From: [redacted]
To: Lou Stubecki
Cc: canopy-research-team@

Subject: Recommendation Report: Increasing Canopy Coverage

Lou,

I hope you find yourself well during these unprecedented times. Thank you for requesting a report on the tree canopy on Seattle's downtown and industrial districts. I've worked over the past two weeks to collects qualitative and quantitative data in hopes of uncovering similarities between urban management units far below the tree canopy target. Attached is the full report, with results, analysis, and recommended changes to polices aimed to increase the canopy coverage in downtown and industrial districts.

Overall, my findings did not incisively identifying strong correlation between census data and levels of tree canopy coverage. Results showed small trends indicating households occupied by their owners, as opposed to those occupied by renters, have greater levels of tree canopy. Based on these trends, I suggest targeting the private land ownership of industrial buildings and high-rise residential structures. I recommend this be done by implementing the following policy changes:

- Requiring the planting of trees on the roofs of new multi-level structures.
- Requiring the planting of (n) number of trees per (x) area of uncovered parking space.
- Provide finical incentives for the ownership and care of trees in urban forestry management units with lowest levels of tree canopy.

Further investigations should be conducted before moving forward with any of these changes; to better identify factors that limit tree canopy coverage, and to understand cost of implementing the recommended changes.

Please read the full report and let me know by email before June 10th if you would like me to conduct additional research on the subject, or shift my research to another focus.

I look forward to hearing your response.

Sincerely,
[redacted]

Altering building code to Improve Tree Canopy Cover in Downtown and Industrial District

Executive Summary

The city of Seattle had the goal of achieving 30% tree canopy coverage by 2037. The most recent study conducted by the City of Seattle that 28% of Seattle is under a tree canopy. The same study found that residential areas and the right-of-way, city-owned land between a street and private property, are the most significant contributor to the tree canopy.

My research began with a class discussion with Lou Stubecki, an Arborculturist from the City of Seattle, where he suggested limited planting space hindered the levels of canopy coverage in urban forestry management units below the 30% goal. I obtained qualitative data obtained from the "Trees for Seattle" and "About Seattle's Neighborhood" websites, containing data on all of Seattle's census tracts. I compared six statistics from 20 census tracts and compared them to the percentage of tree canopy coverage: population density, household density, family-type household percentage, median household income, housing unit density, percentage of owner-occupied housing units. Maps of canopy coverage placed beside maps of trees categorized by their owner type: red dots indicate private ownership; all other colored dots represent city-owned trees.

Results did not reveal a conclusive correlation between any tree canopy coverage and another set of census data, but did show slight trends that support the following statements:

- Canopy coverage is higher in areas with a low population density
- Canopy coverage is higher in areas containing mainly family households
- Canopy coverage is higher in areas where owners occupy housing units as opposed to renters.
- Canopy coverage is higher in areas with higher median household income

The maps were less conclusive but hinted at a higher ratio of public tree ownership to private tree ownership in areas with low levels of canopy coverage.

I recommend the implementation of the following building requirement for new constructions:

- The planting of trees on the roofs of new multi-level structures.
- The planting of (n) number of trees per (x) area of uncovered parking space.

I also recommend providing financial incentives for businesses and landowners to install planting lots within their property. These recommendation aim to increase the canopy coverage in Seattle's downtown, industrial district, and multi-use non-residential areas.

Introduction

Planting trees within cities provide extensive benefits. The City of Seattle currently estimates the annual benefit of urban trees to be worth slightly over 24 million dollars. These estimates take into consideration factors like air quality improvements, CO_2 sequestration, stormwater drainage, energy savings, and aesthetic benefits; a monetary value cannot be placed and all the benefits urban trees provide for Seattle.

The City of Seattle Conducted their most recent canopy cover study in 2016. The study found that 28% of Seattle's total area was covered by tree canopy. Residential areas and the right-of-way, city owned land between a street and private property, were the largest contributors to tree canopy in the city with 72% and 22% of the total canopy respectively.

The City of Seattle identified three categories that determined canopy cover:

- Land usage
- Presence of parks and natural areas
- Socio-economic factors

The 2016 study found that residents of color and people in lower income brackets have lower levels of tree canopy.

A 2015 analysist estimated a canopy cover loss of 2% between 2010 and 2015 (3% margin of error).

When constructing this report, I aimed to identify socio-economic factors in the census tracts with the lowest tree canopy coverage. Census tracts are roughly equivalent to a neighborhood as established by the Census Bureau, containing between 2,500 and 8,000 people.

Currently, 18 of 27 Urban Forestry Management Units have a tree canopy cover below 30%, three of those units have tree canopy coverage below 13%. Two of the units below 13% are located in the Downtown area, the final district encompasses an Industrial area. Zooming into the Forestry Management Districts reveals the census tracts contained within each districts. The Trees for Seattle website provided the geographical location of roughly 250,000 trees and their owners – Private, SDOT, Seattle Park and Recreation, Other City Departments and Public Agencies.

Research Method

My research began with a class discussion with Lou Stubecki, an Arboriculturist for the City of Seattle, who introduced the class to Trees for Seattle and provided a review of Seattle's urban forestry project. The discussion with Stubecki laid the foundation for my research but did not conceive qualitative data.

Urban forestry management units contain several census tracts. When I conducted my research, I looked at census tract data as there was more information regarding socio-economic statistics for census tracts than for the larger urban forestry management units. I aimed to identify similarities amongst census tracts with high tree canopy deficits and compare these to census tracts near or above the 30% tree canopy target. To keep my research consistent, I exclusively used census and urban forestry data available through the City of Seattle Department websites. I created two sets of data to present my research: quantitative socio-economic census tract data, and qualitative map comparisons.

Quantitative Socio-economic Census Tract Data

I compared numbers from the "Trees for Seattle | Street Trees" website to figures from the "About Seattle's Neighborhoods" website. Specifically, I created charts that compared tree canopy coverage with five census tract statistics:

- Population density
- Percentage of family-type households
- Housing unit density
- Percentage owner-occupied housing unit
- Median household income

Each chart contains a total of twenty data points; ten are from the census tracts with the lowest percentage of tree canopy coverage, ten census tracts have a tree canopy coverage near or above 30%. Each of the census tracts that represent areas of high canopy coverage reside in one of the urban forestry management units with and average tree canopy coverage above 30%. I had two criteria when selecting the a single census tract from the urban forestry management unit: (1) the census tract did not encompass a park, and (2) the census tract had a canopy coverage comparable to canopy coverage of the urban forestry management unit.

Qualitative Map Comparisons

Two maps were compared for this analysis; one map showed Seattle's trees and their owner type, the other showed census tracts with and their level of canopy coverage. I aimed to find trends between tree ownership type and canopy coverage by placing the maps side-by-side.

Findings

During the classroom discussion, Stubecki suggested that limited space to plant tree was the biggest challenge to achieving 30% tree canopy in urban forestry management units #26, #27, and #8. All these management units encompass what would be consider downtown Seattle or industrial areas.

Quantitative Socio-Economic Census Tract Data

This section contains charts with distinct socio-economic factors, meant to identify correlations between them and tree canopy coverage.

For the each of the six charts:

- % tree canopy coverage indicated on x-axis
- Census tract statistic indicated on y-axis
- R^2 indicates how close the data of the chart fits the trend line. The value of R^2 is between 0 and 1; the higher the value of R^2, the better the trendline represent the data.
- The slop is indicated in the format: "y = mx + b" where "m" is the slope of the trend line. A negative slope indicates the % of tree canopy coverage decreases as the respective variable increases, and vice versa.

Figure 1 shows tree canopy coverage decrease as population density increases. R_2 is low, below 0.5, meaning the data points do not fit the trend line closely. Data points with higher canopy coverage have a population density ranging from 5.03-16.01 (people/acre), while data points with lower canopy coverage have a population density ranging from 0.88-66.15 (people/acre).

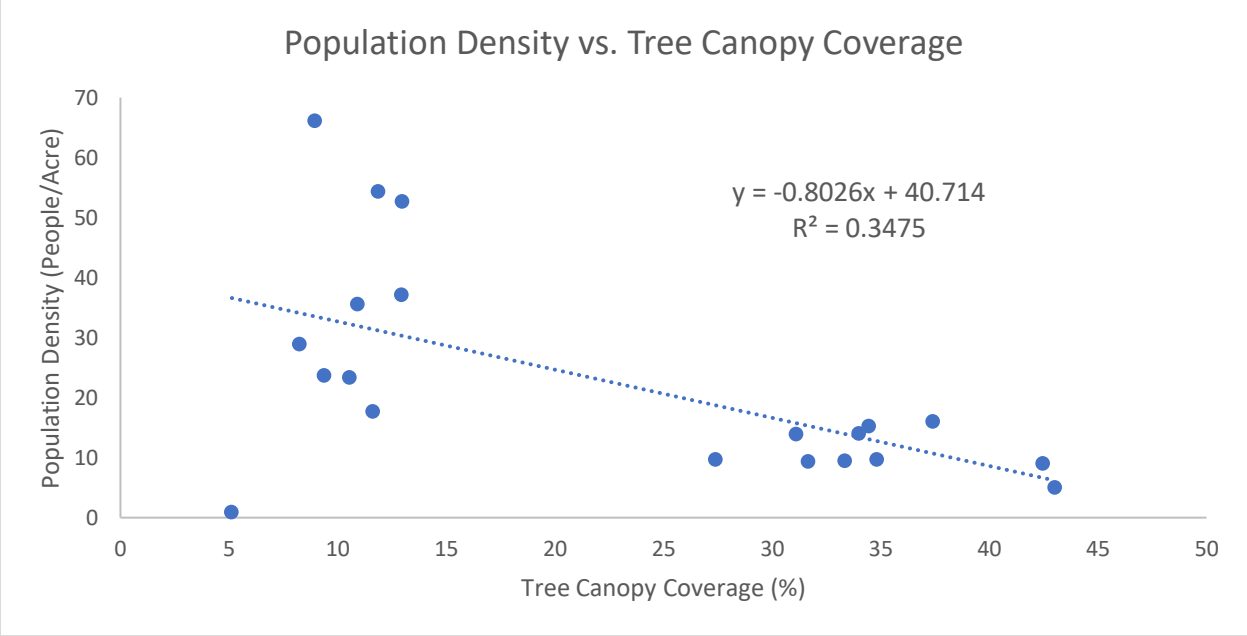


Figure 1: comparing population density to tree canopy coverage.

Figure 2 shows tree canopy increases as the percentage of family-type housing units increase. Family-type households are defined by Census Bureau as, "[Housing unit containing] family householder and all other people in the living quarters who are related to the householder by birth, marriage, or adoption." R_2 is above 0.5, meaning the data points fit the trendline relatively well. Census tracts with higher levels of canopy coverage have family-type households ranging from 51.8-75.9%, census tracts with lower canopy coverage have a family-type households ranging from 15.0-32.8%.

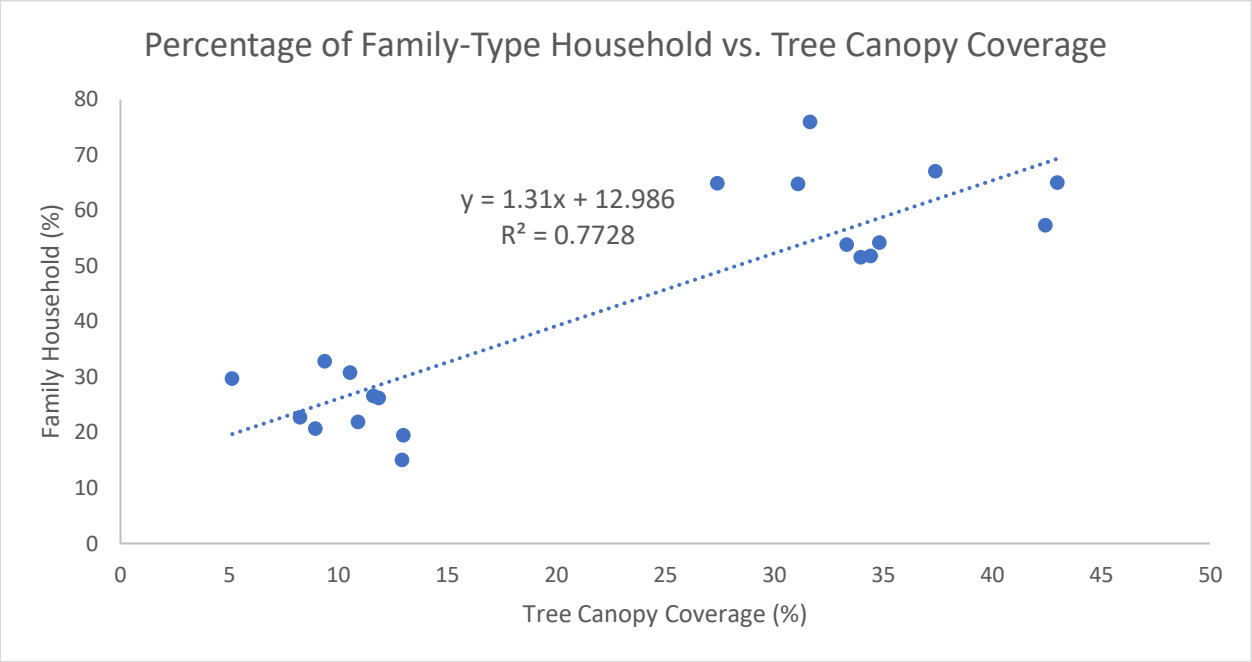


Figure 2: comparing the percentage of family households to tree canopy coverage.

Figure 3 shows that tree canopy increase as median household income increases. Income figures were taken before payments for personal income taxes, social security, union dues, Medicare deductions, etc. R_2 is below 0.5, meaning the data points do not fit the trendline well. Census tracts with higher levels of canopy coverage have a median household income ranging between $52,957-$167,368, census tracts with lower canopy coverage have a median household income ranging between $21,868-$98,250.

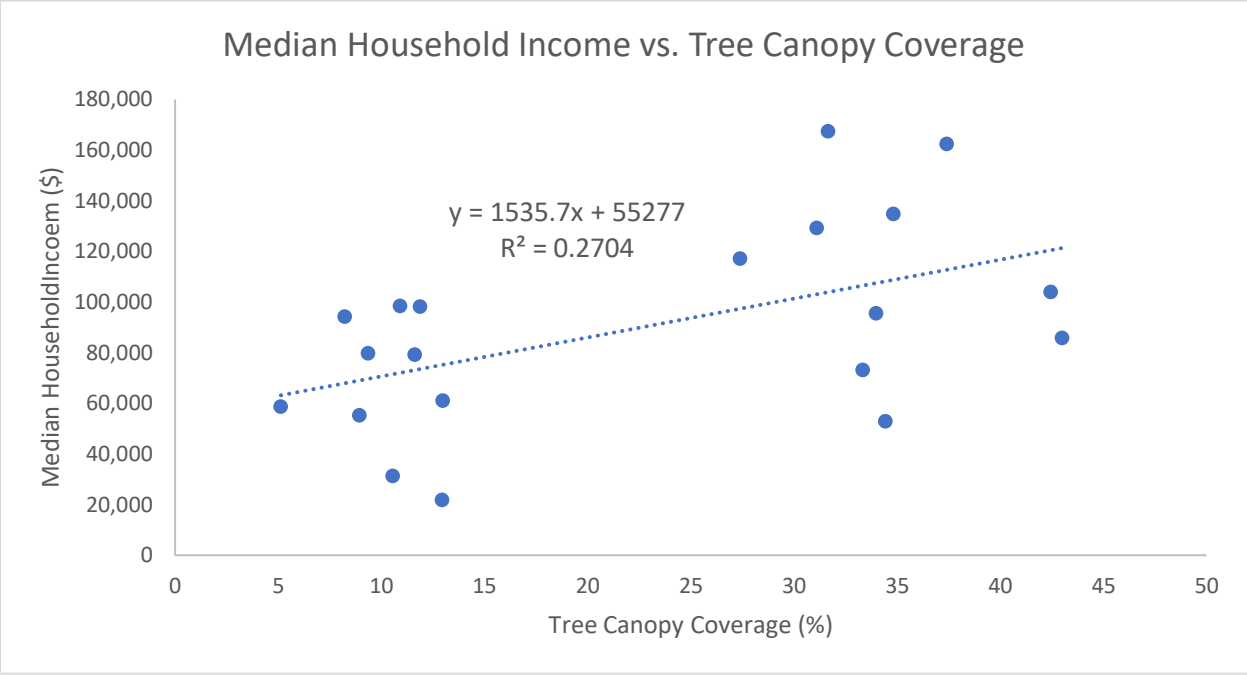


Figure 3: comparing median household income to tree canopy coverage.

Figure 4 shows that tree canopy increases as housing unit density decreases. R_2 is below 0.5, meaning data points do not fit the trendline closely. Census tracts with higher canopy coverage have a housing unit density ranging between 1.88-6.95 (housing units/acre), census tracts with lower canopy coverage have a housing unit density ranging between 0.52-43.8 (housing units/acre).

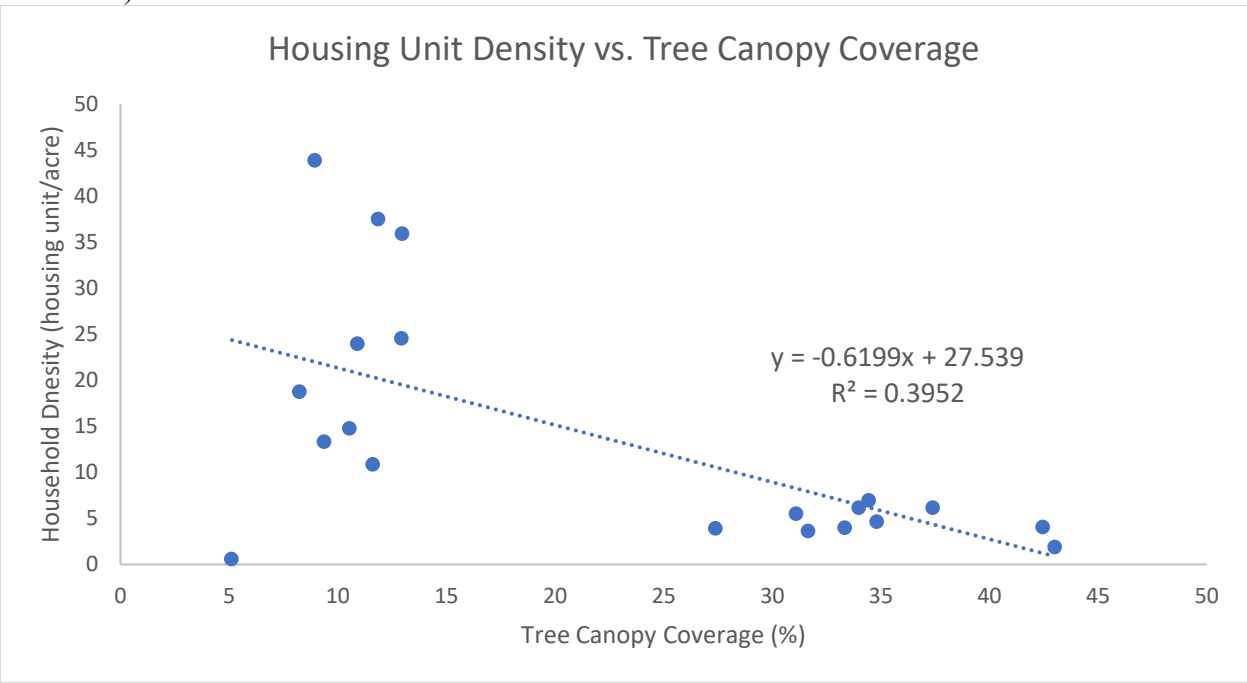


Figure 4: comparing housing unit density to tree canopy coverage.

Figure 5 shows that tree canopy coverage increases as percentage of owner-occupied housing units increases. R_2 is above 0.5, meaning the data points fit the trendline relatively well. Census tracts with higher levels of canopy coverage have owner-occupied housing units ranging from 51.1-93.7%, census tracts with lower canopy coverage have a owner-occupied housing units ranging from 5.9-48.2%

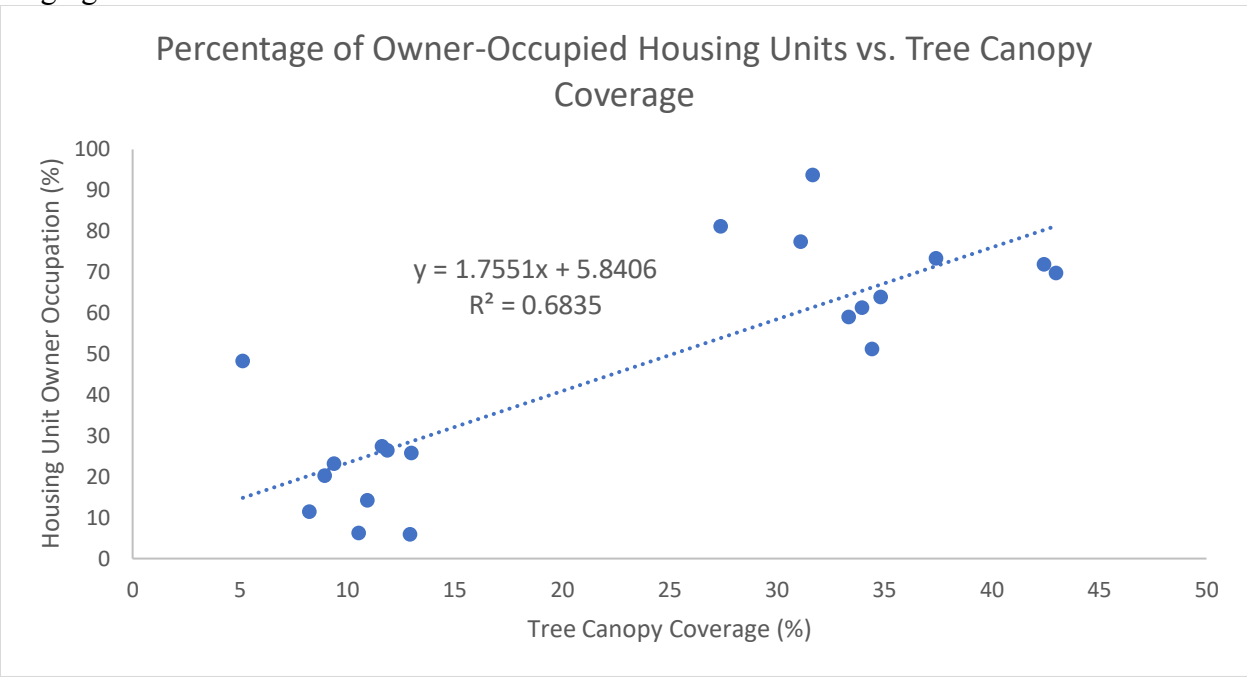
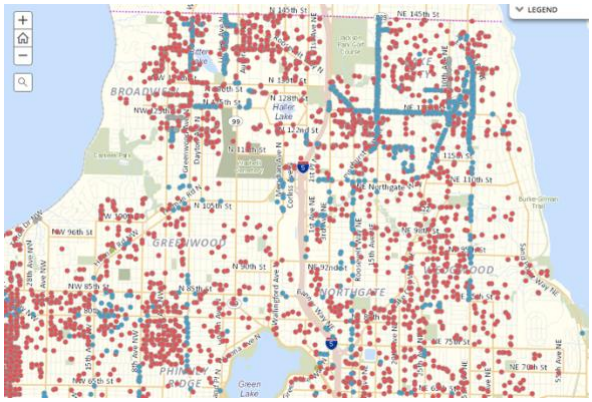
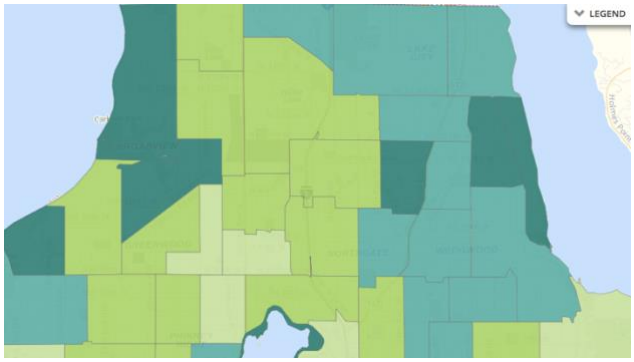


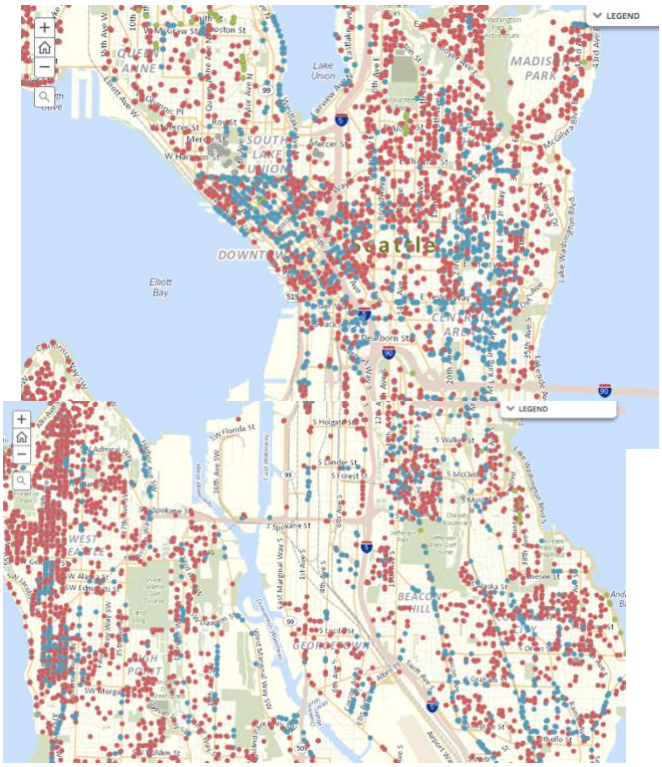
Figure 5: comparing the percentage of owner-occupied housing units to tree canopy coverage.

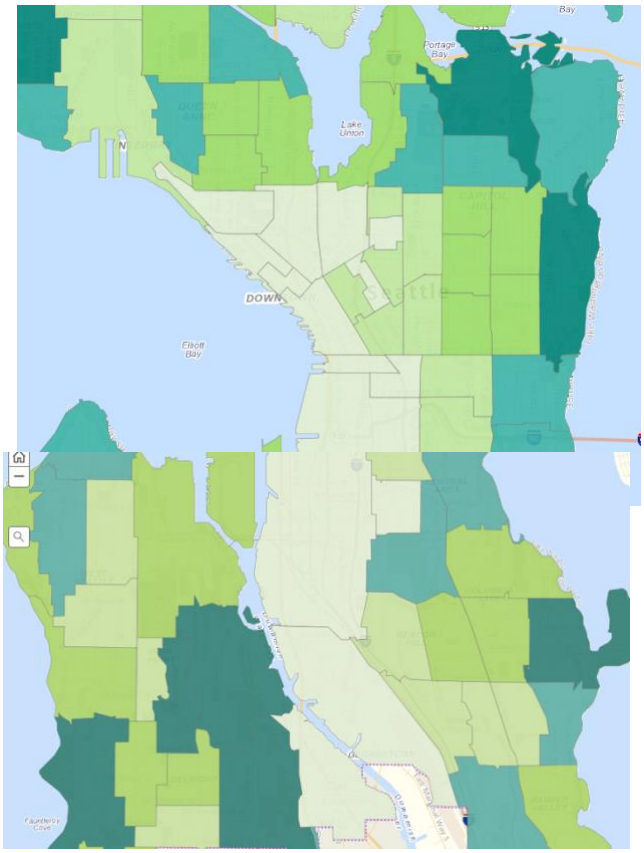
Qualitative Map Comparison

The map on the left shows trees by their owner: red dots are privately owned trees, blue dots are trees owned by STOD, green dots are owned by the Seattle Parks and Recreation, grey dots are owned by other public agencies. The map on the right shows Seattle's census tracts, which are colored to represent canopy coverage; darker greats indicate higher levels of canopy coverage, while lighter greens indicate lower levels of canopy coverage. Parks can be identified by a pale green color on the left-hand map.









Conclusions

The charted data did not demonstrate any concessive finding, but provide general trends to support the following statements:

- Canopy coverage is higher in areas with low population density
- Canopy coverage is higher in areas containing mainly family households
- Canopy coverage is higher in areas where housing units are occupied by owners as opposed to renters.
- Canopy coverage is higher in areas with higher median household income

The trends point to a higher tree canopy coverage in private residences such, such as family homes. Seattle coasty housing market may contribute to tree deficit being prevalent in areas with low household income; individuals with household incomes will find it more difficult to buy their housing units and choose to rent their residence.

Maps comparisons were less substantial than information obtained from the charts. The ratio of red dots to other colored dots appears to be lower in downtown Seattle and the industrial area. This can be attributed to lower percentage of housing unit occupied by owners as opposed to renters in those areas. There will be less attachment to property one does not own, so a person will be less likely to decide and own and care for a street tree.

Recommendation

Based on the conclusion drawn from my findings, I would recommend the following changes to approach the 30% canopy coverage:

- **(n) number of tree be planted per (x) area of uncovered parking for new construction**. This change targets large paved parking areas in the industrial districts. Converting some of the paved ground to soil and planting will limit the swaths of land between trees.
- **Build planting plots on rooftops of multi-level structures.** This change aims to increase canopy coverage in the downtown Seattle. Planting trees on the rooftops of high-rise buildings will place canopy in areas consumed by the footprint of large structures, increasing the canopy of downtown without needing to change the current right-of-way.
- **Provide finical incentives to owner of existing properties to convert paved ground to soil beds and plant trees.** This change targets areas with low levels of home-ownership or non-residential structures. Residents living in rented property may not have the space or option to plant trees, providing incentives for property owners to create space for trees will increase the canopy coverage in multi-use or non-residential areas of Seattle.

Researching the cost and impact of my proposed recommendations is needed before implementation. By the City of Seattle's own estimation, urban trees provide over 24 million dollars in annual benefits, increasing the number of trees should offset some of the cost associated with my recommended changes.

References

- “Story Map Series.” *Seattlecitygis.maps.arcgis.com*, seattlecitygis.maps.arcgis.com/apps/MapSeries/index.html?appid=a7072ffa326c4ef39a0f031961ebace6.
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- US Census Bureau. “Subject Definitions.” *The United States Census Bureau*, 7 Aug. 2019, www.census.gov/programs-surveys/cps/technical-documentation/subject-definitions.html.