

# Tree Canopy Cover Response to Land Development Policies in

# Fairfax County, Virginia

Meghan Failor, Eric Wiseman, J. P. Gannon, and Will Beer

Department of Forest Resources and Environmental Conservation, Virginia Tech, Blacksburg, VA  
meghanfailor@vt.edu



## Fairfax County's Land Development Policies

The Code of Virginia provides municipalities with the power to regulate tree canopy cover. Fairfax County, Virginia created a policy in its Public Facilities Manual that requires tree canopy conservation within its land development approval process. Developers must submit a tree conservation plan with specifications for reaching a 10-year post-development tree canopy cover requirement. These policies have been in place in Fairfax County for over 10 years, so many parcels have passed the 10-year post-development timeline. However, the canopy on these parcels has not been evaluated yet. The purpose of this project is to assess the growth of tree canopy on previously developed parcels in Fairfax County to determine if they have met their 10-year-post-development tree canopy cover requirements. This was accomplished using information on the proposed tree canopy from site plans and canopy data derived from imagery of Fairfax County.

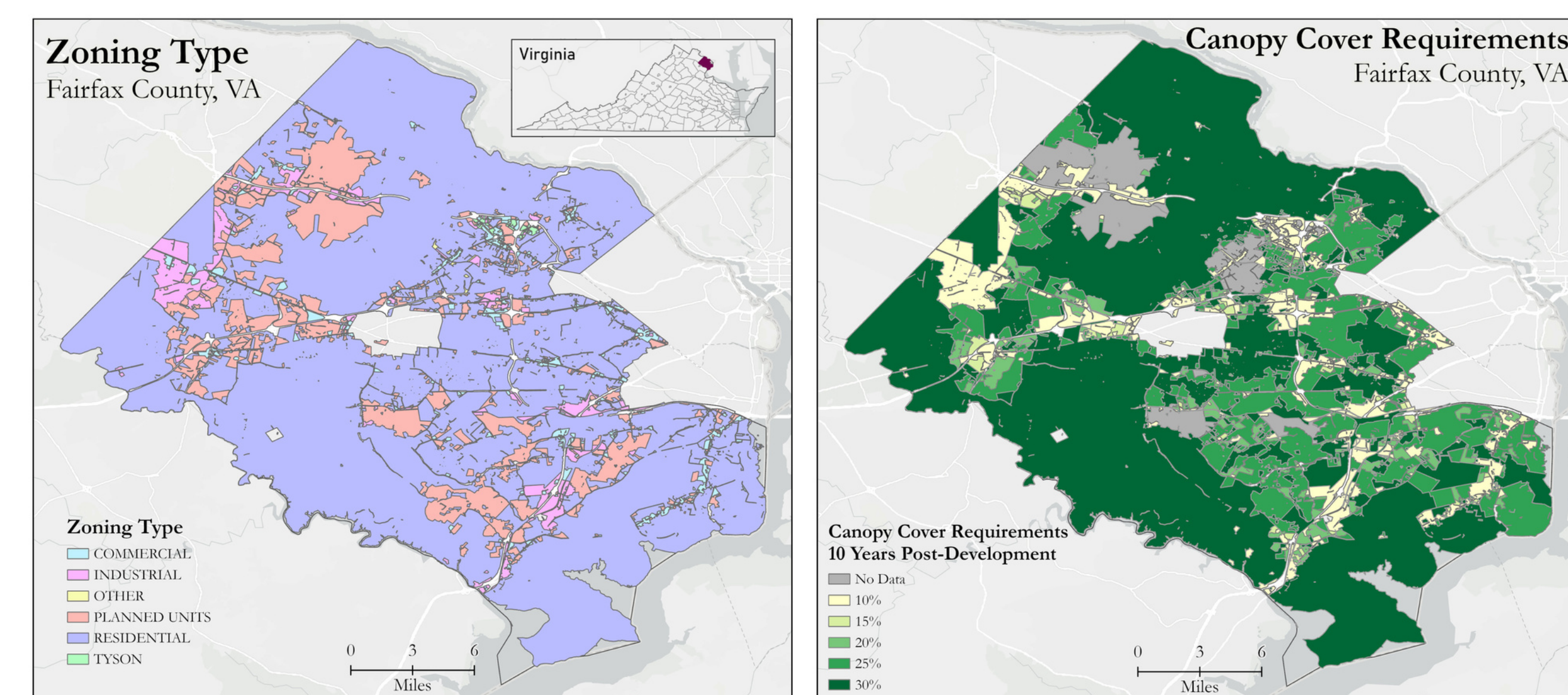


Figure 1: Zoning type and canopy cover requirements for Fairfax County, Virginia

Figure 1 depicts the zone types and canopy cover requirements across Fairfax County. The 10-year-post-development tree canopy cover requirement varies from 10% to 30% based on zoning. The canopy cover requirements were approximated for Fairfax County using zoning data. Table 1 shows the percent of required canopy for each zone code. All industrial and commercial zones codes are required to have 10% canopy 10 years after development, while planned unit and residential zone codes range from 10% to 30% required canopy depending on housing density. The letters in the zone code reference the zone type. For example, R-1 is residential and PDH-1 is planned unit. The number in the zone code indicates the density of homes, specifically dwellings per acre. The zone codes with less dense housing, like R-1, require a higher percentage of canopy 10 years after development, while zone codes with denser housing typically require less canopy.

Table 1: The percent of canopy required for each zone code

Required Canopy	Zone Code
10%	Industrial, Commercial, R-20, R-30, PDH-20, PDH-30, PDH-40
15%	R-12, R-16, PDH-12, PDH-16
20%	R-5, R-8, PDH-5, PDH-8
25%	R-3, R-4, PDH-3, PDH-4
30%	R-A, R-C, R-E, R-1, R-2, PDH-1, PDH-2

## Key Takeaways of Study

- 67% of parcels developed from 2009 to 2021 are meeting their tree canopy requirements.
- 81% of the sample of residential infill lots developed from 2009 to 2011 met their tree canopy requirements.
- Based on the sample, there was a net surplus of 42 acres of tree canopy beyond the required amount for those 151 parcels.
- There is evidence from this study that the ordinance is fulfilling its purpose of conserving tree canopy during land development.

## Geospatial Canopy Data

The canopy on developed parcels was determined using high-resolution canopy cover data from PlanIt Geo, a consulting and software development firm specializing in urban forestry. To develop the canopy cover data, PlanIt Geo used aerial imagery collected by the National Agriculture Imagery Program (NAIP) from 2021 with a 60-centimeter resolution. This imagery was used to determine the amount of canopy on each developed parcel in 2021. Figure 2 shows an example of the canopy data derived from the NAIP imagery.

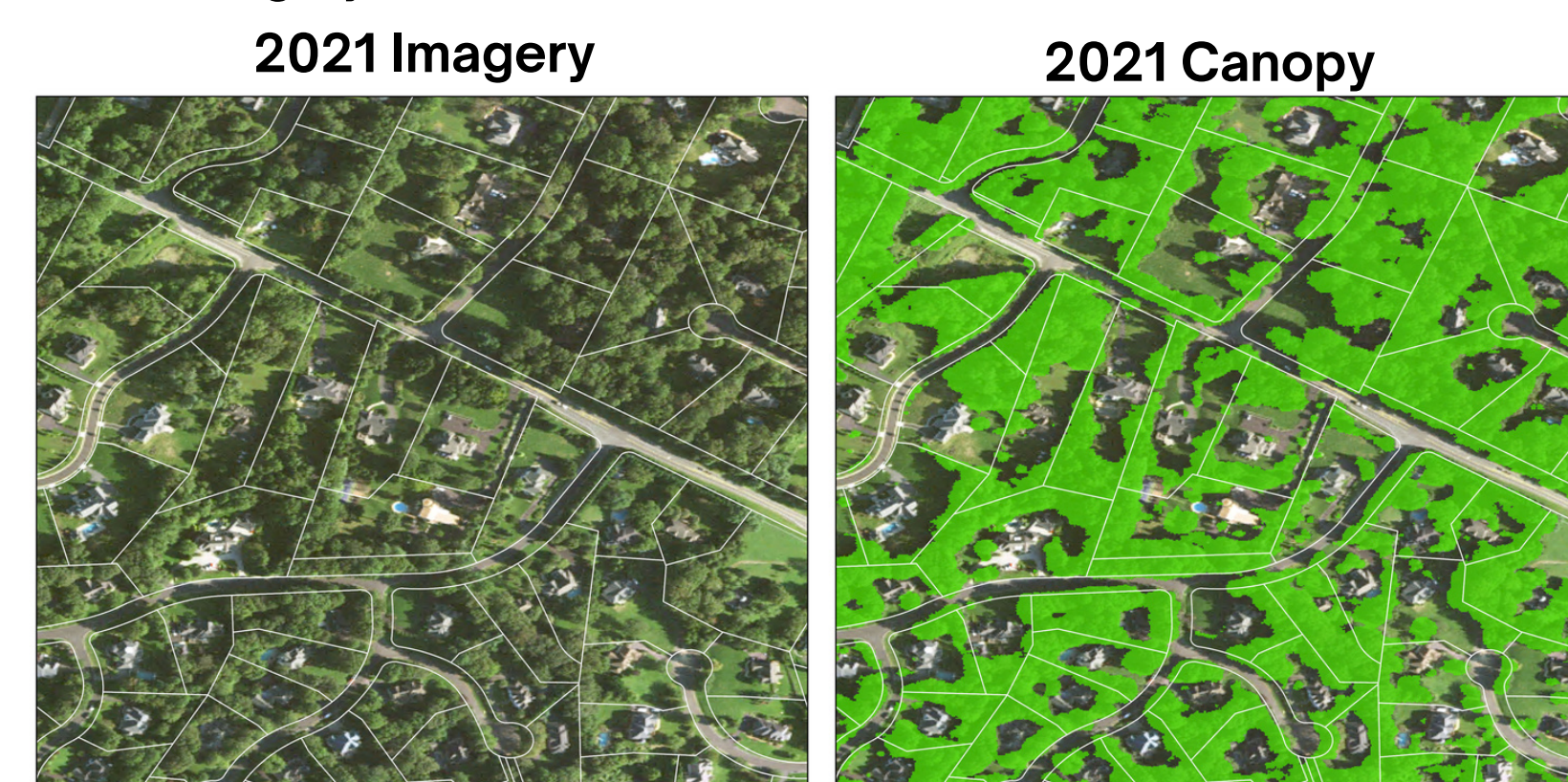


Figure 2: NAIP imagery and PlanIt Geo canopy data with parcel boundaries

In Fairfax County, 7,612 parcels were developed from 2009 to 2021. Their measured canopy in 2021 was compared to their required canopy based on zoning data. 527 parcels could not be assessed because zoning data was not available for their location. Only parcels developed from 2009 to 2011 have had the full 10 years for the canopy to grow, but the about two-thirds of parcels are meeting their estimated canopy requirements.

For the 7,085 parcels that were developed from 2009 to 2021:  
4,849 met their canopy requirements by 2021 (67%)  
2,236 did not meet their canopy requirements by 2021 (34%)

## Site Plan Canopy Data

Site plans, which are created by land developers for each parcel undergoing construction, contain the specifications for development. Within each plan, there is a section regarding the tree canopy requirements. An example of this is shown in Figure 3. The tree canopy information was extracted from a sample of 151 site plans. The sample includes plans with an approval date after January 1, 2009, when the tree conservation ordinance went into effect. Plans with a closed date between 2009 and 2011 are included in the sample because they reached the 10-year post-construction mark by 2021. Only infill lot plans with a residential zone type were included to create a homogeneous study group. 90% of plans with a closed date from 2009 to 2011 are infill lot grading plans, and 93% of these plans have residential zoning. The parcels that meet these constraints are required to have between 20% and 30% canopy. Proportionate stratified random sampling by zone code was used. Table 2 shows how many plans from each zone code were included in the sample. The size of all the parcels developed from 2009 to 2021 and the size of the sample and entire population, there are several abnormally large parcels.

Table 2: Sampling plan based on zone codes

Zone Code	Population	Percent of Population	Sample
R-E	51	12%	18
R-C	23	5%	8
R-8	1	1%	1
R-4	57	13%	20
R-3	81	19%	29
R-2	93	22%	33
R-1	118	28%	42
Total	424	100%	151

A. TREE PRESERVATION TARGET AND STATEMENT		
A1	PRE-DEVELOPMENT AREA OF EXISTING TREE CANOPY (FROM EXISTING VEGETATION MAP)	10597 SF
A2	PERCENTAGE OF GROSS SITE AREA COVERED BY EXISTING TREE CANOPY	28.0%
A3	PERCENTAGE OF 10-YEAR TREE CANOPY REQUIRED FOR SITE (SEE TABLE 12.4)	30%
A4	PERCENTAGE OF THE 10-YEAR TREE CANOPY REQUIREMENT THAT SHOULD BE MET THROUGH TREE PRESERVATION	28.0%
A5	PROPOSED PERCENTAGE OF CANOPY REQUIREMENT THAT WILL BE MET THROUGH TREE PRESERVATION	86.8%
A6	HAS THE TREE PRESERVATION TARGET MINIMUM BEEN MET?	YES
A7	IF NO FOR A6, THEN SHEET NUMBER WHERE DEVIATION REQUEST IS LOCATED	N/A
A8	IF STEP G REQUIRES A NARRATIVE, IT SHALL BE PREPARED IN ACCORDANCE WITH § 12.0507.4	N/A
B. TREE CANOPY REQUIREMENT		TOTAL
B1	GROSS SITE AREA	40717 SF
B2	SUBTRACT TO PARKS, ROAD FRONTAGE AND OTHERS	0 SF
B3	SUBTRACT AREA OF EXEMPTIONS	0 SF
B4	ADJUSTED GROSS SITE AREA (B1-B2-B3)	40717 SF
B5	SITE ZONE USE	R-1
B6	PERCENT OF 10-YEAR TREE CANOPY REQUIREMENT	30%
B7	AREA OF 10-YEAR TREE CANOPY REQUIRED (B4*B6)	12216 SF
B8	MODIFICATION OF 10-YEAR TREE CANOPY REQUIREMENT REQUESTED?	NO
B9	IF B8 IS YES, THEN LIST PLAN SHEET WHERE MODIFICATION REQUEST IS LOCATED	N/A
C. TOTAL OF 10-YEAR TREE CANOPY PROVIDED		
C1	TOTAL OF CANOPY AREA PROVIDED THROUGH TREE PRESERVATION	13248 SF
C2	TOTAL OF CANOPY AREA PROVIDED THROUGH TREE PLANTING	0 SF
C3	TOTAL OF CANOPY AREA PROVIDED THROUGH OFFSITE MECHANISM (D19)	0 SF
C4	TOTAL OF 10-YEAR TREE CANOPY PROVIDED	13248 SF

Figure 3: Excerpt of tree table from site plan

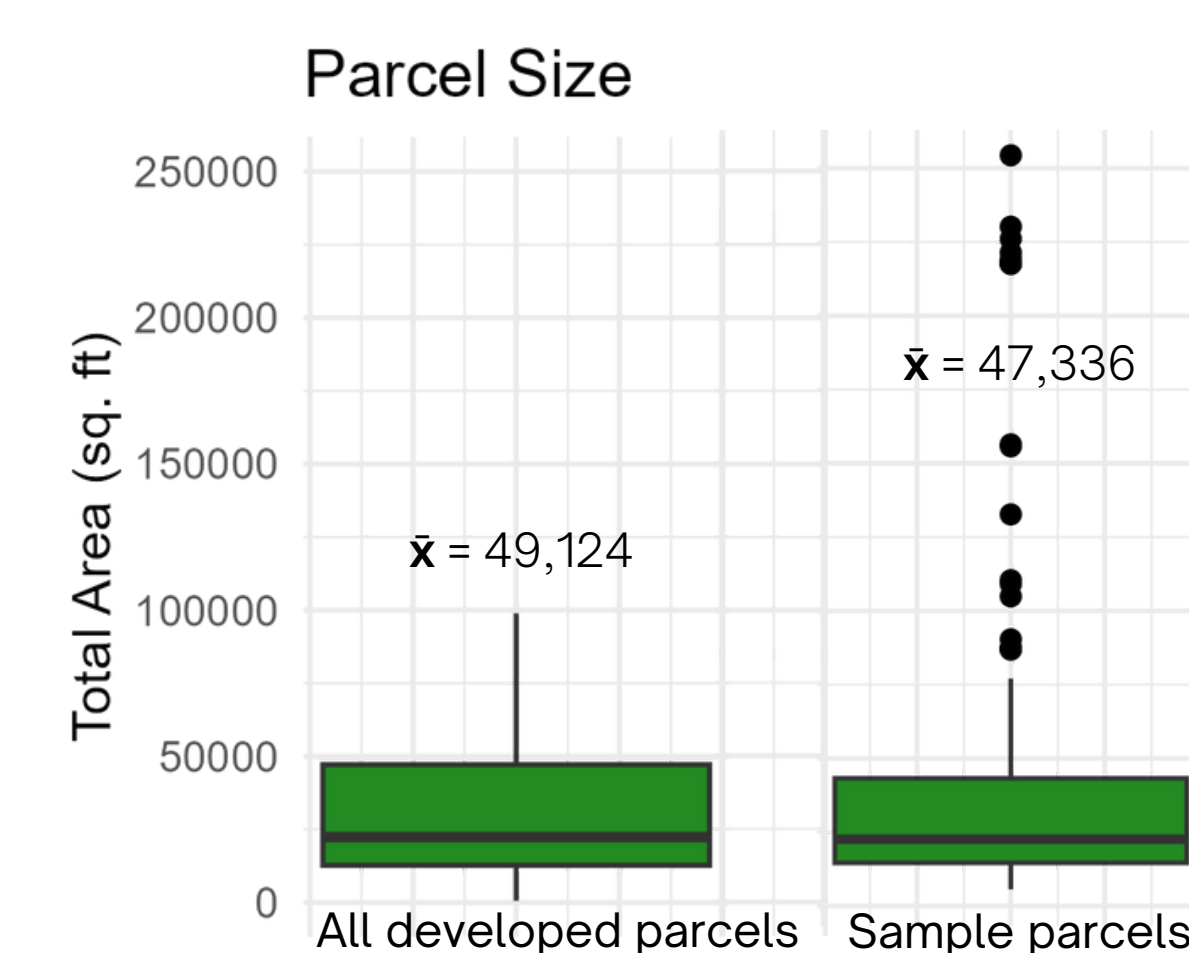


Figure 4: Parcel size for all developed parcels and sample parcels (outliers removed from all developed parcels)

## Required Canopy vs. Measured Canopy

The required canopy is what is mandated by Fairfax County's ordinance and listed in the site plan. The measured canopy is the amount of canopy on the parcel in 2021 based on PlanIt Geo's canopy data. 81% of the parcels in the sample met their canopy cover requirements. On average, the measured canopy was 12,260 square feet greater than the required canopy, and the percent measured canopy was 16.7% more than the percent required canopy on average. Figure 5 shows how many parcels met their requirements for each zone code, and Figure 6 shows the difference in measured and required canopy by zone code. All zone codes in the sample are meeting requirements about 70% of the time or greater.

For the 151 parcels in the sample:  
123 met their canopy requirements by 2021 (81%)  
28 did not meet their canopy requirements by 2021 (19%)

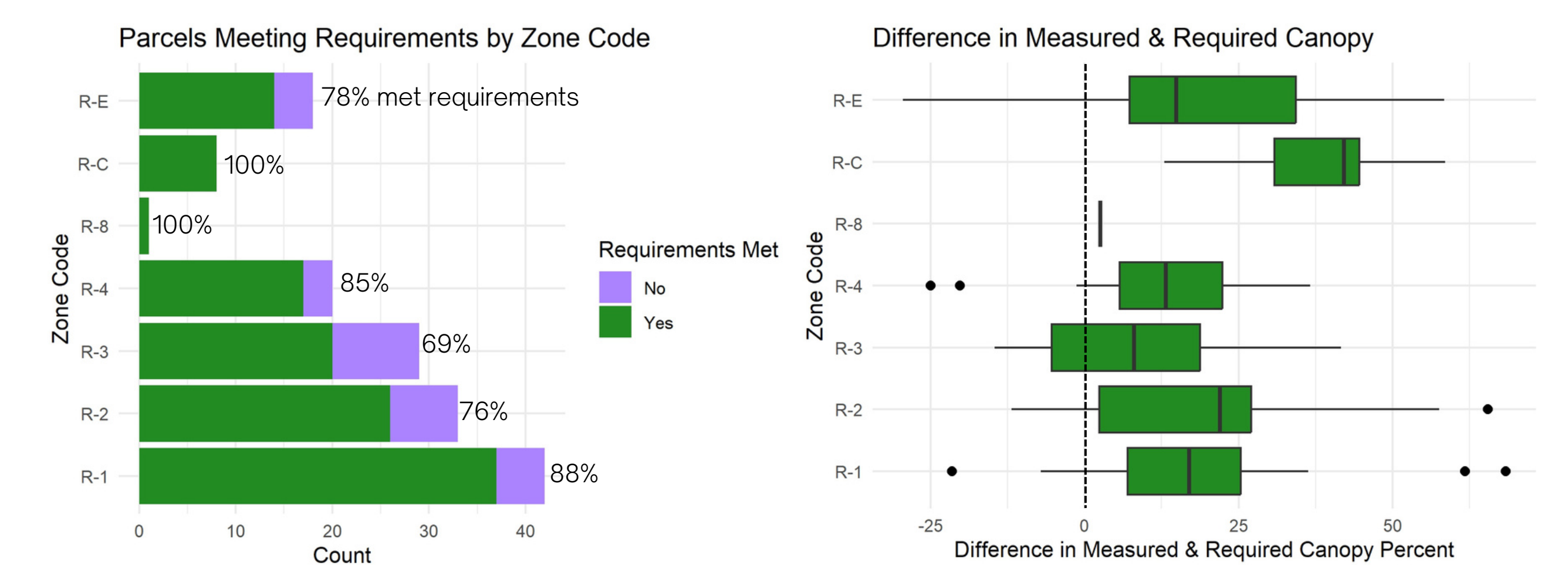


Figure 5: Parcels meeting requirements by zone code

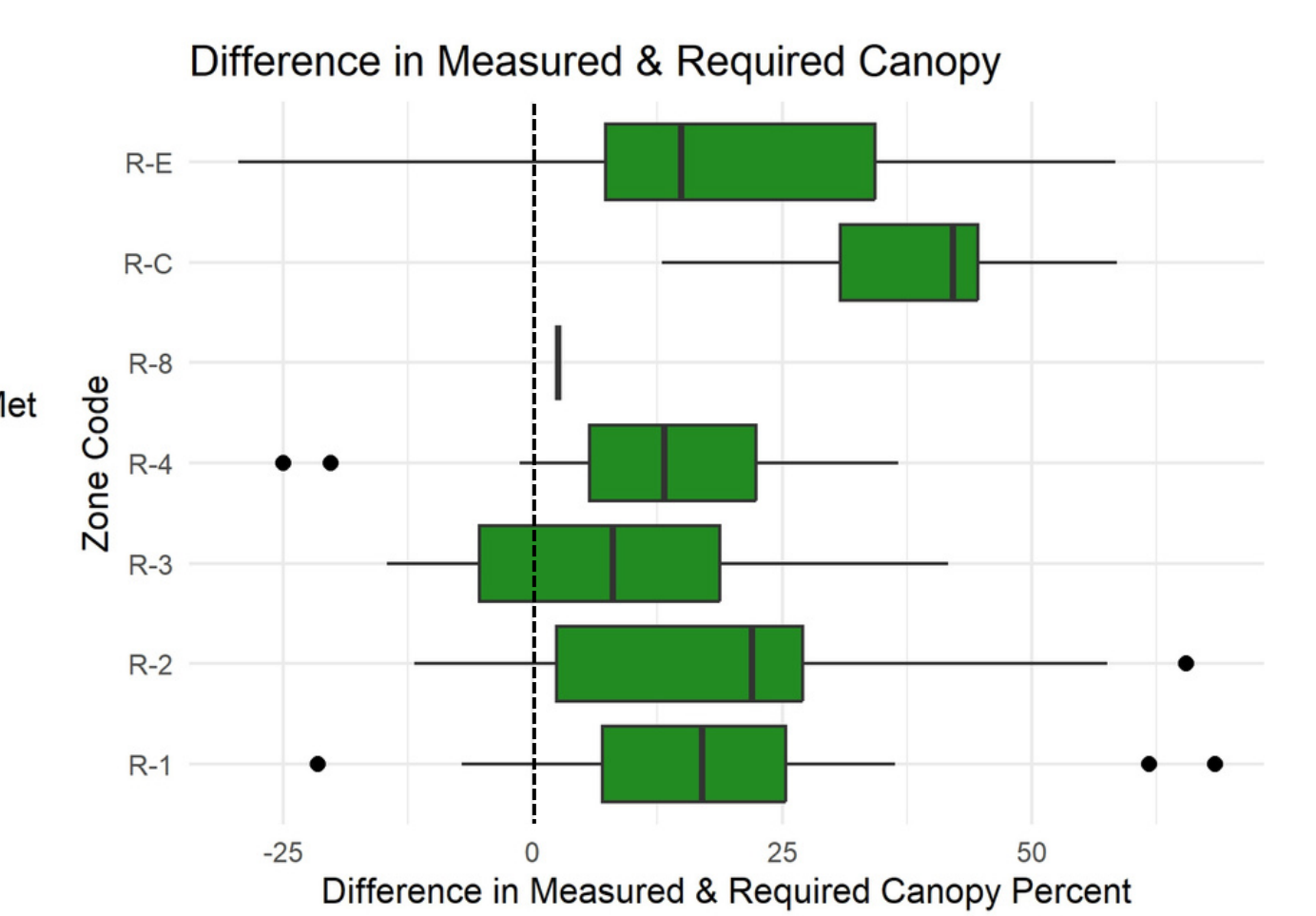


Figure 6: Difference in measured and required canopy by zone code

Total canopy deficit for parcels not meeting requirements: 1.73 acres  
Total canopy surplus for parcels meeting requirements: 44 acres

## Proposed Canopy vs. Measured Canopy

The proposed canopy is the amount of canopy the developers state they will achieve after 10 years. This is often different than the required canopy and is usually more than the required canopy. 70% of parcels in the sample met their proposed canopy. Figure 7 shows the difference in measured and proposed canopy for all the sample parcels. There are 11% more parcels meeting requirements than parcels meeting the proposed canopy. On average, the measured canopy was 1,169 square feet greater than the proposed canopy.

For the 151 parcels in the sample:  
106 met their proposed canopy by 2021 (70%)  
45 did not meet their proposed canopy by 2021 (30%)

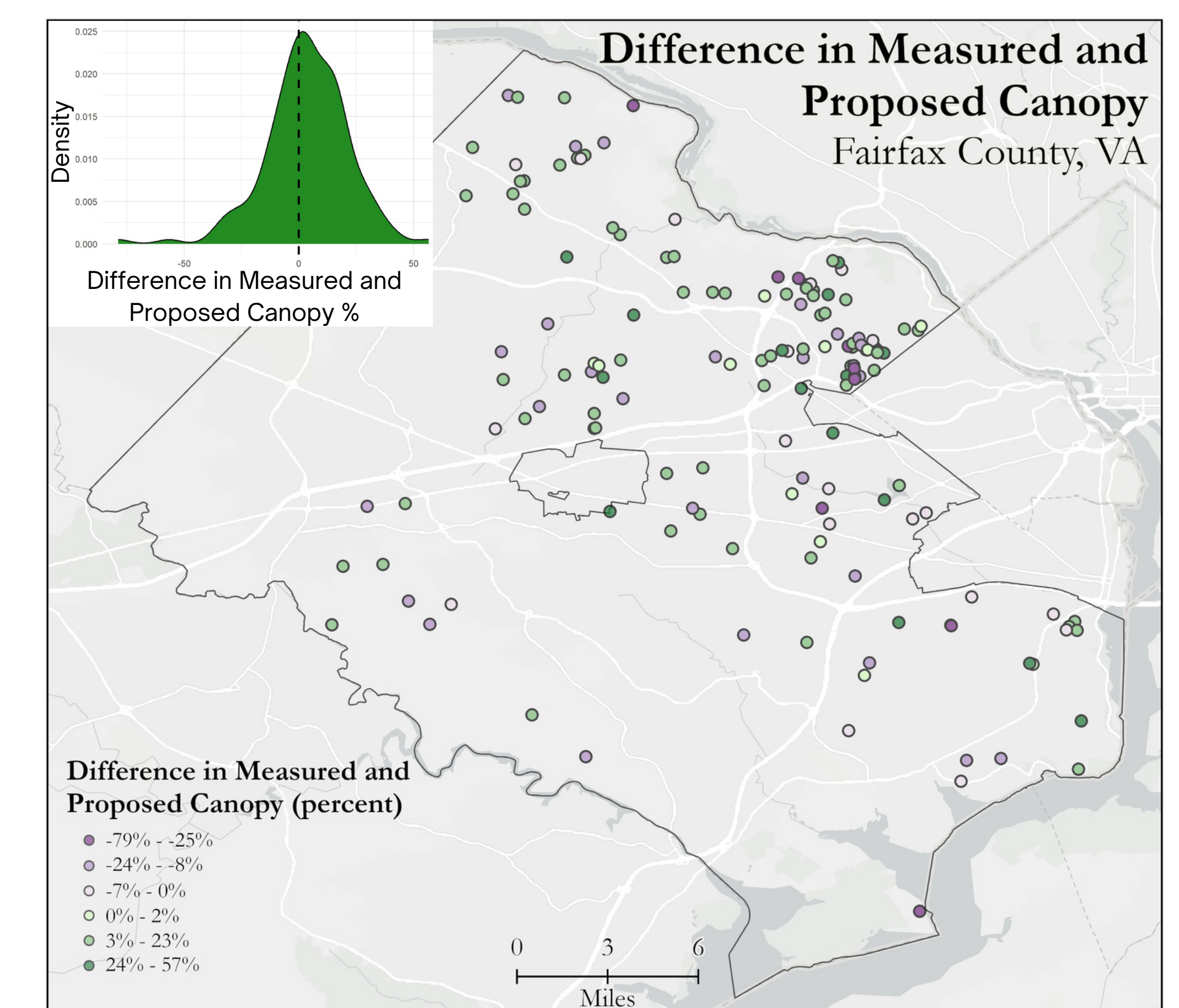


Figure 7: Difference in measured and proposed canopy of parcels and density plot of the difference