1.66	1.52	10.72	#REF!	#REF!	***#REF!***
Impervious Cover (acres)	0.00	1.11	3.68	6.30	#REF!	#REF!	***#REF!***
Total Area (acres)	**0.00**	**2.77**	**5.20**	**25.21**	**#REF!**	**#REF!**	
	D.A. A Errors!	D.A. B Errors!			#REF!		

Drainage Area Compliance Summary

	D.A. A	D.A. B	D.A. C	D.A. D	D.A. E	Total
TP Load Reduced (lb/yr)	0.00	2.84	6.12	15.03	#REF!	#REF!
TN Load Reduced (lb/yr)	0.00	20.79	41.31	57.35	#REF!	#REF!

Summary Print

Virginia Runoff Reduction Method Worksheet

Drainage Area A Summary

Land Cover Summary

	A Soils	B Soils	C Soils	D Soils	Total	% of Total
Forest/Open (acres)	0.00			0.00	0.00	0
Managed Turf (acres)	0.00			0.00	0.00	0
Impervious Cover (acres)	0.00			0.00	0.00	0
					0.00	

BMP Selections

Practice	Managed Turf	Impervious Cover	BMP Treatment	TP Load from	Untreated TP Load	TP Removed	TP Remaining	Downstream

Total Impervious Cover Treated (acres)	4.99
Total Turf Area Treated (acres)	0.46
Total TP Load Reduction Achieved in D.A.	0.00
Total TN Load Reduction Achieved in D.A.	0.00

Drainage Area B Summary

Land Cover Summary

	A Soils	B Soils	C Soils	D Soils	Total	% of Total
Forest/Open (acres)	0.00	0.00	0.00	0.00	0.00	0
Managed Turf (acres)	0.00	1.66	0.00	0.00	1.66	60
Impervious Cover (acres)	0.00	1.11	0.00	0.00	1.11	40
					2.77	

BMP Selections

Practice	Managed Turf	Impervious Cover	BMP Treatment	TP Load from	Untreated TP Load	TP Removed	TP Remaining	Downstream

Total Impervious Cover Treated (acres)	1.11
Total Turf Area Treated (acres)	1.66
Total TP Load Reduction Achieved in D.A.	2.84
Total TN Load Reduction Achieved in D.A.	20.79

Drainage Area C Summary

Land Cover Summary

	A Soils	B Soils	C Soils	D Soils	Total	% of Total
Forest/Open (acres)	0.00	0.00	0.00	0.00	0.00	0
Managed Turf (acres)	0.00	1.52	0.00	0.00	1.52	29
Impervious Cover (acres)	0.00	3.68	0.00	0.00	3.68	71
					5.20	

BMP Selections

Practice	Managed Turf	Impervious Cover	BMP Treatment	TP Load from	Untreated TP Load	TP Removed	TP Remaining	Downstream

Summary Print

Virginia Runoff Reduction Method Worksheet

Total Impervious Cover Treated (acres)	3.68
Total Turf Area Treated (acres)	1.52
Total TP Load Reduction Achieved in D.A.	6.12
Total TN Load Reduction Achieved in D.A.	41.31

Drainage Area D Summary

Land Cover Summary

	A Soils	B Soils	C Soils	D Soils	Total	% of Total
Forest/Open (acres)	0.00	5.04	3.15	0.00	8.19	32
Managed Turf (acres)	0.00	5.04	8.20	0.00	10.72	43
Impervious Cover (acres)	0.00	#REF!	1.26	0.00	6.30	25
					25.21	

BMP Selections

Practice	Managed Turf	Impervious Cover	BMP Treatment	TP Load from	Untreated TP Load	TP Removed	TP Remaining	Downstream

Total Impervious Cover Treated (acres)	6.30
Total Turf Area Treated (acres)	10.72
Total TP Load Reduction Achieved in D.A.	15.03
Total TN Load Reduction Achieved in D.A.	57.35

Drainage Area E Summary

Land Cover Summary

#REF!

	A Soils	B Soils	C Soils	D Soils	Total	% of Total
Forest/Open (acres)	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
Managed Turf (acres)	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
Impervious Cover (acres)	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!
					#REF!	

BMP Selections

Practice	Managed Turf	Impervious Cover	BMP Treatment	TP Load from	Untreated TP Load	TP Removed	TP Remaining	Downstream

Total Impervious Cover Treated (acres)	#REF!
Total Turf Area Treated (acres)	#REF!
Total TP Load Reduction Achieved in D.A.	#REF!
Total TN Load Reduction Achieved in D.A.	#REF!

Runoff Volume and CN Calculations

	1-year storm	2-year storm	10-year storm
Target Rainfall Event (in)	0.00	0.00	0.00

Drainage Areas	RV & CN	Drainage Area A	Drainage Area B	Drainage Area C	Drainage Area D	Drainage Area E
CN		0	76	87	#REF!	#REF!
RR (ft3)		0	4,026	8,001	0	#REF!

Summary Print

Virginia Runoff Reduction Method Worksheet

1-year return period	**RV wo RR (ws-in)**	0.00	0.00	0.00	#REF!	#REF!
	RV w RR (ws-in)	0.00	0.00	0.00	#REF!	#REF!
	CN adjusted	0	100	100	#REF!	#REF!
2-year return period	**RV wo RR (ws-in)**	0.00	0.00	0.00	#REF!	#REF!
	RV w RR (ws-in)	0.00	0.00	0.00	#REF!	#REF!
	CN adjusted	0	100	100	#REF!	#REF!
10-year return period	**RV wo RR (ws-in)**	0.00	0.00	0.00	#REF!	#REF!
	RV w RR (ws-in)	0.00	0.00	0.00	#REF!	#REF!
	CN adjusted	0	100	100	#REF!	#REF!

Summary Print

Trade	Subcontractor	Distance
Division 02 - Existing Conditions	Four Square Industrial Contractors	1 hr 30 min
Division 03 - Concrete	Piedmont Concrete Contractor	7 min
	Casey Concrete Inc.	25 min
Division 04 - Masonry	MH Masonry & Associates	1 hr 5 min
	M3, Inc.	9 min
Division 05 - Metals	Wrights Iron Inc.	41 min
	Southern Structural Steel	2 hr 30 min
Division 06 - Wood, Plastics, Composites	Karn Custom Woodwork	1 hr 8 min
	Aaron & Co. Millwork	8 min
Division 07 - Thermal and Moisture Protection	W A Lynch Roofing Co	9 min
	Paramount Builders	52 min
	Powell and Sons Waterproofing	1 hr 55 min
Division 08 - Openings	Pella Windows and Doors	7 min
	Champion Windows	1 hr 8 min
	Architectural Products of Virginia	1 hr 7 min
Division 09 - Finishes	Palacios Painting	7 min
	Floor Center Inc.	1 hr 44 min
	Carpet Plus	8 min
Division 10 - Specialties	Steiner B. Moore Corp.	2 hr 40 min
Division 11 - Equipment	M3, Inc.	9 min
Division 12 - Furnishings	Albemarle Stoneworks	7 min
	Richard A Olivia & Sons	8 min
Division 14 - Conveying Equipment	Otis Elevator	9 min
Division 21 - Fire Suppression	Riley Fire Protection	1 hr 8 min
	Anne Arundel Fire Protection Inc	2 hr 43 min
Division 22 - Plumbing	Moore's Electrical & Mechanical	13 min
	W.E. Brown	12 min
Division 23 - Heating, Ventilating,	Moore's Electrical & Mechanical	13 min
and Air Conditioning (HVAC)	W.E. Brown	12 min
Division 26 - Electrical	Moore's Electrical & Mechanical	13 min
	Robertson Electrical	8 min
Division 27 - Communications	Design Telecommunication	10 min
Division 31 - Earthwork	Faulconer	3 min
	Southwest excavating	2 hr 9 min
Division 32 - Exterior Improvements	Hero Paving	8 min
	Roger Robertson Paving	22 min
Division 33 - Utilities	Perkinson Construction LLC.	1 hr 41 min

LANDSCAPING SCOPING DOCUMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 32 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
    1. Provide all materials and equipment, including all work necessary to complete planting of trees, shrubs, ground covers, perennials, annuals, and bulbs.
    2. Provide all materials and equipment, including all work necessary to install hardscapes.
    3. Sampling and testing of topsoil, loam borrow, sand based structural soil and planting soil
    4. Perform required maintenance activities on all included features as specified

1.3 UNIT PRICES

A. Work of this Section is affected by unit prices for all plants, soil elements, and hardscapes specified in DOC “Unit Prices”.
B. Quantity allowances for all elements are included in DOC “Allowances”.

1.4 DEFINITIONS

A. Finish Grade: Elevation of finished surfaces.
B. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.
C. Planting Soil: In this section, unless stated otherwise, "Planting Soil" refers to soil that has been blended off-site and modified with components and amendments to match the specific mix recommendations provided by the testing laboratory.
D. Loam: Soil composed of a mixture of particles, usually with nearly equal proportions of sand, silt, and clay, along with organic material

1.5 ACTION SUBMITTALS

A. Product Data: For each type of the following manufactured products required:
    1. Fertilizer
    2. Fungicide
    3. Herbicide
    4. Insecticide

5. Organic Compost
6. Anti-Desiccant
7. Gravel
8. Pavers

B. Samples for Verification: For the following products, sizes indicated as in product data:
    1. Mulch
    2. Organic Compost
    3. Topsoil
    4. Planting Soil
    5. Gravel
    6. Brick Pavers

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For the landscaping subcontractor. Include list of similar projects completed by subcontractor demonstrating subcontractor's capabilities and experience. Include project names, addresses, and year completed, and include names and addresses of owners' contact persons.
    1. Submit qualification data for pesticide applier including state licensure for substances restricted by law

B. Material Test Reports: For each soil material and gravel proposed, must meet classification requirements
C. Product Certificates: For each type of manufactured product, from manufacturer, and complying with the following:
    1. Manufacturer's certified analysis of standard products.
    2. Analysis of other materials by a recognized laboratory made according to methods established by the Association of Official Analytical Chemists, where applicable.
    3. Submit documentation to owner for all fertilizers, lime, herbicides, and pesticides
D. Pesticides and Herbicides: Product label and manufacturer's application instructions specific to project.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Landscape installer with proven expertise, whose work consistently leads to the successful establishment of plants
    1. Professional Membership Requirement: The installer must hold active membership in either the Professional Landcare Network or the American Nursery and Landscape Association, with a good standing status.

2. Experience: Three years experience in landscape installation in addition to requirements
3. Field Supervision: It is mandatory for the installer to have an experienced full-time supervisor present on the project site during the course of work.
4. Pesticide Applicator: State licensed, commercial.

B. Ensure that the plants provided meet the specified quality, size, genus, species, and variety, in accordance with the relevant provisions outlined in ANSI Z60.1.
C. Measurements: Follow the guidelines set forth in ANSI Z60.1 for accurate measurements. Avoid pruning to achieve the necessary sizes.

1.8 PROJECT CONDITIONS

A. All plants and lawn components must be protected from damage at all times. Those that are damaged must be replaced, repaired, or modified to meet specifications.
B. While construction is ongoing, all facilities and existing/newly landscaped areas must be protected from damage. Any damaged components will restored to their original condition.
C. All work areas will be well maintained and kept both clean and orderly while installation is taking place to prevent any safety hazards on the site or adjacent property.

PART 2 - PRODUCTS

2.1 PLANTS

A. The drawings contain a comprehensive inventory of plant materials detailing quantities, sizes, and root conditions. In the event of any discrepancies between the plant list and the drawings, the information presented in the drawings will be considered authoritative for determining quantities.
B. Plants must be of vigorous health, devoid of any diseases, insect pests, as well as their eggs and larvae.
C. Planting plans are presented in diagrammatic form. The contractor is responsible for ensuring an adequate supply of plant materials to meet the design specifications outlined in the drawings, and must confirm the required quantities before bidding or ordering plant materials.

2.2 SOIL

A. The soil should naturally be fertile and classified as sandy loam to silty loam, supporting the growth of turf and plants. It should be consistent in composition, without any subsoil, clay lumps, stones larger than 1 inch in diameter (or ¾ inch for athletic field uses), roots, trash, or debris.

B. Soil shall be of satisfactory quality free of rock or gravel larger than specified in drawings in any dimension, debris, waste, frozen materials, vegetation, and other damaging matter.

2.3 FERTILIZER

A. Granular, non-burning product composed of not less than fifty (50) percent slow-acting, guaranteed analysis fertilizer. Fertilizer shall be specified in the contract documents as to composition but is subject to revision to suit project site conditions.

2.4 MULCH

A. The mulch must consist of 100% fine-shredded pine bark or double shredded, aged hardwood mulch, commonly found in the Charlottesville area. It should be uniform in size and free from rot, leaves, twigs, debris, stones, or any materials harmful to plant growth. The bark used for mulch must have been shredded and stockpiled for a minimum of six months and a maximum of two years before application. No chunks larger than 3 inches or thicker than 1/4 inch should remain on site.

2.5 HARDSCAPES

A. Specify the types of materials, such as concrete pavers or natural stone, and detail their quality, including strength, color, and texture. Provide clear installation instructions, covering subgrade preparation, base layers, and laying techniques to ensure proper construction. Additionally, outline dimensions, patterns, and layouts for hardscape features, ensuring precision and alignment with design specifications.
B. Address grading and drainage requirements to prevent water accumulation and ensure proper runoff away from structures. Specify finishes and sealants to enhance durability and aesthetics, and include maintenance guidelines to prolong the lifespan of hardscape surfaces. Finally, ensure compliance with accessibility and safety standards for pedestrian and vehicular use, and establish procedures for quality control, including inspections and warranty requirements, to uphold project standards.

PART 3 - EXECUTION

3.1 PREPARATION

A. Throughout construction, ensure the protection of all structures, utilities, sidewalks, pavements, and existing and newly installed vegetated areas from any potential damage.
B. Postpone grading and topsoil spreading if adverse weather conditions could lead to washouts or material loss.

C. For existing vegetated areas unaffected by excavation or grading, follow these steps: Remove all existing vegetation without mixing it into the surface soil. Loosen the topsoil to a depth of at least 4 inches, and remove stones larger than 1 inch, as well as sticks, roots, rubbish, and any other debris, disposing of them off the Owner's property legally.
D. Plant materials in temporary storage or transit should be handled according to detailed specifications to preserve their integrity and health.

3.2 PLACING PLANTING MIXTURE

A. Remove existing soil as required to accommodate the proposed planting mixture depth.
B. Provide the specified depth of planting mixture (8 to x inches as indicated on drawings) in perennial, annual, and bulb planting areas, ensuring it is not placed over saturated or frozen subgrade soil.

3.3 PLANTING TREES AND SHRUBS

A. Planting pits for individual trees and shrubs should be approximately 3 times the diameter of the root ball, while those for shrub mass-planting areas should extend at least 12 inches beyond the combined root ball area.
B. Bare root plant pits should match the diameter of the fully extended root system, with the uppermost roots placed just below finish grade, and smeared or smoothed sides should be scarified or loosened during excavation.
C. Ensure the root ball is set on firm undisturbed soil, with the root ball flare positioned 1 inch above the finished planting soil grade, and remove all wrappings, wire baskets, and non-biodegradable burlap from root balls before planting.
D. Trees and shrubs should be carried and set in pits by the root ball, with each plant placed straight and upright in the center of the hole and the most desirable face toward the most prominent view.
E. Backfill pits with native excavated soil or planting mixture, ensuring frozen soil is not used, and tamp down and water the soil when approximately two-thirds backfilled to eliminate air pockets, before forming a saucer around the outer rim of the pit and finishing the grading to the required elevations after plants have fully settled.

3.4 PLACING HARDSCAPES

A. Install hardscape materials according to the specified layout and patterns, ensuring precise alignment and spacing between elements.
B. Use appropriate techniques and equipment to set and secure hardscape features, such as concrete pavers, natural stone, or brick, ensuring stability and longevity.
C. Apply finishes or sealants as necessary to enhance durability and aesthetics, and conduct thorough inspections to ensure compliance with design specifications and quality standards.

3.5 PLANTING PERENNIALS, ANNUALS, AND BULBS

A. Ensure planting beds are pitched to drain away from buildings for proper water management.
B. Keep herbaceous plants at least 18 inches away from tree or shrub trunks and 8 inches from the edge of the bed.
C. For small quantities of bulbs, drive planting holes through mulch using a bulb planter or hand trowel, ensuring the basal plate faces downward before covering with soil and mulch. For larger quantities, excavate designated areas to the specified planting depth, placing bulbs with their basal plates facing downward, and then cover with soil and mulch. Thoroughly water plants immediately after planting and before mulching to promote healthy growth.

3.7 FERTILIZER APPLICATION

A. Apply fertilizer evenly and according to the recommended application rates specified in the landscaping plan, ensuring uniform coverage across the planting area.
B. Use appropriate methods, such as broadcasting or targeted application around plant roots, to ensure efficient nutrient uptake and promote healthy growth.
C. Avoid over-application of fertilizer, which can lead to nutrient imbalances or environmental runoff, and follow any specific timing or frequency guidelines outlined in the landscaping plan.

3.8 MULCHING

A. Apply mulch evenly to the specified depth, ensuring coverage around plants while avoiding direct contact with stems or trunks.
B. Maintain mulch at the recommended thickness and replenish as needed to retain moisture, suppress weeds, and regulate soil temperature.

3.9 MAINTENANCE

A. Conduct regular inspections of plants and hardscape elements to identify any signs of damage, disease, or deterioration, addressing issues promptly to prevent further damage.
B. Implement a consistent watering schedule based on plant needs and weather conditions, ensuring adequate moisture for plant health and vitality.
C. Prune plants as needed to maintain shape, promote airflow, and remove dead or diseased branches, using appropriate tools and techniques to minimize stress and damage.
D. Monitor hardscape elements for signs of wear, erosion, or displacement, repairing or replacing materials as necessary to ensure structural integrity and aesthetic appeal.
E. Apply fertilizers, mulch, and other amendments as specified in the landscaping plan to promote healthy plant growth and maintain soil fertility.

F. Keep planting beds and hardscape surfaces free of weeds, debris, and litter through regular maintenance activities such as weeding, sweeping, and debris removal, enhancing the overall appearance and functionality of the landscape.

Construction Subcontractor Short List	4/2024	5/2024	6/2024	7/2024	8/2024	9/2024	10/2024	11/2024	12/2024	1/2025	2/2025	3/2025
Preconstruction												
SD												
50% CDs												
90%CDs												
100% CDs												
Team Selection												
Subcontractor Buyout												
Sitework & Structures												
Surveying												
Sitework												
Foundations												
Framing												
Slab on Deck												
Skin												
Interiors												
MEP												
Wall rough ins												
Insulation/drywall												
Interior finishes												
Doors & specialties												
Inspection & Closeout												
Inspections												
Landscaping												
Punch list												
Turnover												

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Preconstruction												
SD												
50% CDs												
90%CDs												
100% CDs												
Team Selection												
Subcontractor Buyout												
Sitework & Structures												
Surveying												
Sitework												
Foundations												
Framing												
Slab on Deck												
Skin												
Interiors												
MEP												
Wall rough ins												
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