Land Use/Transportation Evaluation for the Forest Drive Corridor

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An initiative of the National Center for Smart Growth

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Executive Summary

The 3.5-mile Forest Drive corridor is a County arterial road within the City of Annapolis and extending into Anne Arundel County at either side of the municipal boundary (see Figures 1 and 2). While the County is responsible for the road – its potential expansion and maintenance – the City is responsible for land uses in the corridor, thus setting up potential conflicts over policies, costs and responsibilities. Because this corridor has been subject to development and redevelopment activities and pressures for some time, recently large residential planned unit developments (PUDs), the City is interested in its capacity**.** Standard traffic studies have been commissioned to address congestion mitigation and identify engineering and other options. These include a 2015 Traffic Concepts study and 2016 County Major Intersections/Important Facilities (MIIF) study. The abutting land uses have been assumed to be relatively stable and predictable in these studies. This is not a reasonable assumption, however, given the continued development pressures. How much of what kind of development might be the straw that breaks the camel's back? This is an unanswered and important question. This project sought to answer this question by creating a transportation/land use analysis tool that is applied to parcels in this corridor but is also, in principle, applicable to other corridors.

Because this is a joint City/County project, it is viewed as an opportunity to bring these jurisdictions together over a difficult topic. The work in this project used the GIS land use database developed for the City by PALS during the summer of 2016 and applied the sketch software tool CommunityViz to the GIS databases to produce a tool that can generate various land use/transportation alternatives and their transportation impacts.

Key findings of this study were:

- Roughly 324 parcels out of over 3,500 within the chosen study area are suitable for redevelopment based on their existing land uses.
- A simplified maximum build-out of allowable uses might add nearly 7,000 new morning peak trips and almost 8,000 afternoon peak trips to the corridor, which differs significantly from the growth in daily traffic volumes projected by the 2016 MIFF.
- Given the current Level of Service issues already faced in this area of the City, land use and transportation planning must proceed cautiously in the years ahead to avoid worsening congestion and gridlock on Forest Drive.

Existing Conditions

The corridor is shown in context in Figure 1. Figures 2 through 4 show the study area, current land use, and road classifications. Figure 5 shows the current level of service on the corridor in the morning and evening rush hour, derived from the Maryland Statewide Transportation Model (MSTM) (National Center for Smart Growth, 2016). These show severe congestion (LOS F) in 2012 (baseline year for the model) on much of the corridor and on adjacent roads. Table 1 provides the data sources used in this study.

Methodology and Process

The methodology was driven by study objectives:

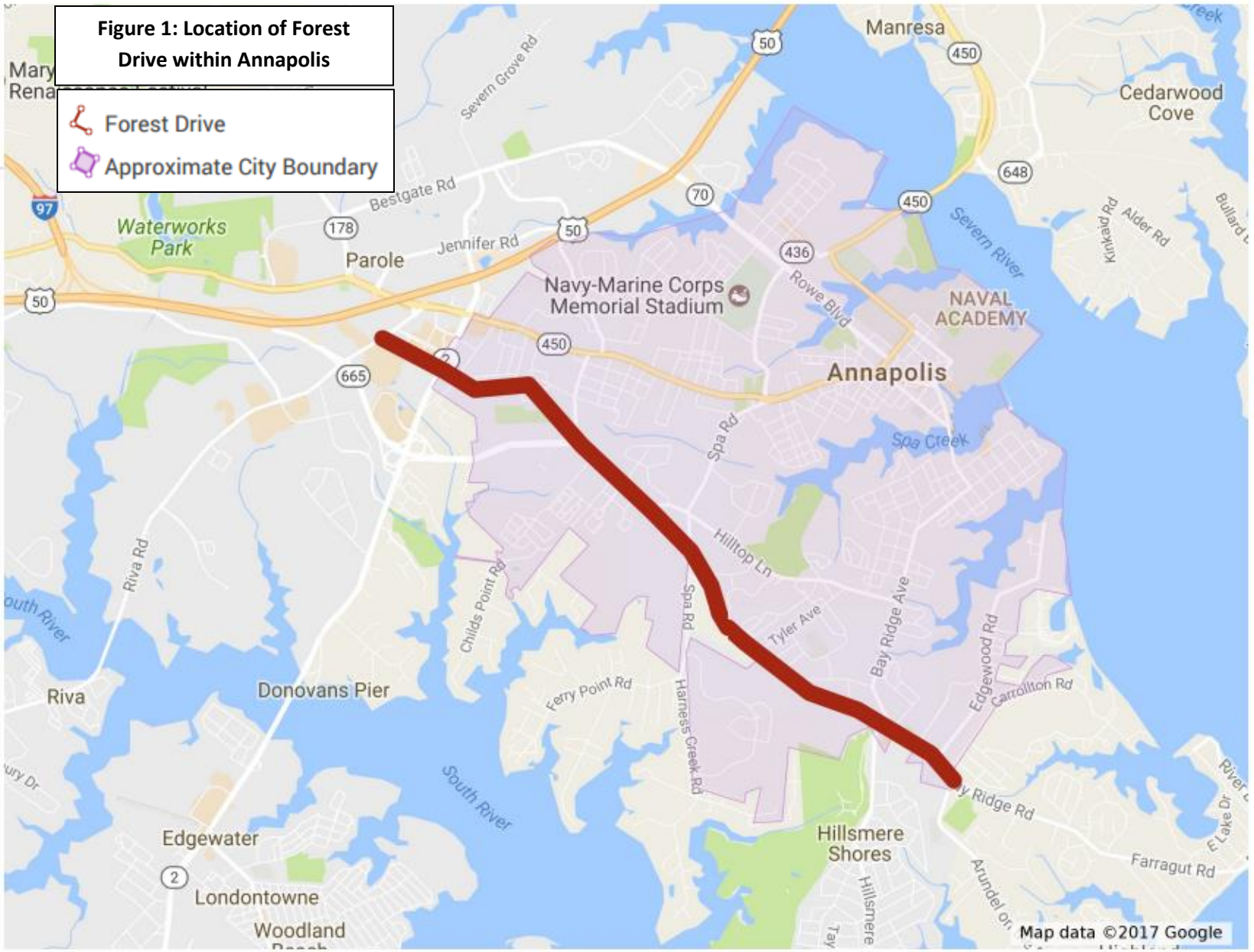
- Assess the potential and need for expansion of Forest Drive as a result of assumed land use changes on adjacent parcels within City boundaries,
- Identify parcels most suitable for new development or redevelopment and generate an alternative development scenario using CommunityViz sketch software,
- Develop a build-out analysis procedure that is applied to parcels in this corridor, and can also be applied to other city corridors, and
- Estimate corresponding traffic patterns in different time of day that is associated with potential new development or redevelopment in the city.

Tasks, methodology and responsibilities for this project included the following:

Technology Access

The City purchased a CommunityViz license (3 seats) that covered a 5-month student CommunityViz license, which was installed on a UMD campus device. Training was conducted by Paul Patnode (Planning Technology Lead, Maryland-National Capital Parks and Planning Commission) of City staff (Sally Nash, Chief of Comprehensive Planning) and the independent study student (Derek Lombardi) and occurred over two sessions in August 2016.

Figure 1: Location of Forest Drive within Annapolis



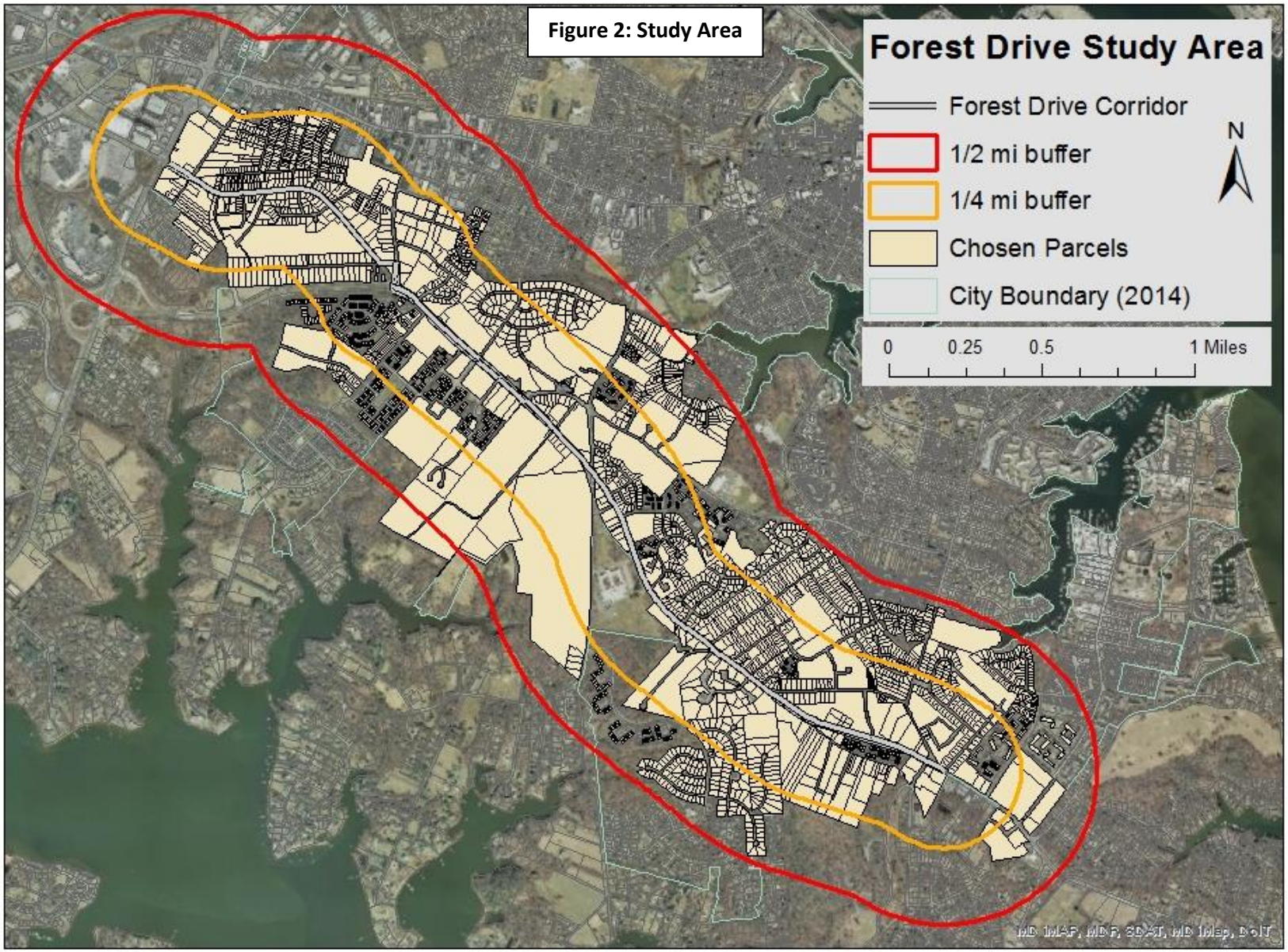


Figure 2: Study Area
Forest Drive Study Area
Forest Drive Corridor
1/2 mi buffer
1/4 mi buffer
Chosen Parcels
City Boundary (2014)
N
0
0.25
0.5
1 Miles

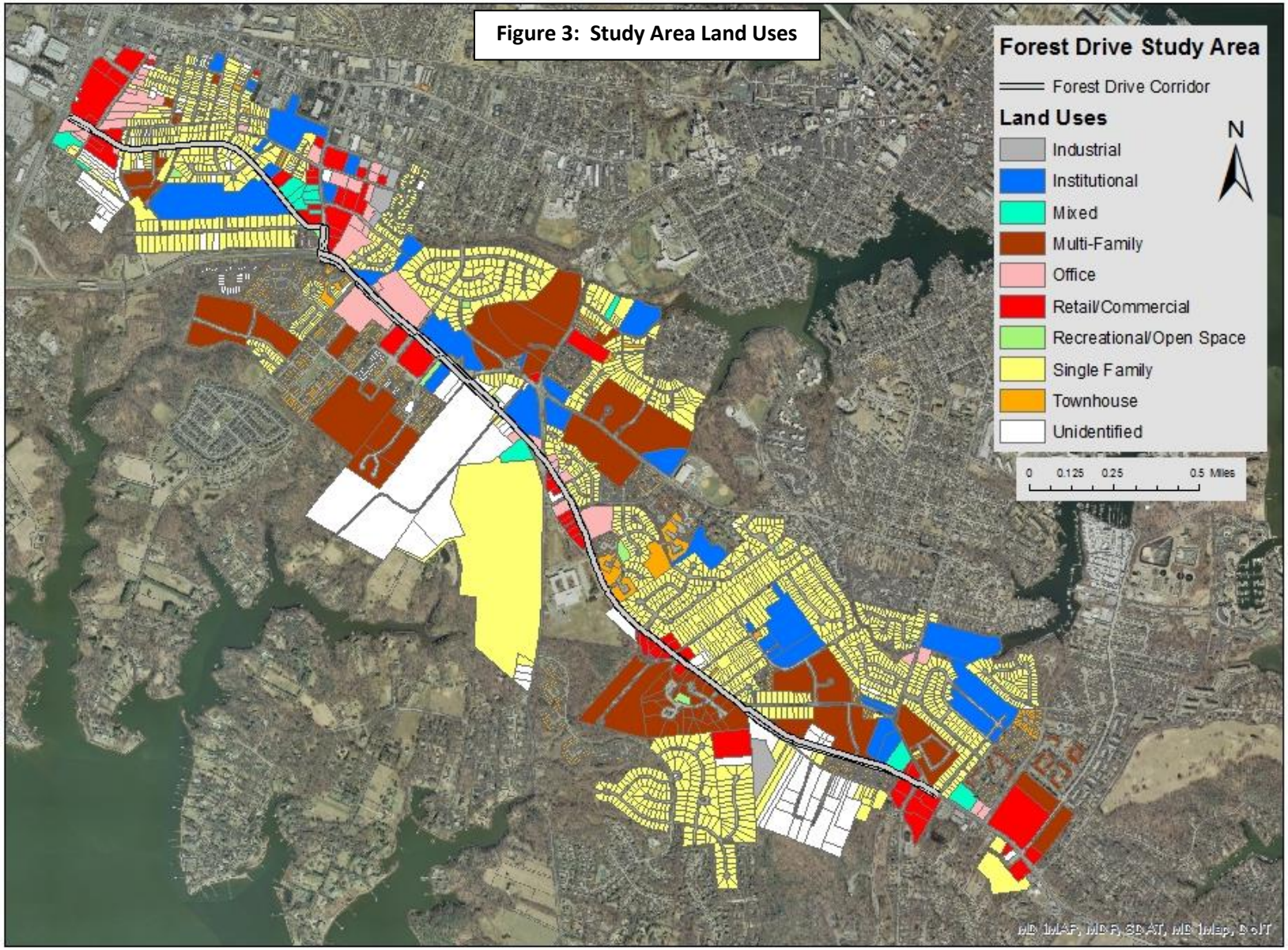


Figure 3: Study Area Land Uses
Forest Drive Study Area
Forest Drive Corridor
Land Uses
Industrial
Institutional
Mixed
Multi-Family
Office
Retail/Commercial
Recreational/Open Space
Single Family
Townhouse
Unidentified
N
0 0.125 0.25 0.5 Miles

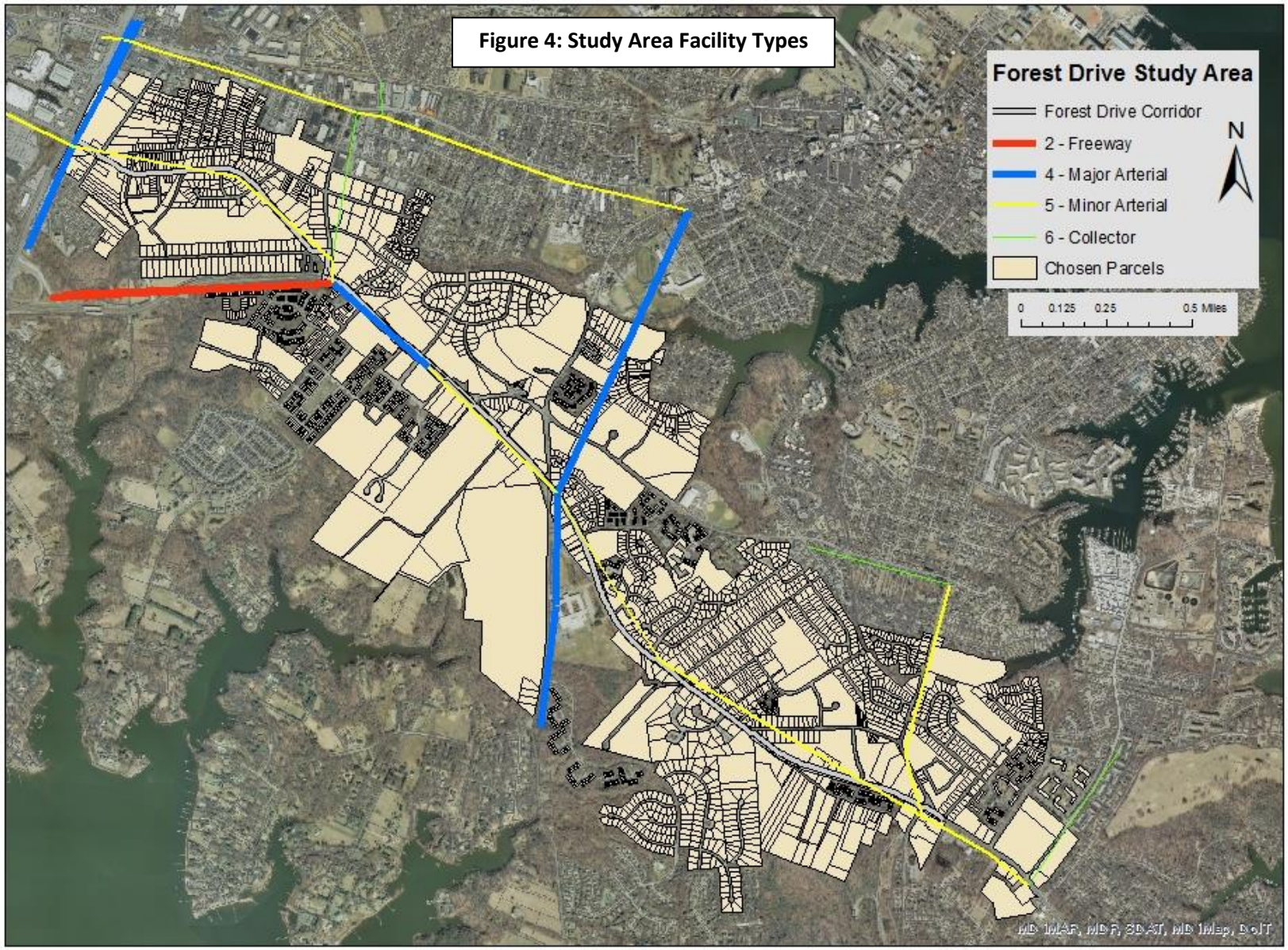
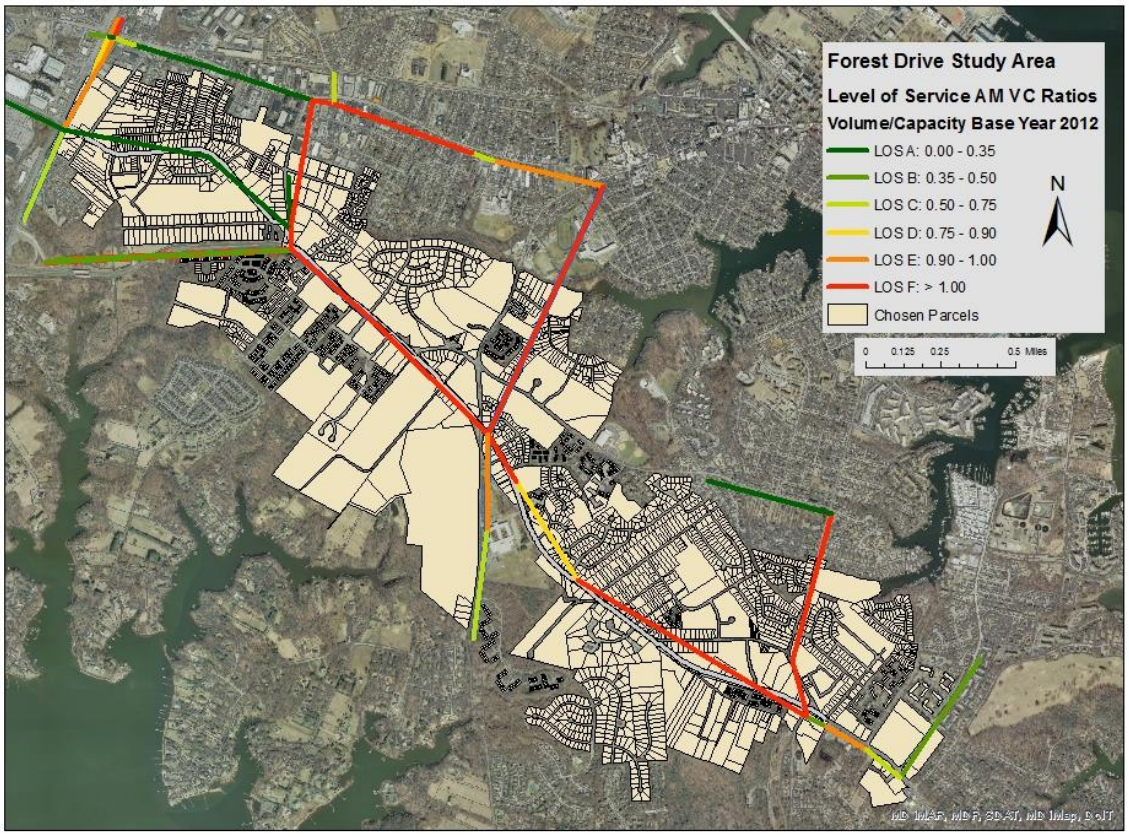


Figure 4: Study Area Facility Types

Figure 5: 2012 Levels of Service (LOS) on Forest Drive Area Road Segments



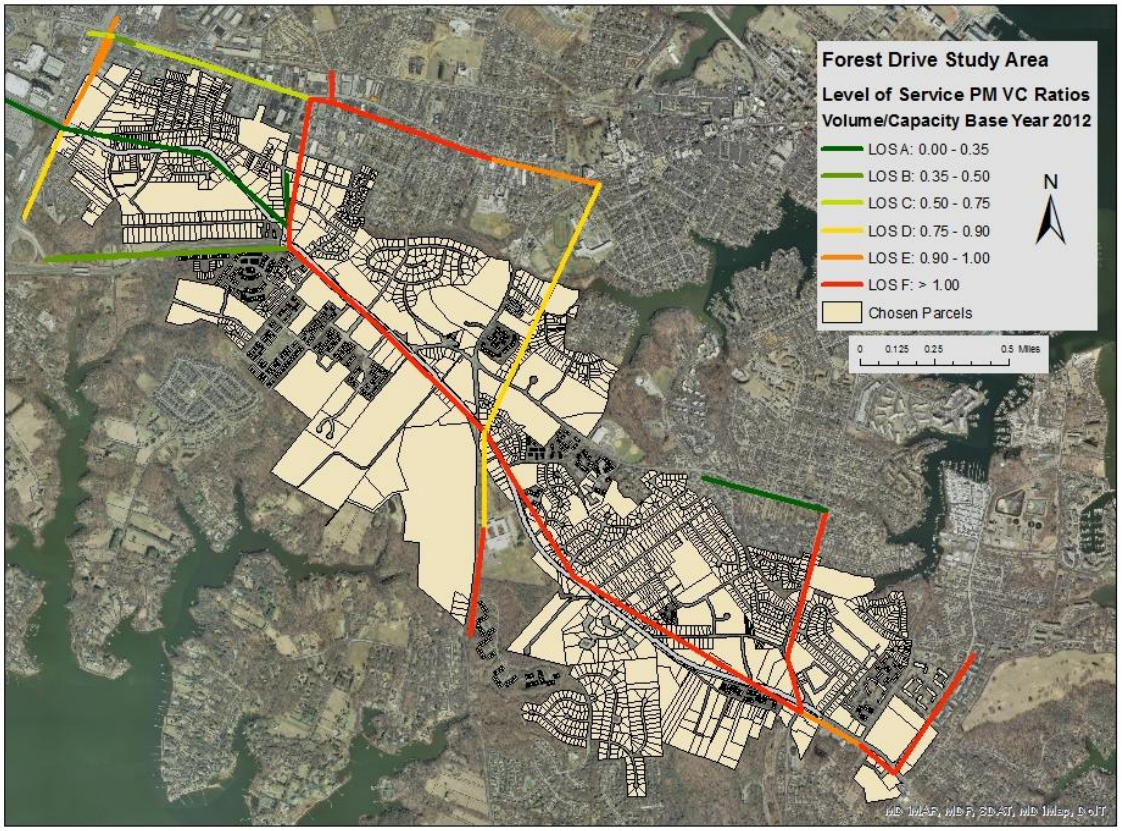


Table 1: Data Sources

Source	Datasets
Baltimore Metropolitan Council (BMC)	Average weekday daily raw simulated traffic volume, TAZ structure
Maryland Department of Planning (MDP)	Aerial imagery shapefiles
Institute of Transportation Engineers (ITE)	Trip generation rates Trip Generation Manual, 9th Edition Vol. 2-3
Maryland Statewide Transportation Model (MSTM)	Transportation network shapefile Transportation facility types Volume/capacity ratios; level of service data
City of Annapolis	Shapefiles for parcels, roads, zoning, parcels, city boundary
Maryland Dept of Assessments and Taxation	SDAT Real Property Data
National Center for Smart Growth (NCSG)	City of Annapolis land use database developed in Summer 2016
Google Maps	Street view and aerials used to confirm/update current land uses
Traffic Concepts	2015 Forest Drive Corridor Analysis Model
Anne Arundel County	2016 Major Intersections and Important Facilities (MIIF) Study

Base Mapping and Establishing the Study Area

The student and faculty (Dr. Chao Liu) reviewed the land use and zoning maps, datasets, aerials, and the 2015 Traffic Concepts study, and used this information to define the corridor. The study area covered all 3.5 miles of Forest Drive within City limits. A land use buffer between ¼ and ½ mile was mapped on either side of the corridor. The study area was then set to encompass all parcels within ¼ mile of Forest Drive with additional parcels manually selected if they were perceived to be in contiguous 'neighborhoods' with those that fell within the ¼ mile buffer (see Figure 1). These neighborhoods were largely assumed from aerial imagery. It should be noted that some neighborhoods included properties that fell outside of the City of Annapolis – these properties in Anne Arundel County were excluded regardless of their contiguous relationship with City land.

Identifying Land Suitable for Development

The student and faculty defined and identified undeveloped and underdeveloped parcels in the study area (called 'Chosen Parcels' in Figure 5) using the following criteria, provided by the City:

- Residentially zoned parcels with no land improvement value
- Selected commercial, industrial, mixed, or institutional parcels (all undeveloped and some developed)

Figure 6 uses purple cross-hatching to display those parcels within the study area that were identified as suitable for development. Figure 7 on the following page displays their existing land uses. Given the broad selection criteria, a large number of parcels were included in this exercise: 324 out of the 3,517 in the study area. It should be noted that only a limited number of parcels had proposed or planned developments in the pipeline. These are depicted in Appendix Figure A3. Because this study had a long-term development timeline, it assumed that even currently built-out non-residential parcels may see intensified uses in the years to come. Likewise, undeveloped parcels without proposed or planned developments were also included under the assumption that they may be built out over time.

Figure 6: Parcels Suitable for Development

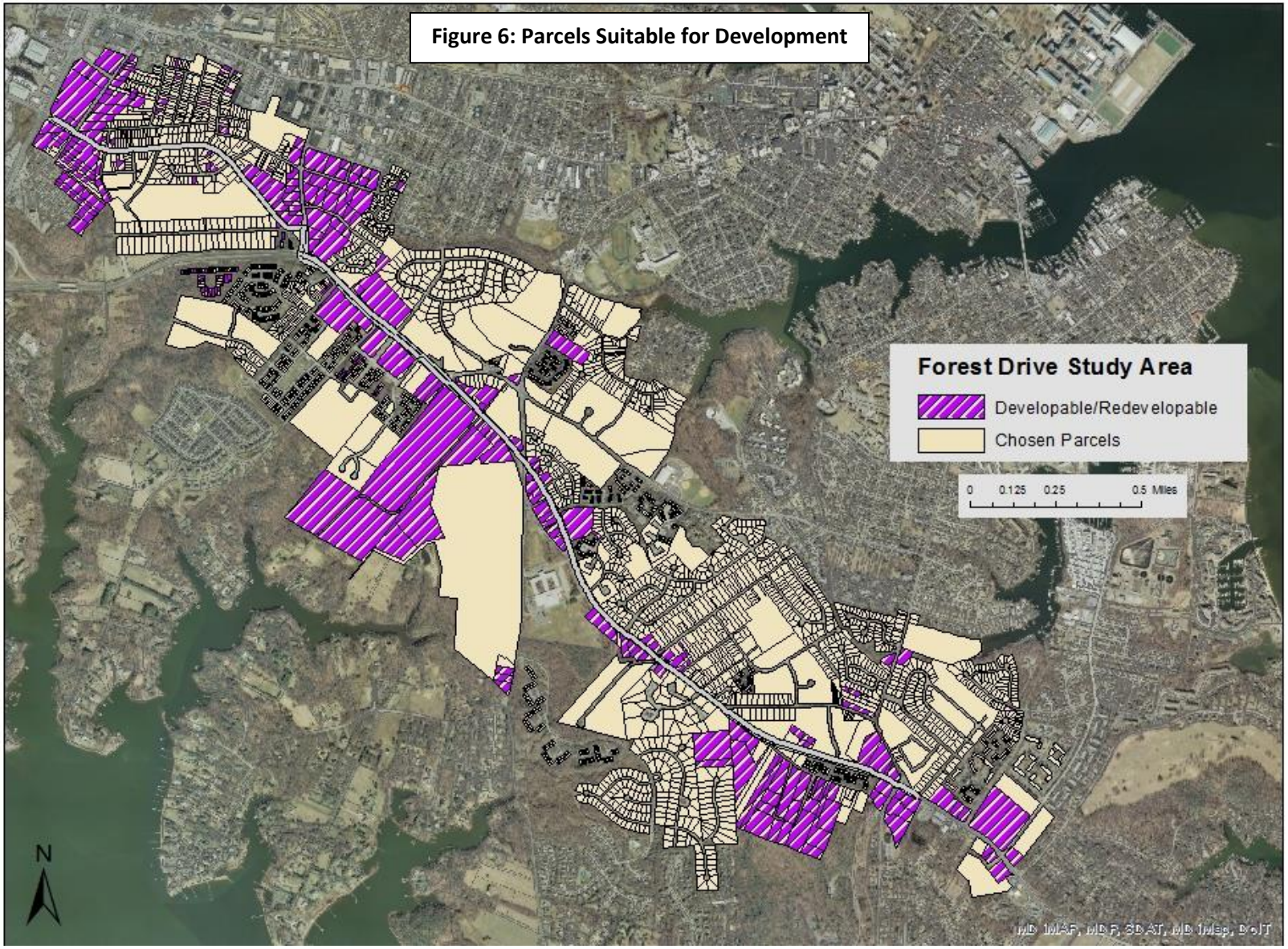
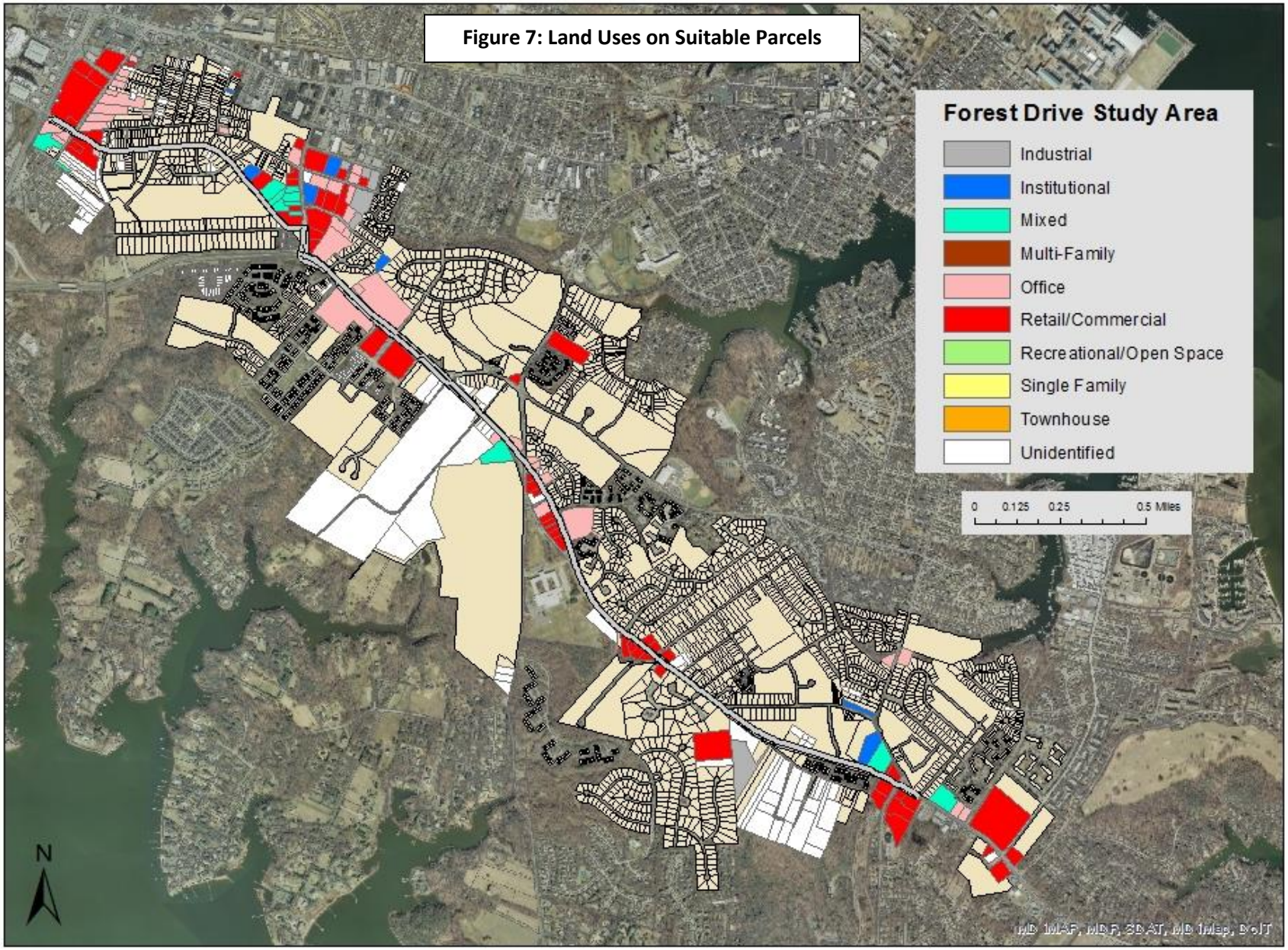


Figure 7: Land Uses on Suitable Parcels



Calculating Baseline Totals for Trips Generated in the Study Area

The 9th edition of the Institute of Transportation Engineers (ITE) Trip Generation Manual was consulted to determine morning and afternoon peak trip generation rates for the various land uses found within the Forest Drive corridor. These uses and their corresponding trip generation values are listed in Table 2. Once compiled, peak AM trips and peak PM trips were added as new fields to the GIS shapefile and the ITE rates were applied to the parcels using the ArcGIS Field Calculator. Each parcel was thus assigned an estimated baseline number of peak trips for both morning and afternoon from which to make comparisons at later stages. Maps displaying the peak trips at each time are included in the appendix as Figures A1 and A2.

CommunityViz Build-Out Wizard

It was determined that the CommunityViz Build-Out Wizard tool would be the most user-friendly and customizable way to represent future development within the corridor area. This means that the land uses along the corridor on the redeveloped or newly developed parcels all build out to their maximum potential (or realistic yield for commercial parcels). No timeframe exists for this buildout which could occur in 20 or 40 years depending on the market. In the modeling of the impacts, we assume buildout by 2035, the horizon year of the travel demand model itself. Importantly in such studies, the question of the growth in through trips (from outside the study area) arises. While our model includes them in overall regional growth, they are not separated out from trips produced locally in terms of the future volumes on Forest Drive. The growth of trips because of specific corridor development is simply added to the total trips produced in the baseline estimates.

Though other CommunityViz tools such as the Land Use Designer and formulas linked to a series of dynamic attributes were explored, they were found to be clumsy and unable to deliver rapid results that could easily be tested and retested. The Build-Out Wizard allows the user to specify an existing ArcMap polygon layer that contains land use information to populate categories within which 'Density Rules' and efficiency constraints can be entered. From these criteria, the Wizard generates both Numeric and Spatial Build-Out layers within the existing ArcMap document. For the purpose of this exercise, the Wizard produces two useful output layers that are then automatically added to the map document: *Buildable Area* and *Buildings*, which are described below.

- **Buildable Area**: parcel polygons that match the land use layer entered into the Wizard.
- **Buildings**: spatially scattered points that represent four different building types – Single Family, Multi-Family, Mixed Use[1], and Non-Residential buildings.

Each 'Building' type is placed only on 'Buildable Area' parcel polygons whose land use specifications (here, their zoning category) indicated them as allowable. Within the Buildings layer, attributes are generated such as number of dwelling units per residential building and non-residential floor area, from which peak trips will later be calculated as they were for the baseline scenario. The Build-Out Wizard's input criteria can easily be tweaked, allowing the user to re-run the Wizard to generate outputs that either overwrite or provide an alternative to the previous results.

However, it should be noted that any attributes added by the user to the Build-Out layers will not be dynamic, meaning peak trips or other values that are manually derived from the Build-Out attributes must be recalculated any time the Wizard is re-run. This proved to be a barrier for this analysis, as it became clear that running multiple scenarios would be a tedious endeavor due to the need for repeated trip calculations after each change to the Wizard's input criteria. Therefore, the study was limited to one alternative scenario – Max Zoning Build-Out – with input criteria that closely resemble the bulk and density requirements and allowances in the Annapolis City Code. To further simplify this scenario, each land use category is assumed to have only a single use (e.g. an 'R3' zone is assumed to be 100% residential).

Once the City's zoning categories were spatially joined to the redevelopable parcels layer, this layer was run through the Build-Out Wizard using Density Rules extracted and estimated from the zoning code, such as dwelling units per acre and Floor Area Ratio (FAR). Table 3 shows a selection of values that informed some of the criteria entered into the Wizard for the assumed land use within each zoning category. In the event that certain criteria were either unspecified or unclear in the zoning code, or the specification yielded inaccurate build-out results, such as density factors and units per building for townhouse and multi-family, values were instead estimated from within the study area and substituted in the Wizard. This approach was also used to estimate efficiency factors, particularly for non-residential

[1] The Mixed Use building type was not used in this Build-Out analysis. The Wizard requires the user to enter an inflexible value or proportion of building space for each assumed use within a mixed use building. This was thought not to be realistic and it was expected to make estimating trips by building type too difficult in the next phase of analysis.

buildings. Tables 4 and 5 show these calculated study area estimates, and the underlined values were those that were used as inputs for the Build-Out Wizard as substitutes for missing, unclear, or inaccurate information. The final results for multifamily, townhouse, and non-residential parcels thus mathematically incorporate both the density/FAR values listed in Table 3 as well as the corresponding efficiency assumption listed in Tables 4 and 5. For non-residential uses, the actual efficiency yields were used throughout. It is worth noting in Table 5 that actual commercial yields *are only about one tenth* of the permitted intensity of the zoning in Table 3.

A screen capture of the Build-Out Wizard is included in Appendix Figure A4.

Table 2: ITE Trip Rates for Forest Drive Corridor Study Area Land Uses

Use	AM Peak Trip Rate	PM Peak Trip Rate	Measurement Unit
Single Family	0.75	1	Trips per dwelling Unit, weekdays
Town House	0.44	0.52	
Multi-Family	0.51	0.62	
Continuing Care	0.14	0.16	Trips per Unit, weekdays
Office	1.56	1.49	Trips per 1,000 SF gross floor area, weekdays
Light Industrial	0.92	0.97	
Heavy Industrial	0.51	0.68	
Warehousing	0.3	0.32	
Church	0.56	0.55	
Day Care Center	12.18	12.34	
Elementary School	5.2	1.21	
Private School (K-8)	11.59	6.53	
Synagogue	0.14	1.69	
Museum	1.04	7.3	
Animal Hospital	4.08	4.72	
Health/Fitness Club	1.41	3.53	
Community Center	2.05	2.74	
Post Office	8.23	11.22	
Cemetery	0.17	0.84	Per acre, weekdays
Unidentified	0	0	
Building Materials Store	2.6	4.49	Trip generation per 1,000 SF gross fl area, weekdays
Hardware/Paint Store	1.08	4.84	
Nursery (Garden Center)	2.43	6.94	
Shopping Center	0.96	3.71	
Specialty Retail Center	6.84	2.71	
Automobile Sales	1.92	2.62	
Automobile Parts Sales	2.21	5.98	
Tire Store	2.89	4.15	
Supermarket	3.4	9.48	
Convenience Market (15-16 hours)	31.02	34.57	
Discount Supermarket	2.53	8.34	
Wholesale Market	0.51	0.88	
Apparel Store	3.83	4.2	
Pharmacy with Drive Thru	3.45	9.91	
Furniture Store	0.17	9.91	Trip generation per 1,000 SF gross fl area, weekdays
Fast Food Without Drive Thru	43.87	26.15	
Fast Food With Drive Thru	45.42	32.65	
Automobile Care Center	2.25	3.11	
Gas Station	12.16	13.87	
Gas Station w Conv Market	10.16	13.51	
Gas Station w Conv Market/Car Wash	11.84	13.86	
Self Service Car Wash	8	5.54	
Drive-in Bank	2.63	5.42	
Hair salon	1.21	1.45	
High-Turnover Sit Down Restaurant	10.81	9.85	
Variety Store (dollar store)	3.81	6.82	
Medical-Dental Office	2.39	3.57	
Fire Station (Government Office)	1.02	1.21	

Table 3: Assumed Land Uses and Build-Out Criteria by Annapolis Zoning Category

Zoning	Description (Assumed Land Use)	Max Build-Out Permitted
R1A	Single Family	2 du/acre
R1B	Single Family	3.5 du/acre
R1	Single Family	6 du/acre
R2	Single Family	8 du/acre
R3	General Residence (Townhouse)	8 du/acre
R4	General Residence (Multi-Family)	9 du/acre
P	Professional Office (Office)	FAR 1.8 (clubs, health/medical, religious) FAR 2.0 (funeral parlors) FAR 2.4 (daycares, dwellings, group homes, offices) Other uses subject to design plan review
PM	Professional Mixed Office (Office)	FAR 0.75
PM2	Professional Mixed Office Park (Office)	FAR 2.0 (dwellings) FAR 0.6 (office/commercial) FAR 0.25 (neighborhood retail)
B2	Community Shopping (Retail/Commercial)	FAR 2.0
B3	General Commercial (Retail/Commercial)	FAR 2.4 30 foot setback
BCE	Business Corridor Enhancement (Retail/Commercial)	FAR 2.0 (multi-family dwellings) Other uses subject to design plan review
I1	Light Industrial	FAR 1.2

Table 4: Observed Density Estimates for Residential Parcels in Study Area

Land Use	Count (Parcels in Study Area)	Sum Acreage	Sum of DUs	Units/acre	Units/parcel
Multi-Family	90	228.02	3651	**16.01**	**40.57**
Single Family	1827	520	1827	3.513461538	1
Townhouse	1206	44.43	1206	27.14321082	1
Townhouse (more than 1 per parcel)	8	11.42	165	**14.45**	**20.63**

Table 5: Efficiency Rates for Existing Non-Residential Parcels in Study Area

Land Use	Count (Parcels in Study Area)	Sum Building Square Footage	SF/building	Efficiency Rate (Building SF/ Total SF)
Industrial	6	68,980	11,496.67	**15.02%**
Office	44	581,858	13,224.05	**25.86%**
Retail/Commercial	61	709,882	11,637.41	**19.04%**

Results

Max Zoning Build-Out Scenario

Figure 8 displays the results of the Build-Out. According to the criteria entered, the Wizard generated 550 buildings: 163 Single Family Residences and 259 Multifamily Residences, within which are a total of 1,718 total dwelling units, as well as 128 Non-Residential 'buildings.' The Wizard created only one building point per non-residential parcel category, but it may be inferred that each non-residential parcel is suitable for more than one building. In other words, while the Build-Out Wizard suggests that each parcel zoned P, PM, PM2, B2, B3, BCE, or I1 will have one non-residential building suitable for that category, in reality it may be that the output floor area is divided amongst several buildings. So, it is important to note that the Total Floor Area, roughly 2,211,863 square feet, might be divided amongst more than 128 buildings.

Calculating Trips Attributable to Redevelopment

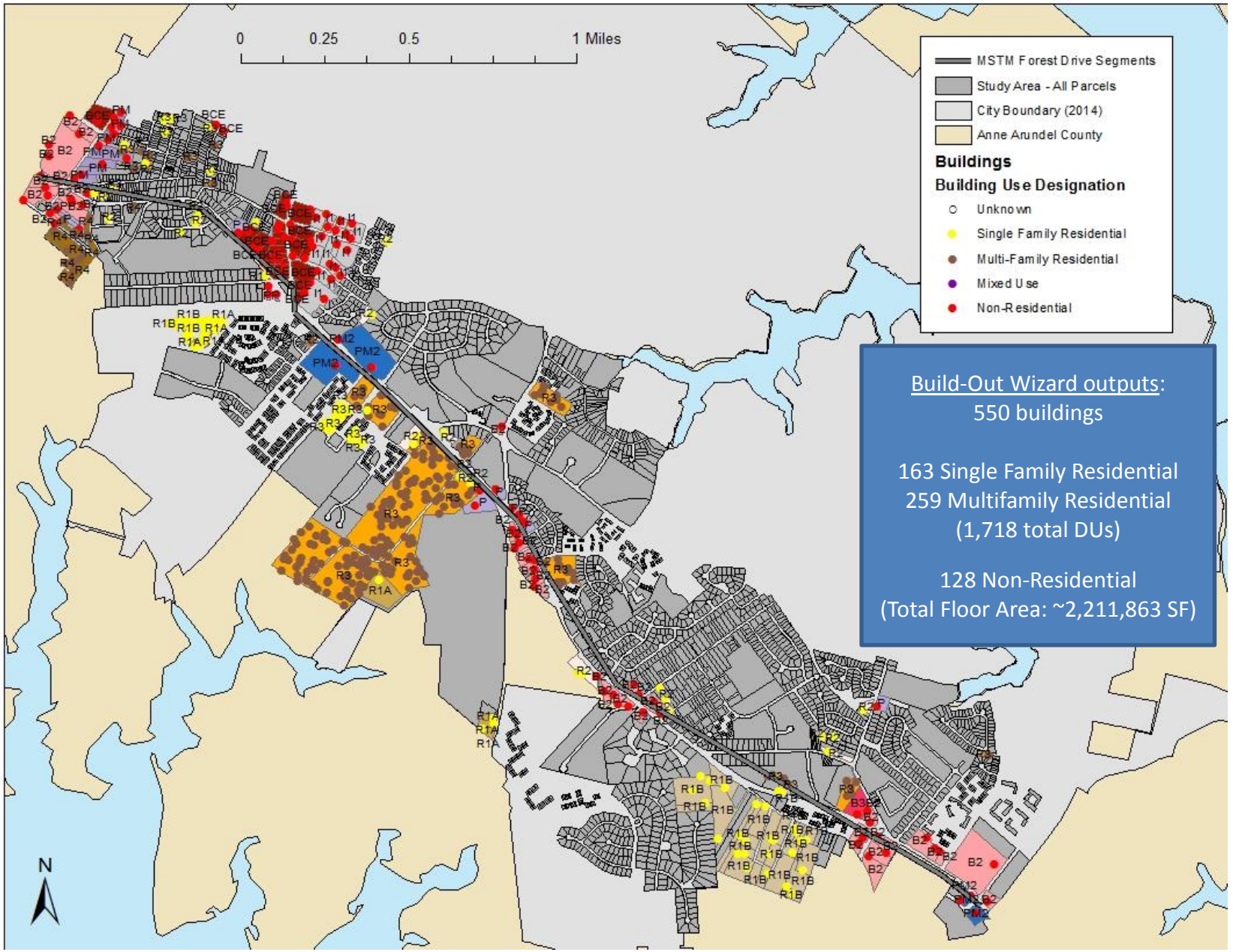
The next stage involved determining how the intensified and expanded use of redevelopable parcels would affect the count of trips on Forest Drive. Fields were manually added to the Wizard's Buildings layer to represent AM Peak Trips and PM Peak Trips, as was previously done for the baseline scenario. Calculating the peak trips attributable to residential uses was relatively straightforward, using the same procedure specified above and the unit-based trip generation rates listed for each residence type in Table 2. However, because several of the non-residential land uses specified by the ITE Trip Generation Manual were collapsed into a single category, a different approach was required to estimate peak trips from commercial, industrial, and office parcels.

Table 6 shows the estimated trip rates for each land use type based on the existing square footage and the trips calculated for the baseline study area scenario. These rates were multiplied by the Build-Out floor area calculated for each future non-residential building in the P, PM, PM2, B2, B3, BCE, or I1 zones.

Table 6: Estimated Trip Generation Rates for Non-Residential Land Uses in the Study Area

Land Use	Count (Parcels in Study Area)	Sum Building SF	Baseline AM Trips	AM Trips/SF	Baseline PM Trips	PM Trips/SF
Industrial	6	68,980	51.52	0.00075	80.85	0.0012
Office	44	581,858	946.81	0.0016	904.35	0.0016
Retail/Commercial	61	709,882	2,883.77	0.0041	3,258.43	0.0046
Total	111	1,360,720	3,882.1	-	4,243.63	-

Figure 8: Build-Out Wizard Results



Calculating the Change in Trips Generated near Forest Drive after Redevelopment

A key challenge in all traffic impact analyses is how trips generated on parcels are distributed and allocated to roadways. With CommunityViz, which has been adapted to this study, some trial and error on methodology was necessary to arrive at the most efficient and acceptable approach.

Using basic ArcGIS functions, the baseline and build-out trip data were spatially joined to the nearest segment of the MSTM network on Forest Drive. Because the MSTM network shapefile includes bidirectional road segments, additional Excel operations were necessary to sum the trips that were randomly joined to segments on the same stretch of Forest Drive, but traveling in opposite directions. While it would be useful to understand the direction of travel, this analysis was limited in its capacity to represent this information accurately, and so only the total trip estimate is shown.

Next, calculations were performed to subtract any baseline trips associated with redevelopable parcels, thereby determining the net number of trips associated with the build-out, and finally, the change of trips from baseline to build-out. The results can be seen in Figures 9 and 10. Overall, nearly 7,000 new morning peak trips and almost 8,000 afternoon peak trips would be generated by redevelopment according to this model. Table 7 displays a comparison of the baseline versus buildout conditions showing trip increases of between 70 and 80 percent for both morning and afternoon peak travel hours. *This differs significantly from the growth in daily traffic volumes projected by the 2016 MIFF, which ranged from 12% (east of Chinquapin Round Road) to 7% (west of Bay Ridge Avenue) by 2035.* It should be noted, however, that the MIIF study focused on transit potential for this corridor and did not really address land use seriously.

Table 7: Comparison of Baseline vs. Buildout Conditions

AM Trips – Baseline Scenario estimate	AM Trips – Buildout Scenario estimate	Estimated Change	% Change
9,442	16,411	6,968	73.8%

PM Trips – Baseline Scenario estimate	PM Trips – Buildout Scenario estimate	Estimated Change	% Change
10,057	18,053	7,996	79.5%

A significant impact would be felt on the northwestern part of Forest Drive where many existing commercial developments would likely intensify, and existing undeveloped R4 parcels would see the addition of new multifamily housing units. New townhouse development in the Crystal Springs area would put a strain on the centermost segment of Forest Drive. Underdeveloped commercial areas and undeveloped single-family land on the southeastern end of the corridor also stand to contribute many more trips should their use be maximized.

While many assumptions were fed into this model, the implications of redevelopment along Forest Drive are evident and how adjacent land is used must be carefully considered. In general, the trips generated by this exercise are very high, as would be expected in a maximum buildout scenario. It is likely that the corridor would experience changes of a smaller magnitude and in a more controlled fashion given the incremental nature of planning, development review, permitting, and other processes that affect municipal growth. However, given the current Level of Service issues already faced in this area of the City, and the likelihood that through trips would cause even greater changes in corridor usage, land use and transportation planning must proceed cautiously in the years ahead to avoid worsening congestion and gridlock on Forest Drive.

Figure 9: Change in AM Peak Trips Attributable to Nearby Redevelopment

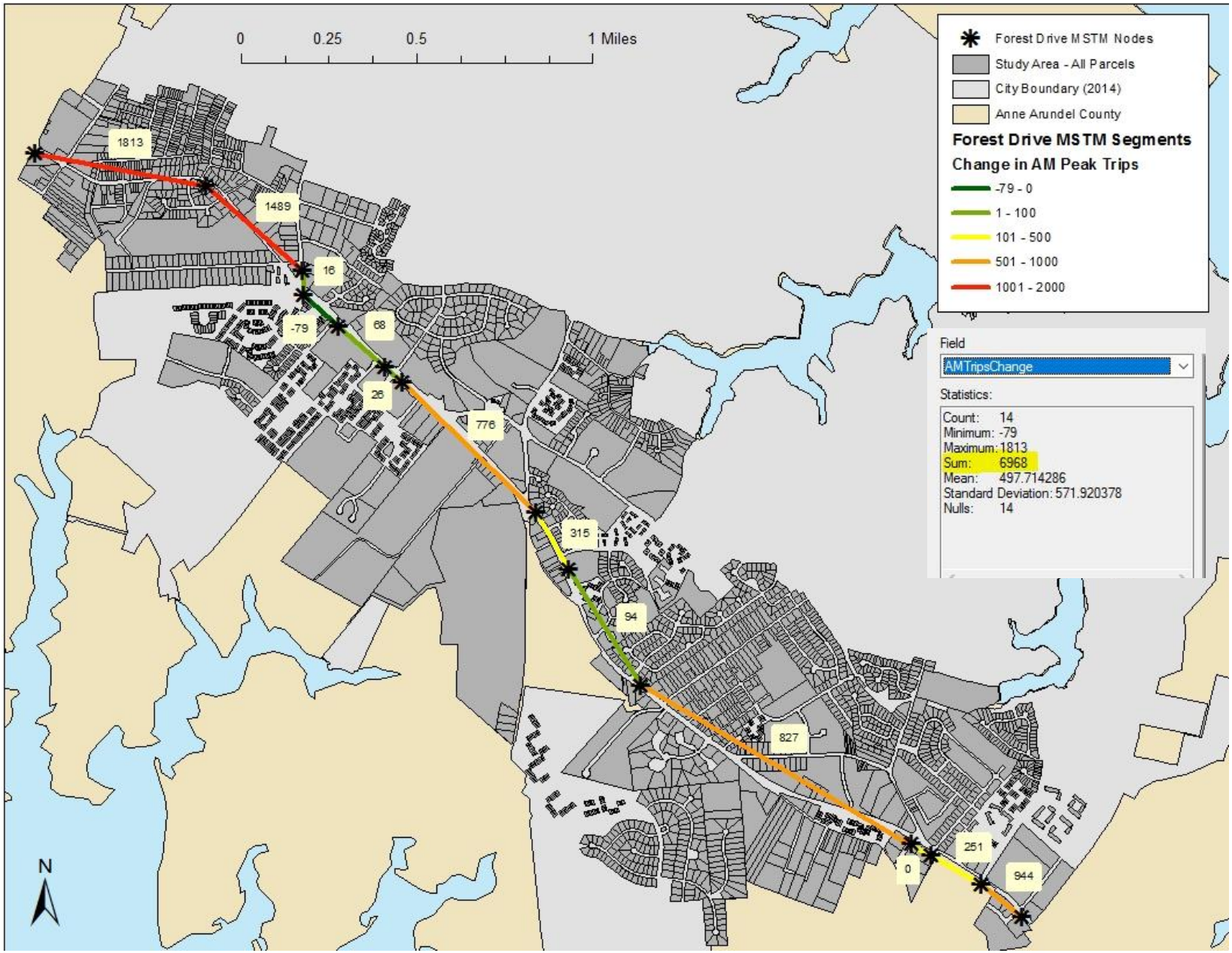
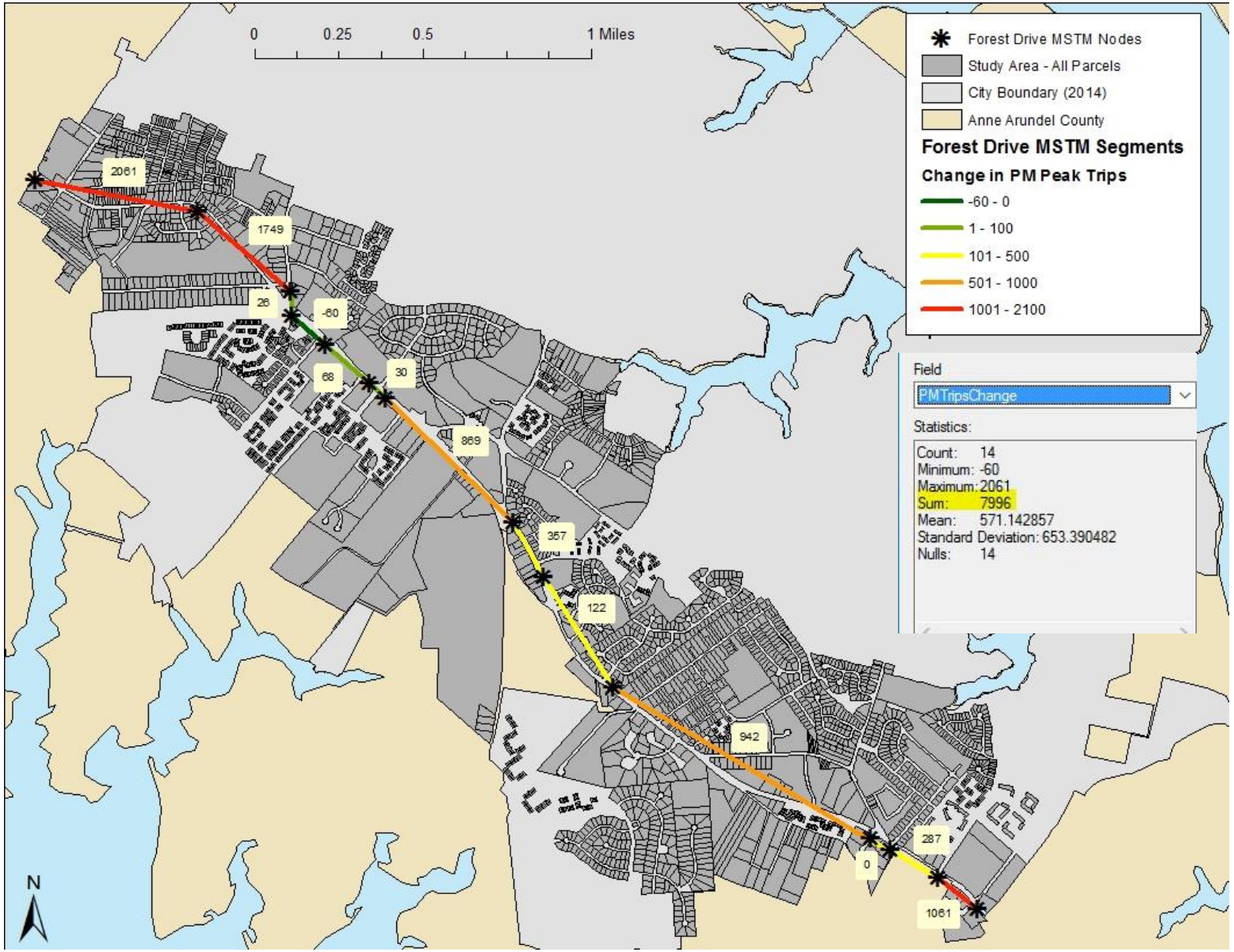


Figure 10: Change in PM Peak Trips Attributable to Nearby Redevelopment



Future Research

This independent study was an exploratory use of ArcGIS and CommunityViz tools to understand aspects of the pressures future development might impart on the Forest Drive Corridor. With increased capacity and familiarity with the software and the study area, many alternative scenarios could be constructed, more concrete conclusions might be drawn, and key policy decisions can be made.

For future assessments, considerations should be given to the limitations described below.

- The TAZ level trip generation data, distribution (trip tables) and assignment data from the BMC model were shared by the City before the semester began, but it was not determined to be of any use for this study. This was primarily because TAZ boundaries were inconsistent with City and County boundaries and the eventual study area that was determined using distance-based buffers and because the distribution and assignment routines of the model were not the same as those used for this simpler methodology.
- Ignoring County land that is adjacent to City neighborhoods in the Forest Drive corridor creates an unrealistic view of the demand pressures placed on the corridor by nearby land uses. Future studies would benefit from incorporating County parcels that are expected to funnel onto Forest Drive as a result of the limitations presented by the peninsular geography or connections in the existing road network.
- Underdeveloped parcels were crudely defined and could use further refinement in order for this tool to better address the most likely future development scenario. However, the software might be better leveraged to incorporate evaluative criteria for development potential, such as:
    - Land value more than improvements (screening out for gas stations, used car lots, contractors' yards etc. that distort this data) value;
    - Age of buildings;
    - Residential density well below permitted by zoning;
    - Public ownership and easements, etc.

  These criteria were in consideration at the early stages of this study but were ultimately abandoned in favor of the less specific factors that were specified by the City and explained on page 9. One useful tool for this deeper analysis might be the CommunityViz Suitability Wizard, which assigns scores to certain geographies based on weighted user-defined criteria from within

a given map document. Since this exercise was intended to inform the city-wide underdeveloped land analysis to be undertaken in Spring 2017 by PALS students, it is recommended that some of these criteria be incorporated into their approach.

- In general, the ITE land use categories were not perfect matches with the actual land uses along Forest Drive, and so the trip generation estimates are exactly that – estimates, based on the assumed uses specified in the land use database, through visual observation on site visits, and via site exploration through Google Maps.
- Some parcels are split zoned or have an allowable mix of uses that this study was unable to reasonably incorporate.
- The Build-Out Criteria listed in Table 3 may not be a realistic representation of future development on Forest Drive, even in spite of allowable density as specified in the zoning code. In particular, using floor area ratios of 2.0 and above for commercial categories significantly inflates the trip estimates for potential densification of such parcels in the vicinity of Forest Drive, even with the conservative observed efficiency factors in place. The tendency for development review factors, or other market, financial, or regulatory factors to influence what is ultimately put on the ground is difficult to approximate within the CommunityViz model. Future assessments should use more reasonable density factors according to more realistic expectations of ongoing development on the corridor.
- Through-trip considerations were an initial concern, and ultimately could not be factored in. While the traffic on Forest Drive is obviously composed of more trips than those that are generated by parcels within this study area, the scope of this project allowed only for a more concentrated look at how future development on a limited array of parcels will change the trip count. If these numbers can be more adequately incorporated into a larger traffic analysis that accounts for through trips on Forest Drive, then the results will likely be of greater use to the City, County and community.
- The Build-Out Wizard generally has a limited capacity for customizing density, efficiency, and land use options. There may potentially be more sophisticated decision tools within the CommunityViz package that this study did not have the time or capacity to utilize, such as travel direction or a decaying rate of corridor use by distance from Forest Drive.
- Lastly, as previously mentioned, this study was unable to make trip counts dynamic such that alternative scenarios beyond the Max Zoning Build-Out were feasible. Even within the Max Zoning Build-Out, the rules and inputs were limited to a very basic set of criteria pulled out of a

zoning code that happens to be far more flexible than this study allowed for. It is recommended that more scenarios be explored using a range of criteria options.

References

Trip generation. (2003). Washington: Institute of Transportation Engineers.

The Maryland Statewide Transportation Model (MSTM). (2016). National Center for Smart Growth Research and Education. http://smartgrowth.umd.edu/statetransportationmodel.html

MIIF Study

Appendix

Figure A1: Baseline Scenario AM Peak Trips

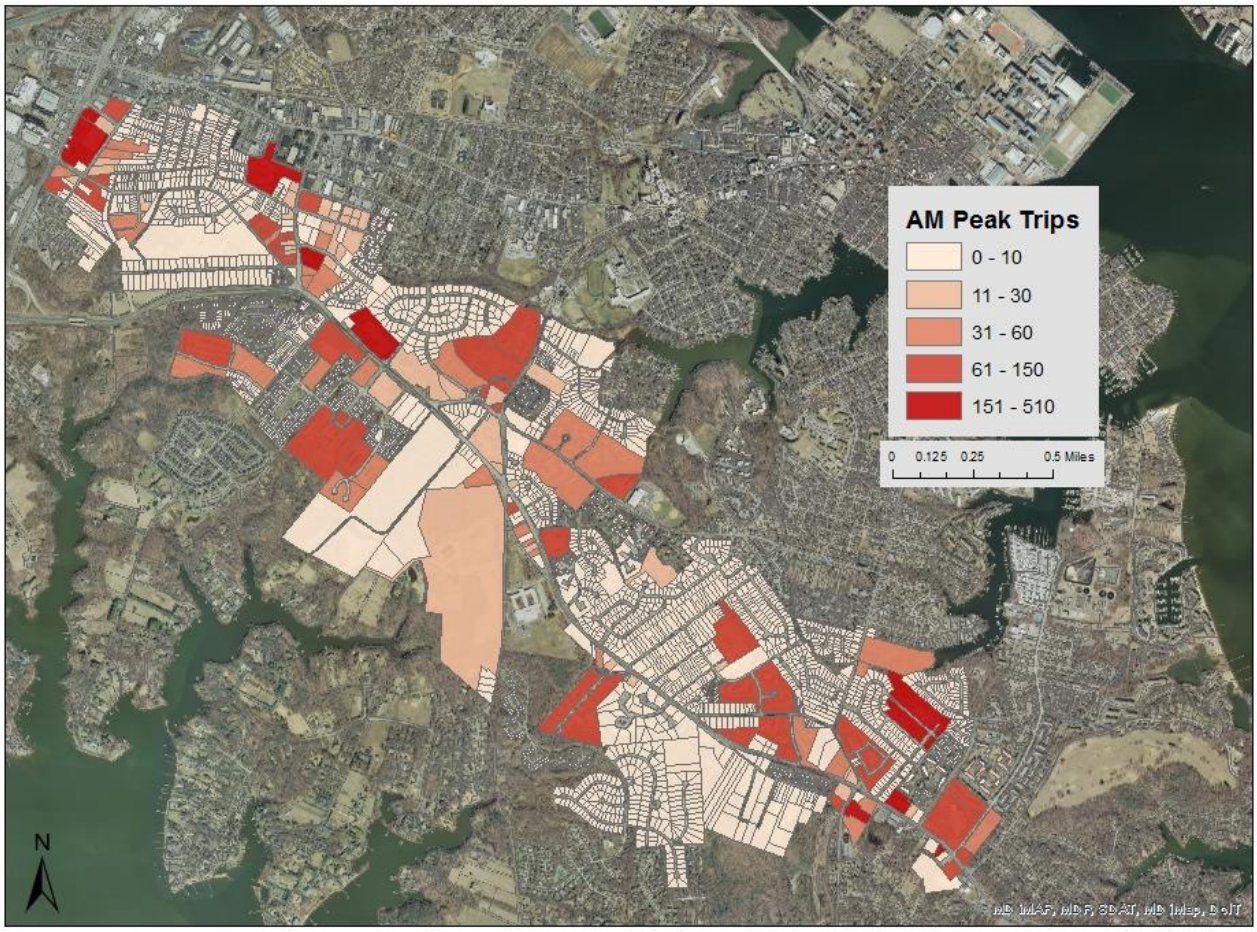


Figure A2: Baseline Scenario PM Peak Trips

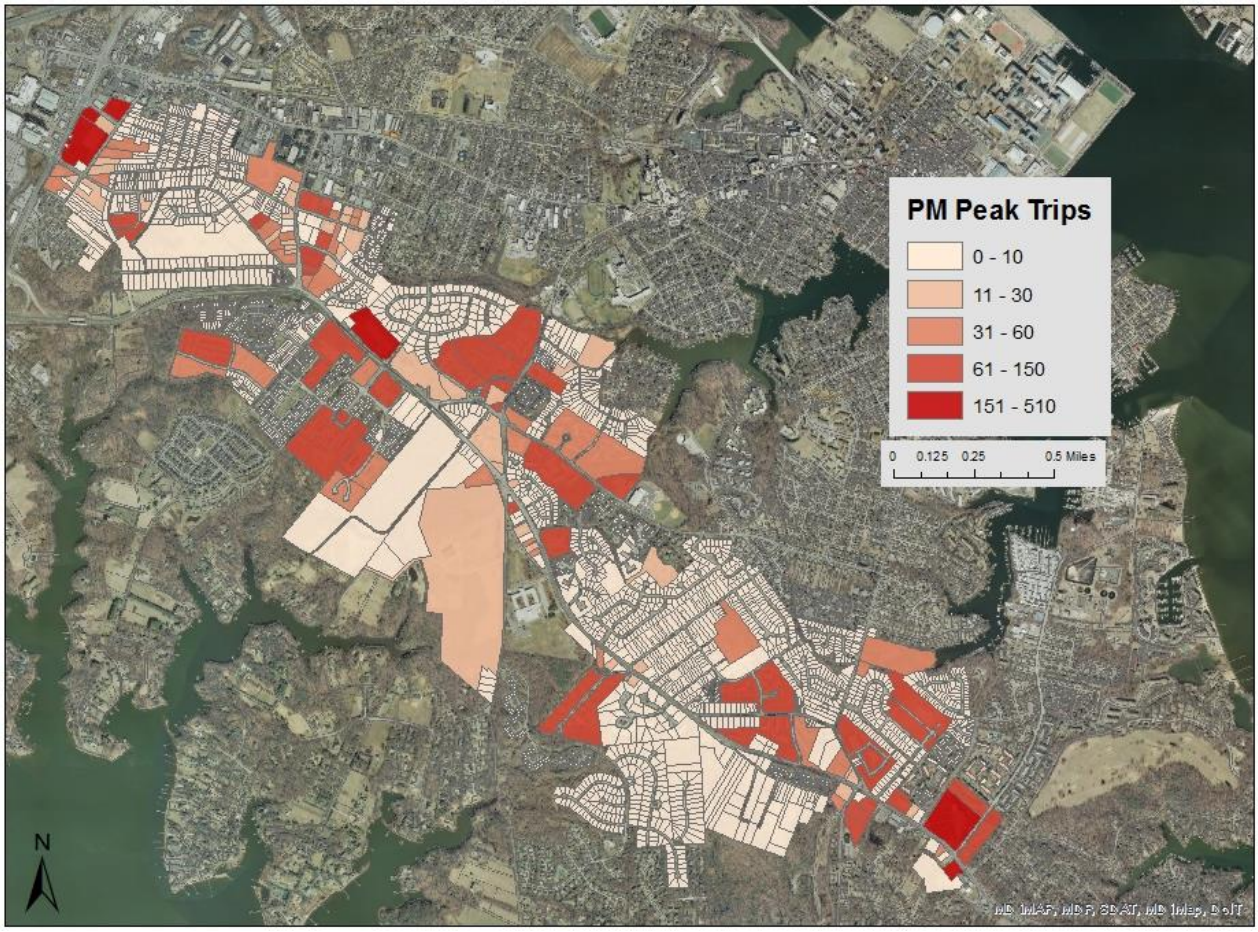
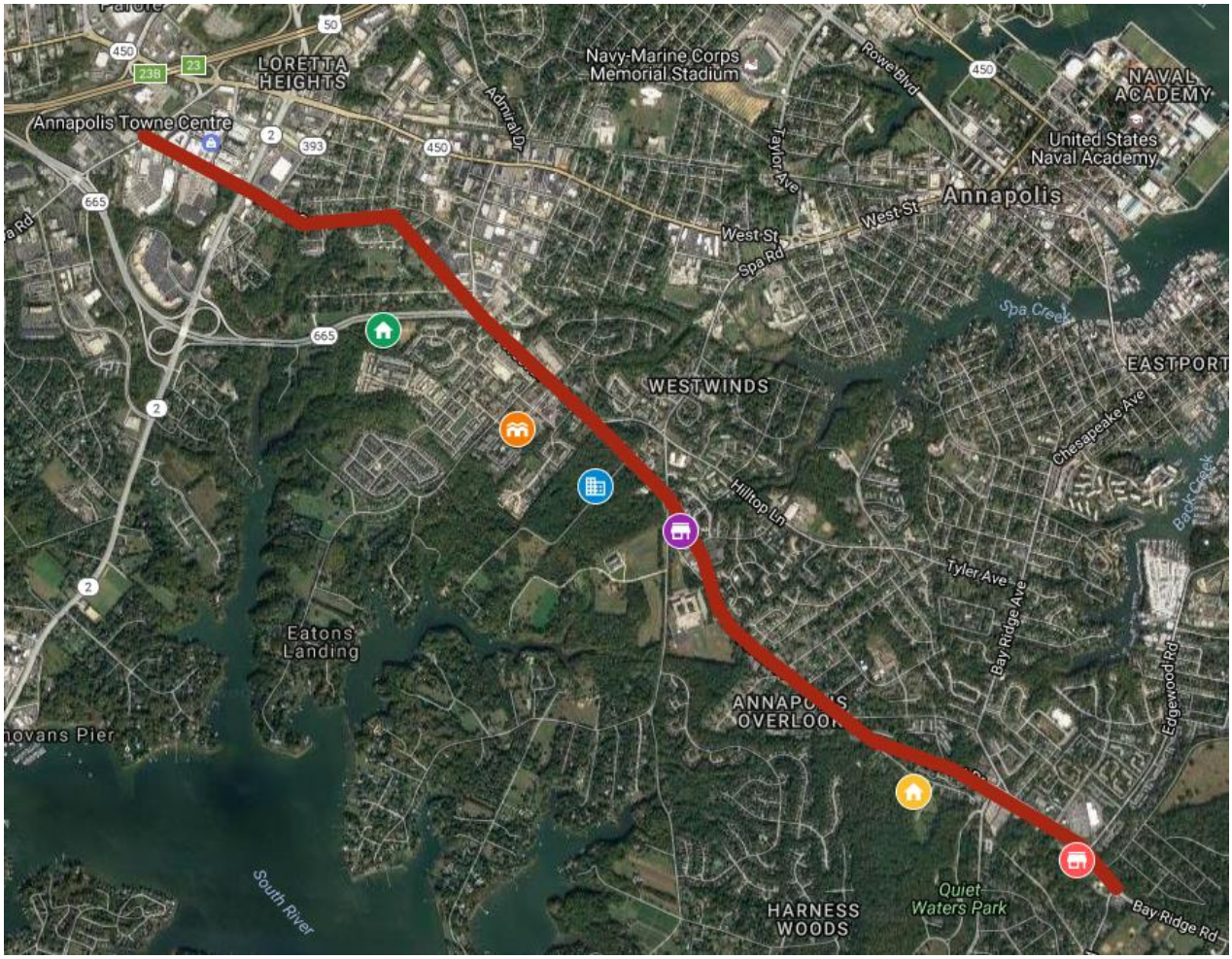


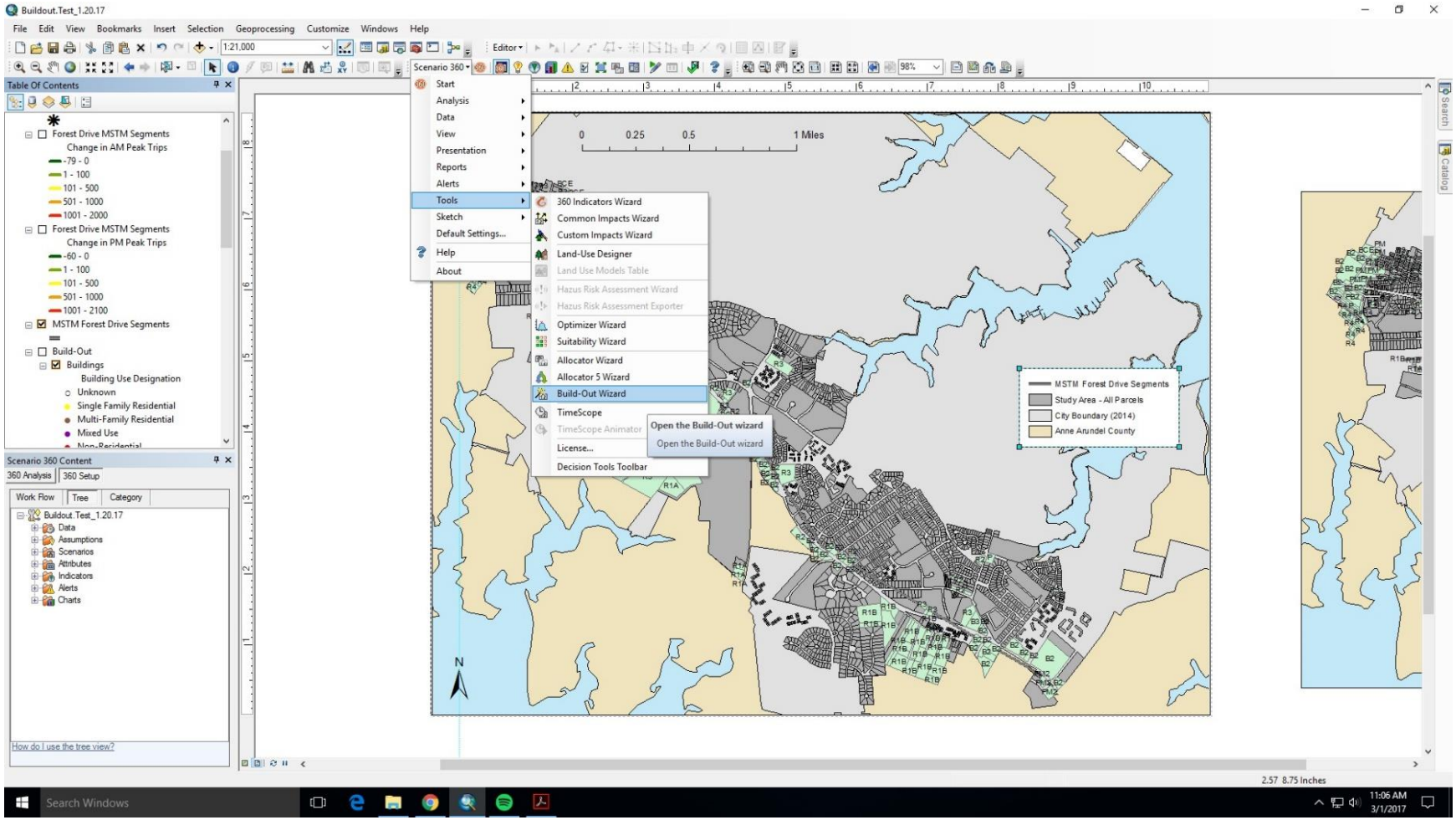
Figure A3: Forest Drive Corridor Development Pipeline

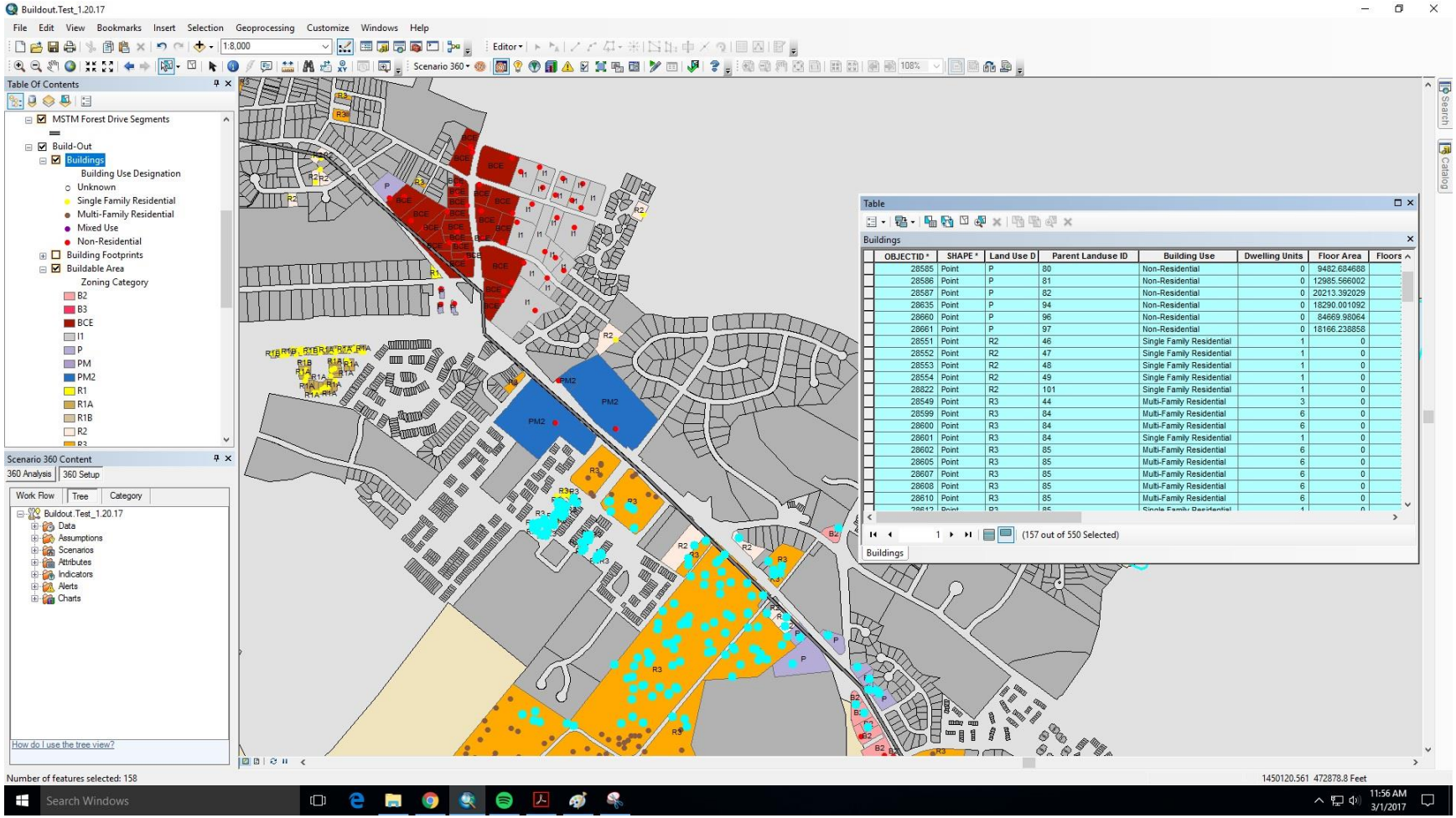


Development Pipeline

- Quiet Waters Preserve (SF/Towns)
- Village Greens Townhomes
- Rocky Gorge (SF/Towns)
- Bay Village (retail/office)
- 1503 Forest Drive (office/retail)
- Crystal Springs (mixed)

Figure A4: CommunityViz Build-Out Wizard




Buildout.Test_1.20.17
File Edit View Bookmarks Insert Selection Geoprocessing Customize Windows Help
Table Of Contents
MSTM Forest Drive Segments
Build-Out
Buildings
Building Use Designation
Unknown
Single Family Residential
Multi-Family Residential
Mixed Use
Non-Residential
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Buildable Area
Zoning Category
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B3
BCE
I1
P
PM
PM2
R1
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R1B
R2
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360 Setup
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Category
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Data
Assumptions
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Indicators
Alerts
Charts
How do I use the tree view?
Table
Buildings
OBJECTID * SHAPE * Land Use D Parent Landuse ID Building Use Dwelling Units Floor Area Floors
28585 Point P 80 Non-Residential 0 9482.684688
28586 Point P 81 Non-Residential 0 12985.566002
28587 Point P 82 Non-Residential 0 20213.392029
28635 Point P 94 Non-Residential 0 18290.001092
28660 Point P 96 Non-Residential 0 84669.98064
28661 Point P 97 Non-Residential 0 18166.238858
28551 Point R2 46 Single Family Residential 1 0
28552 Point R2 47 Single Family Residential 1 0
28553 Point R2 48 Single Family Residential 1 0
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28822 Point R2 101 Single Family Residential 1 0
28549 Point R3 44 Multi-Family Residential 3 0
28599 Point R3 84 Multi-Family Residential 6 0
28600 Point R3 84 Multi-Family Residential 6 0
28601 Point R3 84 Single Family Residential 1 0
28602 Point R3 85 Multi-Family Residential 6 0
28605 Point R3 85 Multi-Family Residential 6 0
28607 Point R3 85 Multi-Family Residential 6 0
28608 Point R3 85 Multi-Family Residential 6 0
28610 Point R3 85 Multi-Family Residential 6 0
(157 out of 550 Selected)
Buildings
Number of features selected: 158
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Search Windows
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3/1/2017