

URBAN TREE CANOPY ASSESSMENT

BELLEVUE,
WASHINGTON
JULY | 2022





AN ASSESSMENT OF
URBAN TREE CANOPY IN
**BELLEVUE,
WASHINGTON**



**We do not inherit
the Earth from
our ancestors—
we borrow it from
our children.**

-Chief Seattle



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PREPARED FOR

City of Bellevue, Washington

COMPLETED

June 2022

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**8,459 ACRES OF
TREE CANOPY
COVERING 39%
OF BELLEVUE**

EXECUTIVE SUMMARY

PURPOSE OF THIS ANALYSIS

The City of Bellevue is located within King County, Washington, in the Seattle metropolitan area (Figure 1). It is approximately 33.8 square miles or 21,623 acres. Across the city, trees along streets, in parks, yards, and natural areas constitute a valuable urban and community forest. This resource is a critical element of the region's green infrastructure, contributing to environmental quality, public health, water supply, local economies, and aesthetics. The primary goal of this assessment was to provide an updated baseline and benchmark of the City's tree canopy, assess how it has changed, and interpret the results across a range of geographic boundaries.

URBAN TREE CANOPY IN BELLEVUE

In 2019, Bellevue had 39% urban tree canopy (UTC) cover, 22% possible planting area (PPA), and 39% unsuitable areas for planting not including any surface water bodies within the city boundary. The City's total land cover including surface water bodies contained 39% tree canopy, 2% shrub vegetation, 21% other vegetation; 0.1% soil/dry vegetation; 38% impervious surfaces, and 1% water. Urban tree canopy assessments routinely exclude surface water bodies when reporting tree canopy and plantable space percentages. In further dividing the City's urban tree canopy, 8% was overhanging

impervious surfaces. The City has commissioned several UTC assessments in the past, but most of them used different techniques to map and quantify tree canopy and land cover making accurate comparisons challenging. This study created a current (2019) and historical (2011) land cover map using identical methods. The City of Bellevue gained 2% (411 acres) urban tree canopy since 2011.

ASSESSMENT BOUNDARIES AND ANALYSIS RESULTS

This study assessed UTC and PPA at multiple geographic scales to provide actionable information to a diverse range of audiences. By identifying what resources and opportunities exist at these scales, the City can be proactive in their approach to protect and expand their urban tree canopy. Metrics were generated at the following geographies: the citywide boundary (1); City of Bellevue designated future land use classes (6); neighborhoods (16); 100-foot stream buffers (1); drainage basins (28); schools (81); U.S. census block groups (109), and right-of-way areas within census block groups (103). Changes in canopy from 2011 to 2019 were assessed within the same boundaries.



Figure 1. | Bellevue occupies approximately 33.8 square miles in King County, Washington.

RECOMMENDATIONS

The results of this analysis can be used to develop a continued strategy to protect and expand Bellevue’s urban forest. Previous studies indicated that Bellevue has lost a substantial amount of its canopy, but this study revealed that Bellevue’s citywide canopy has actually grown. The trend of large canopy losses has slowed as development of natural areas has declined. Additionally, trees in the City’s residential areas have experienced significant growth. Annexation, population growth, and land use changes are all factors of the urban environment that can contribute to changes in citywide canopy numbers. It is important for the City to use this assessment to inform future investments in the urban forest so that all those who live, work, and play in Bellevue can benefit from the urban forest. The City must proactively work to protect the existing urban forest and replenish the canopy with additional trees. Through management actions, strategic plantings, and protections for existing canopy informed by the UTC, PPA, and change metrics included in this report, Bellevue has an opportunity to expand its current urban tree canopy to its fullest potential.



Figure 2. | Based on an analysis of 2019 high-resolution imagery, Bellevue contains 39% tree canopy, 22% areas that could support canopy in the future, and 39% unsuitable areas for planting.

PROJECT METHODOLOGY

Land cover, urban tree canopy, and possible planting areas were mapped using the sources and methods described below. These data sets provide the foundation for the metrics reported at the selected geographic assessment scales.

DATA SOURCES

This assessment utilized high-resolution (60-centimeter) multispectral imagery from the U.S. Department of Agriculture's National Agriculture Imagery Program (NAIP) collected in 2019 to derive the land cover data set. The NAIP imagery was used to classify all types of land cover.

MAPPING LAND COVER

The land cover data set is the most fundamental component of an urban tree canopy assessment. Tree canopy and land cover data from the EarthDefine US Tree Map (<https://www.earthdefine.com/treemap/>) provided a six-class land cover data set. The US Tree Map is produced using a modern machine learning technique to extract tree canopy cover and other land cover types from the latest available 2019 NAIP imagery. These six classes are shown in Figure 3 and described in the Glossary on page 31.



**URBAN TREE
CANOPY**



SHRUB



**OTHER
VEGETATION**



**SOIL AND DRY
VEGETATION**



**IMPERVIOUS
SURFACES**



**SURFACE
WATER**

Figure 3. | Six (6) distinct land cover classes were identified in the 2019 tree canopy assessment: urban tree canopy, shrub, other vegetation, bare soil and dry vegetation, impervious (paved) surfaces, and water.

IDENTIFYING POSSIBLE PLANTING AREAS AND UNSUITABLE AREAS FOR PLANTING

In addition to quantifying Bellevue’s existing tree canopy cover, another metric of interest in this assessment was the area where tree canopy could be expanded. To assess this, all land area in Bellevue that was not existing tree canopy coverage was classified as either possible planting area or unsuitable for planting.

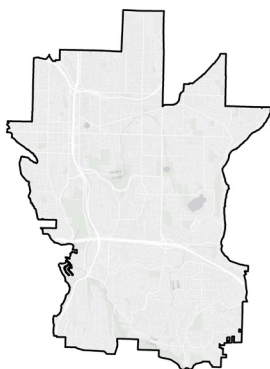
Possible planting areas were derived from the non-canopy vegetation layer. Unsuitable areas, or areas where it was not feasible to plant trees due to biophysical or land use restraints (e.g. golf course playing areas, recreation fields, utility corridors, etc.), were manually delineated and overlaid with the existing land cover data set (Figure 4).



Figure 4. | Vegetated areas where it would be biophysically feasible for tree plantings but undesirable based on their current usage (left) were delineated in the data as “Unsuitable” (right). These areas included recreational sports fields, golf courses, and other open space.

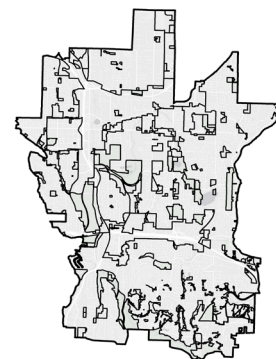
DEFINING ASSESSMENT LEVELS

In order to best inform the City of Bellevue’s various stakeholders, urban tree canopy and other associated metrics were tabulated across a variety of geographic boundaries (Figure 5). These boundaries include the city boundary, designated land use classes, neighborhoods, stream corridors, drainage basins, schools, census block groups, and right-of-way by census block groups.



CITY BOUNDARY

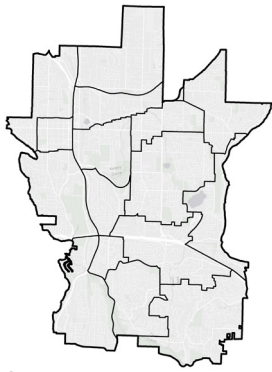
The City of Bellevue’s **citywide boundary** is the one (1) main area of interest over which all metrics are summarized.



LAND USE CLASSES

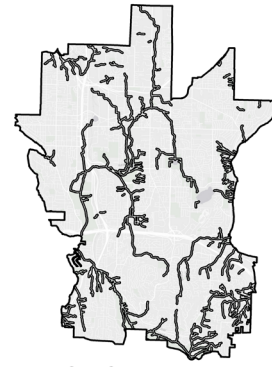
Six (6) designated **land use classes** were also assessed to provide detail on the current human land use configuration of the city.

Figure 5. | Eight (8) distinct geographic boundaries were explored in this analysis: the full city boundary, designated land use classes, neighborhoods, stream corridors, drainage basins, schools, census block groups, and right-of-way by census block groups.



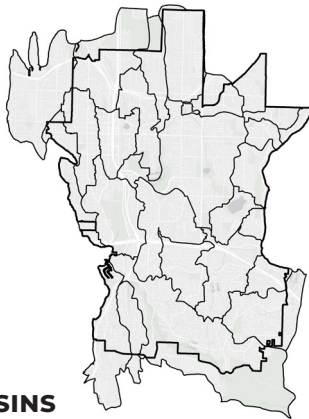
NEIGHBORHOODS

Sixteen (16) **neighborhoods** were assessed to quantify urban tree canopy at an easily-conceptualized scale.



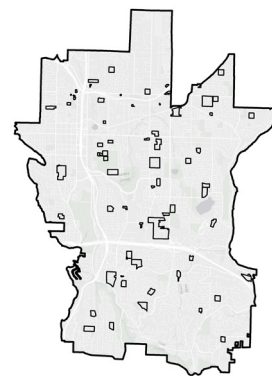
STREAM CORRIDORS

Stream corridors play an important role in urban environments. Tree canopy within 100 feet of streams was assessed.



DRAINAGE BASINS

Since trees play an important role in storm water management, twenty-eight (28) **city drainage basins** were also assessed.



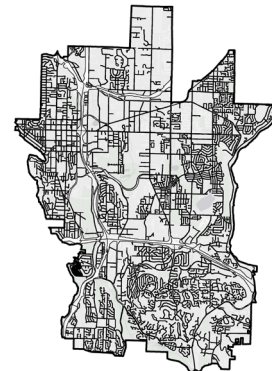
SCHOOLS

UTC was assessed for all of the **schools** in Bellevue, totaling eighty-one (81).



CENSUS BLOCK GROUPS

One hundred and nine (109) **census block groups** were assessed to provide information at a small geographic scale. Census block groups (CBGs) are used by the U.S. Census Bureau to assure statistical consistency when tracking populations across the United States and can be valuable indicators of environmental justice as they are directly linked with demographic and socioeconomic data.



RIGHT OF WAY BY CENSUS BLOCK GROUP

In addition to the UTC throughout the census block groups' entire areas, UTC was also assessed within the **right-of-way found within each census block group**. This measure is useful for quantifying and tracking Bellevue's street trees.

Figure 5. | Eight (8) distinct geographic boundaries were explored in this analysis: the full city boundary, designated land use classes, neighborhoods, stream corridors, drainage basins, schools, census block groups, and right-of-way by census block groups.

STATE OF THE CANOPY AND KEY FINDINGS



This section presents the key findings of this study including the land cover base map, canopy analysis, and change analysis results, which were analyzed across the various geographic boundaries described in the previous section. These results, or metrics, help inform a strategic approach for identifying existing canopy to preserve as well as areas suitable to plant trees in the future. Urban tree canopy, possible planting area, and areas unsuitable for planting are presented as percentages of the City’s land area with bodies of water omitted.

CITYWIDE LAND COVER

In 2019, tree canopy constituted 39% of Bellevue’s land cover; shrub was 2%; other vegetation was 21%; soil/dry vegetation was 0.1%; impervious was 38%; and water was 1%. These land cover results are presented below in Table 1.

LAND COVER CLASS	ACRES	% OF TOTAL
Tree Canopy	8,459	39%
Other Vegetation	4,459	21%
Shrub	394	2%
Impervious Surfaces	8,113	38%
Soil & Dry Vegetation	17	0.1%
Water	181	1%

Table 1. | Land cover classification results

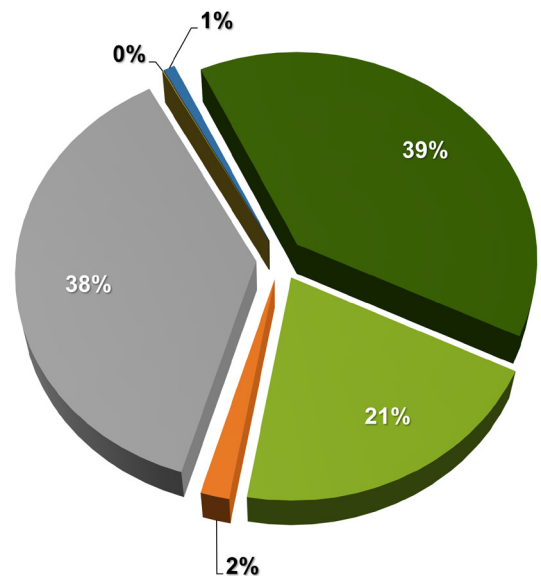


Figure 6. | Land cover classification results (percentages based on total city area).

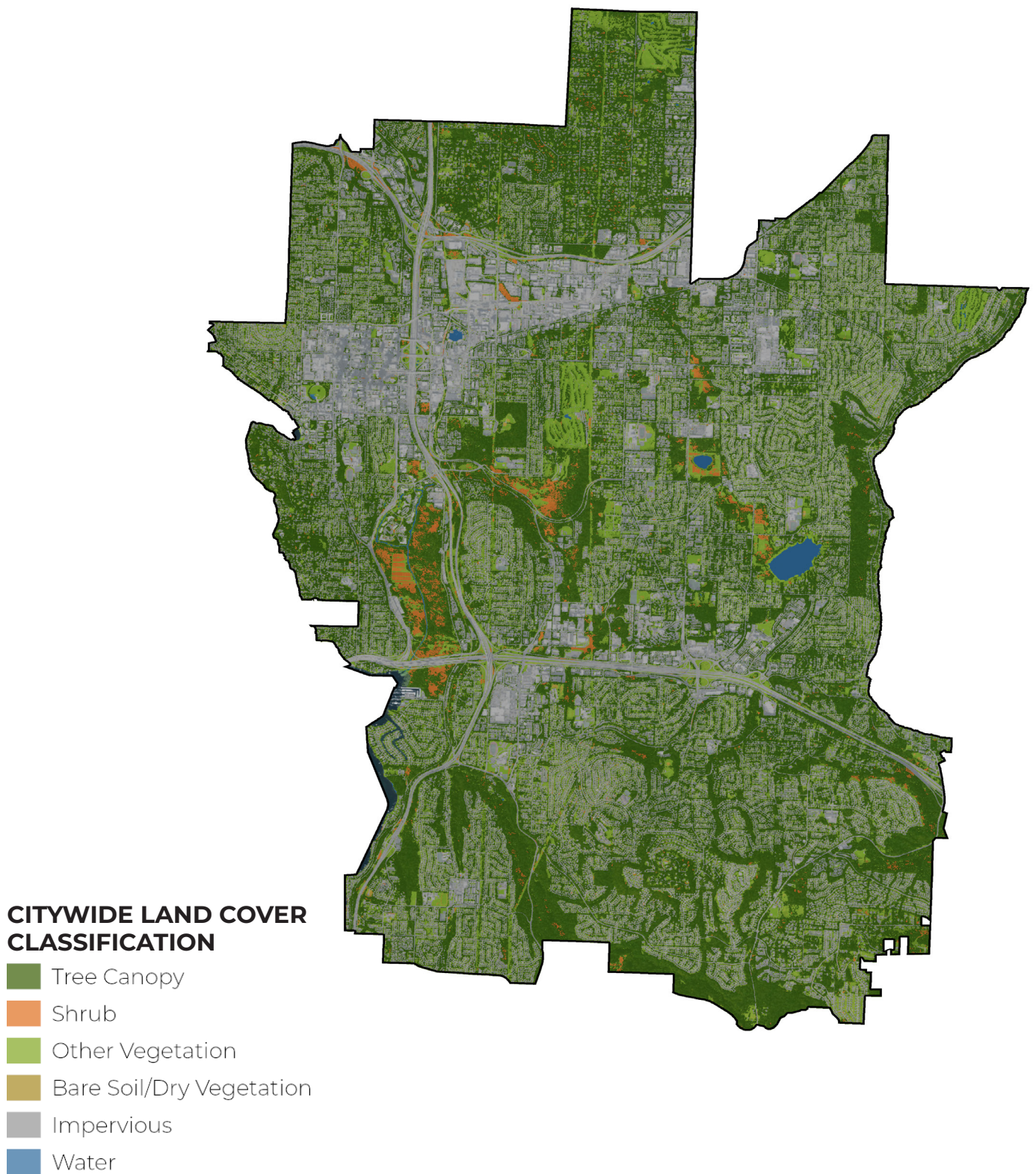


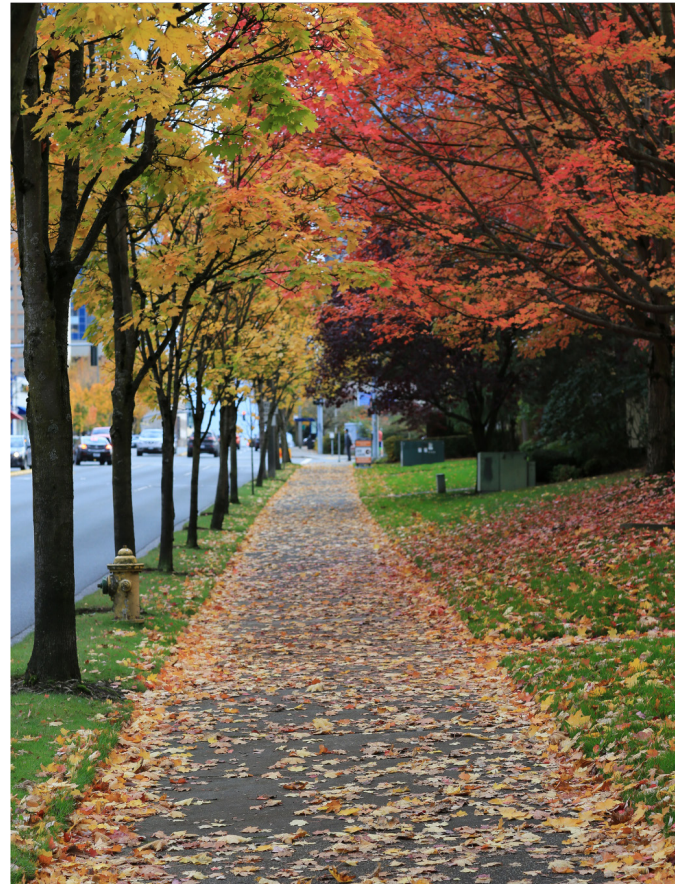
Figure 7. | Detailed land cover classes for Bellevue, Washington based on 2019 NAIP imagery.

CITYWIDE URBAN TREE CANOPY

This urban tree canopy assessment utilized the land cover map as a foundation to determine possible planting areas (PPA) throughout the city. Additional layers and information regarding land considered unsuitable for planting were also incorporated into the analysis. Note that the results of this study are based on the city’s land area with bodies of water omitted.

Results of this study indicate that within the City of Bellevue, 8,459 acres are covered with urban tree canopy, making up 39% of the city’s 21,442 land acres; 4,709 acres are covered with shrubs or other vegetation where it would be possible to plant trees (PPA), making up 22% of the city; and the other 8,274 acres were considered unsuitable for tree planting, making up 39% of the city. The unsuitable areas include recreational sports fields, golf course playing areas, buildings, roads, other impervious surfaces, and areas of bare soil and dry vegetation.

The city’s 8,459 acres of urban tree canopy were further divided into subcategories based on whether the trees were overhanging an impervious surface or a pervious surface. Trees overhanging impervious surfaces can provide many benefits through ecosystem services such as localized cooling by providing shade and increasing stormwater absorption. Results indicated that in Bellevue, 8% of all tree canopy was overhanging impervious surfaces.



City of Bellevue	Acres	%
Total Area	21,623	100%
Land Area	21,442	99%
UTC	8,459	39%
PPA Vegetation	4,709	22%
Total Unsuitable UTC	8,274	39%

Table 2. | Urban tree canopy assessment results, by acres and percent (percentages based on land acres).

UTC POTENTIAL IN BELLEVUE (%)

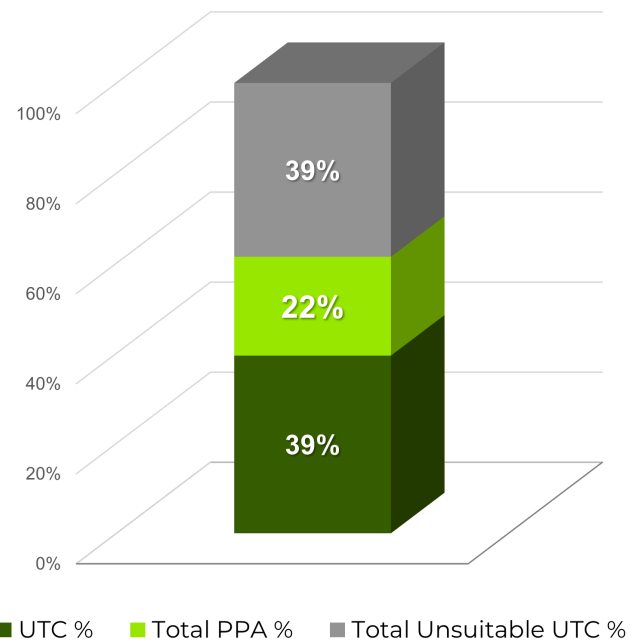


Figure 8. | Urban tree canopy, possible planting area, and area unsuitable for UTC in Bellevue.

CITYWIDE URBAN TREE CANOPY POTENTIAL

- Urban Tree Canopy
- PPA Vegetation
- Unsuitable Vegetation
- Unsuitable Impervious
- Unsuitable Soil
- Water

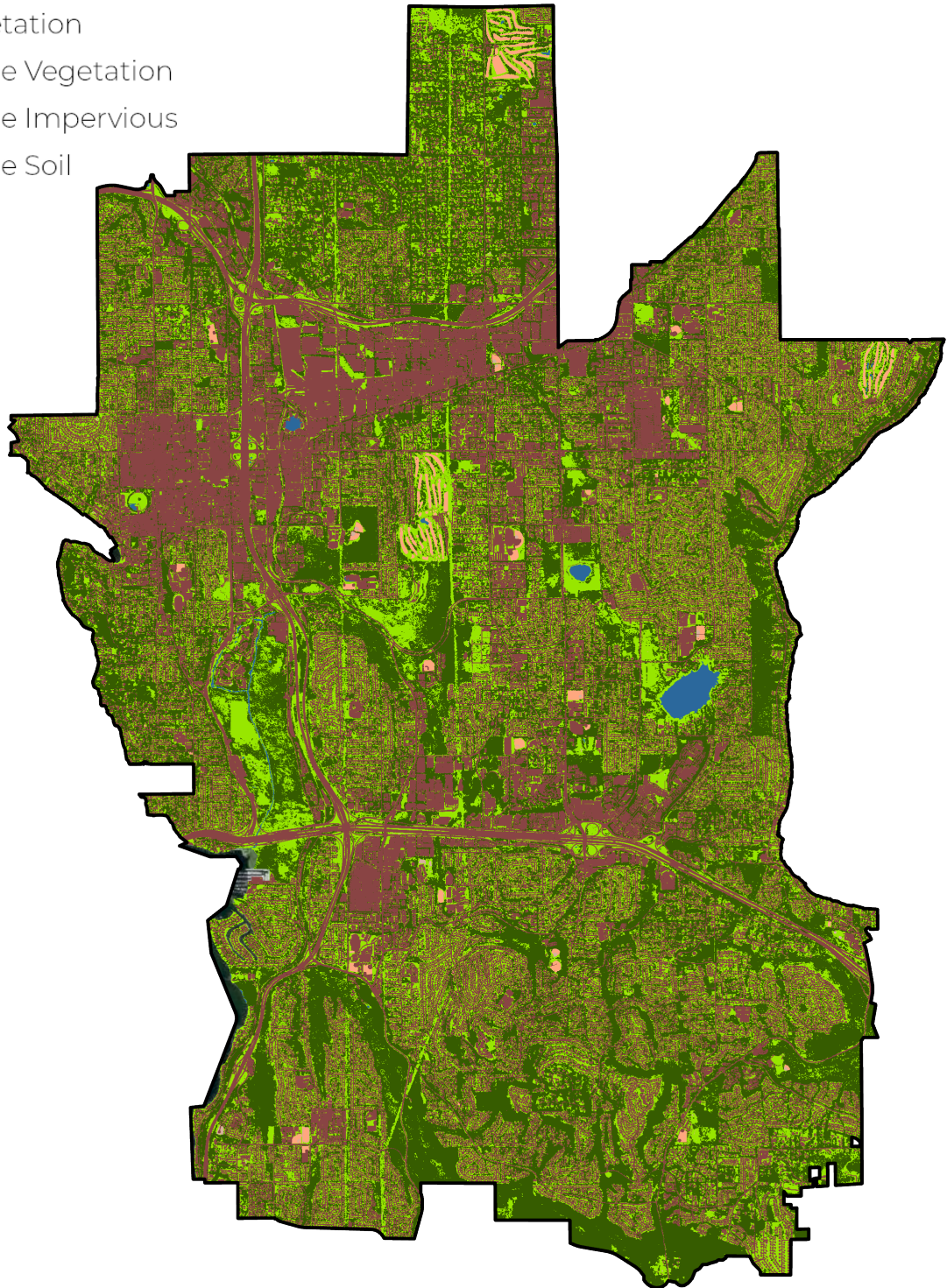


Figure 9. | Urban tree canopy, possible planting area, and area unsuitable for UTC in the City of Bellevue.

URBAN TREE CANOPY BY DESIGNATED LAND USE

Urban tree canopy was assessed for the City of Bellevue’s designated land use classes. Parks had the highest UTC with 72% of all park area covered by tree canopy, whereas the Central Business District had the lowest UTC at 8%. In terms of possible planting areas, the Suburban Residential land use area had the greatest proportion with 26% PPA. Suburban residential areas contributed the greatest amounts of both UTC and PPA towards the citywide totals, making up 65% of the city’s UTC and 76% of all PPA in Bellevue.

Designated Land Use	Land Area		Urban Tree Canopy			Possible Planting Area		
	Acres	Dist.	Acres	%	Dist.	Acres	%	Dist.
Central Business District	389	2%	31	8%	0%	14	4%	0%
Commercial & Mixed Use	2592	12%	554	21%	6%	311	12%	7%
Industrial	221	1%	60	27%	1%	38	17%	1%
Parks	2515	12%	1817	72%	21%	522	21%	11%
Suburban Residential	14127	66%	5525	39%	65%	3611	26%	76%
Urban Residential	1708	8%	565	33%	7%	228	13%	5%
Totals	21552	100%	8552	40%	100%	4724	22%	100%

Table 3. | Urban tree canopy assessment results by designated land use class.*

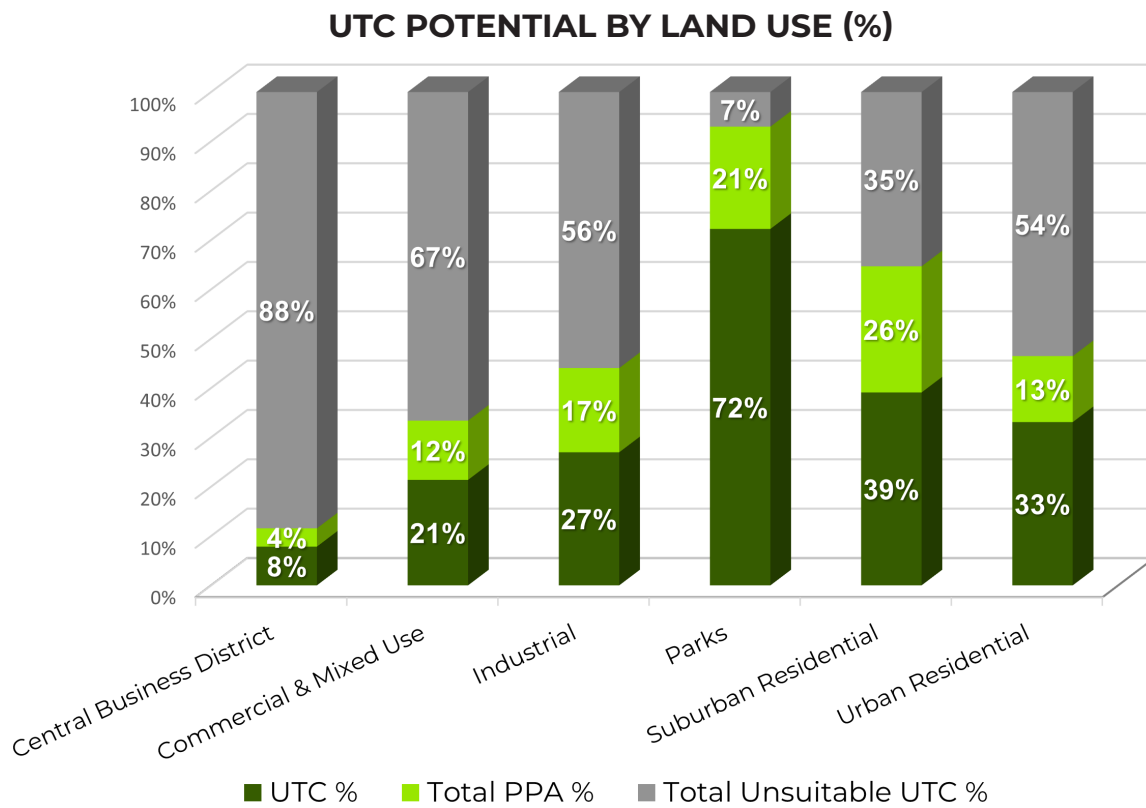


Figure 10. | Urban tree canopy, possible planting area, and area unsuitable for UTC in Bellevue by designated land use.

* Designated Land Use acreage includes the Urban Growth Area in Cougar Mountain, which is outside of city limits, but included in the Comprehensive Plan, along with a portion of Newcastle Park, which the City owns and maintains.

URBAN TREE CANOPY % BY DESIGNATED LAND USE

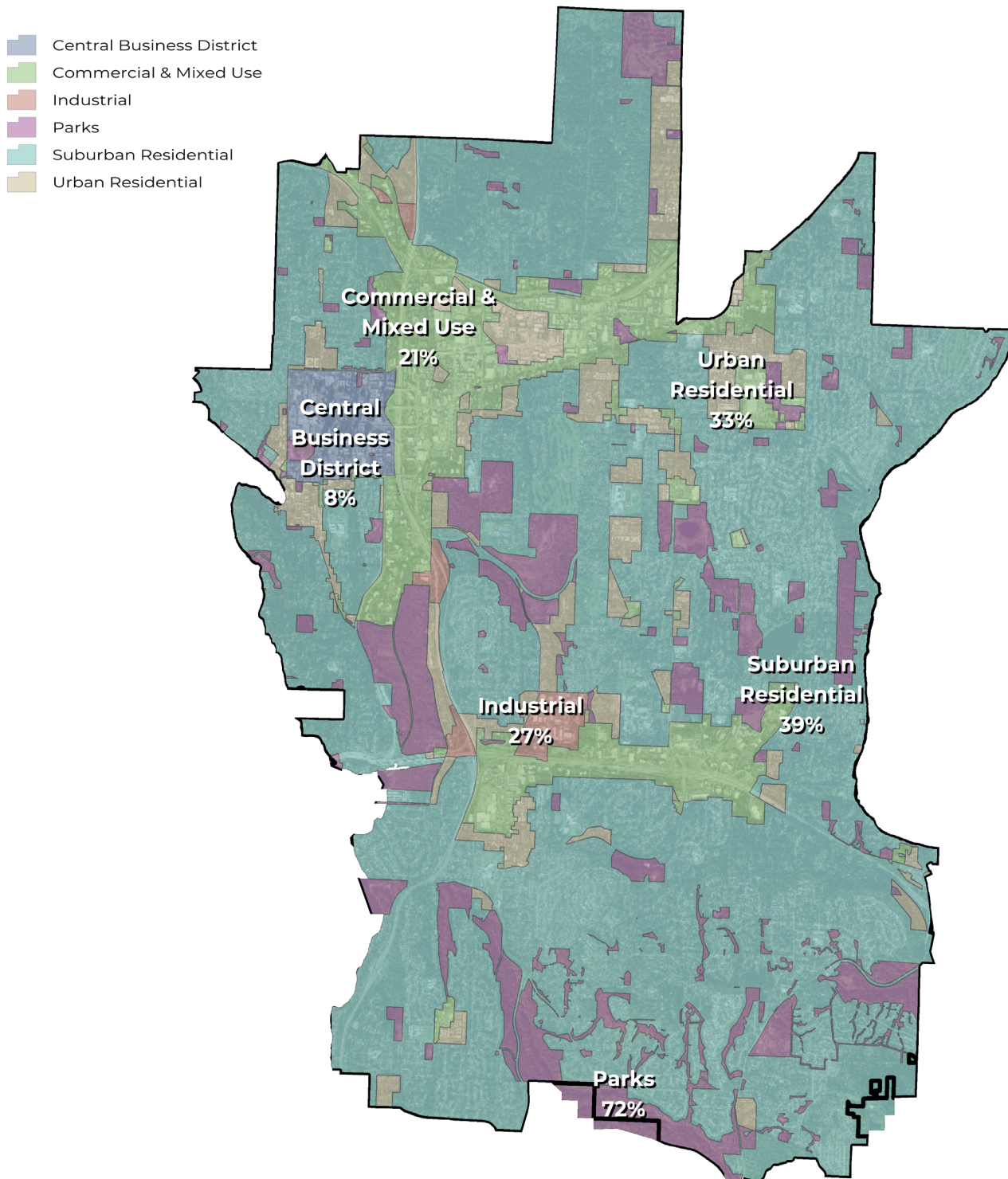


Figure 11. | Urban tree canopy in Bellevue by designated land use. * Designated Land Use acreage includes the Urban Growth Area in Cougar Mountain, which is outside of city limits, but included in the Comprehensive Plan, along with a portion of Newcastle Park, which the City owns and maintains.

URBAN TREE CANOPY BY NEIGHBORHOODS

Urban tree canopy metrics were also assessed at the neighborhood level. This analysis revealed that Bellevue has a great deal of variation in UTC throughout the city. While some neighborhoods such as Bridle Trails and Cougar Mountain/Lakemont had around 50% canopy cover, others such as Downtown, BelRed, and Factoria had less than half that. Downtown Bellevue had the lowest canopy cover at just 9%. Neighborhood parks, greenbelts, and open spaces are included in the tree canopy figure, so some neighborhoods may be more influenced by tree canopy within these areas of greenspace than others. PPA varied considerably less throughout neighborhoods with the majority remaining relatively close to the citywide average of 22%. The neighborhood that contributed the most to the city’s overall PPA was Lake Hills, with 587 acres, or 26% possible planting area, contributing 12% of the city’s total PPA.

Neighborhood	Land Area		Urban Tree Canopy			Possible Planting Area		
	Acres	Dist.	Acres	%	Dist.	Acres	%	Dist.
BelRed	962	4%	134	14%	2%	88	9%	2%
Bridle Trails	2027	9%	1038	51%	12%	463	23%	10%
Cougar Mountain / Lakemont	2369	11%	1230	52%	15%	506	21%	11%
Crossroads	815	4%	251	31%	3%	134	17%	3%
Downtown	433	2%	38	9%	0%	31	7%	1%
Eastgate	1767	8%	668	38%	8%	348	20%	7%
Factoria	389	2%	78	20%	1%	66	17%	1%
Lake Hills	2261	11%	801	35%	9%	587	26%	12%
Newport	1719	8%	725	42%	9%	414	24%	9%
Northeast Bellevue	1415	7%	490	35%	6%	356	25%	8%
Northwest Bellevue	1327	6%	460	35%	5%	288	22%	6%
Somerset	1313	6%	585	45%	7%	279	21%	6%
West Bellevue	1677	8%	695	41%	8%	418	25%	9%
West Lake Sammamish	1126	5%	543	48%	6%	272	24%	6%
Wilburton	1113	5%	431	39%	5%	279	25%	6%
Woodridge	731	3%	294	40%	3%	180	25%	4%
Totals	21444	100%	8460	39%	100%	4710	22%	100%

Table 4. | Urban tree canopy by neighborhood.

**URBAN TREE CANOPY %
BY NEIGHBORHOOD**

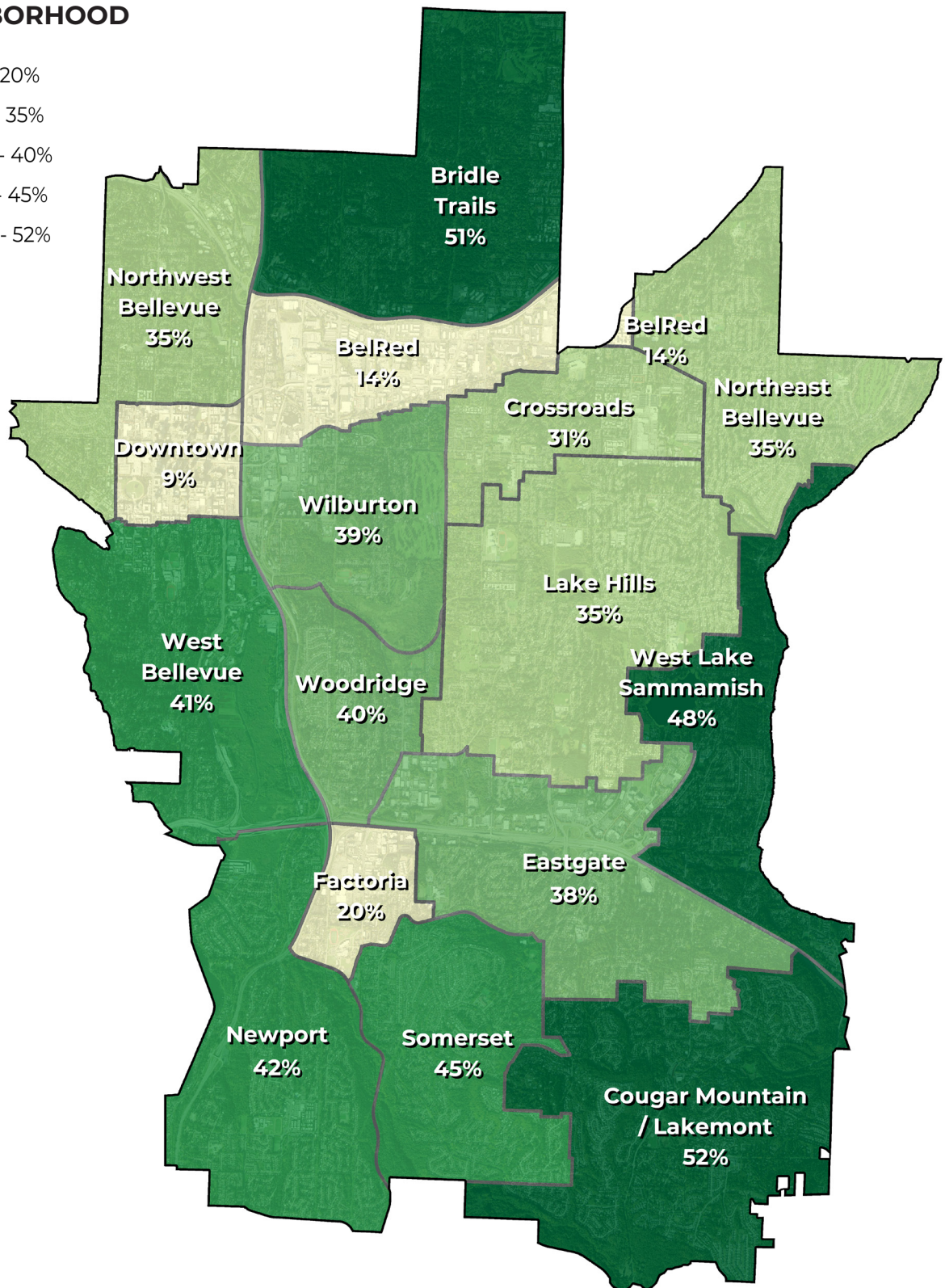
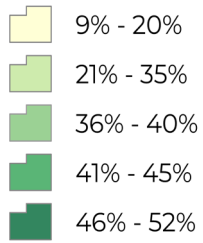


Figure 12. | Urban tree canopy in Bellevue by neighborhood.

URBAN TREE CANOPY BY STREAM CORRIDORS

Tree canopy was assessed within stream corridors. These corridors represent the area within 100 feet of a stream, on both sides of the stream. Tree canopy coverage in these areas can provide enhanced wildlife habitat as well as improved water quality. Bellevue's stream corridors had an average of 65% tree canopy coverage. This is nearly 30% higher than the city-wide average. The stream corridors studied contained 408 acres of possible planting area, or 18% of the total stream corridor areas. Trees planted within these areas can help to intercept and absorb stormwater runoff that may otherwise carry unhealthy pollutants into the streams.



LAND COVER CLASS BY STREAM CORRIDORS (%)

- Urban Tree Canopy
- PPA Vegetation
- Unsuitable Vegetation
- Unsuitable Impervious
- Unsuitable Soil
- Water

UTC POTENTIAL BY STREAM CORRIDORS (%)

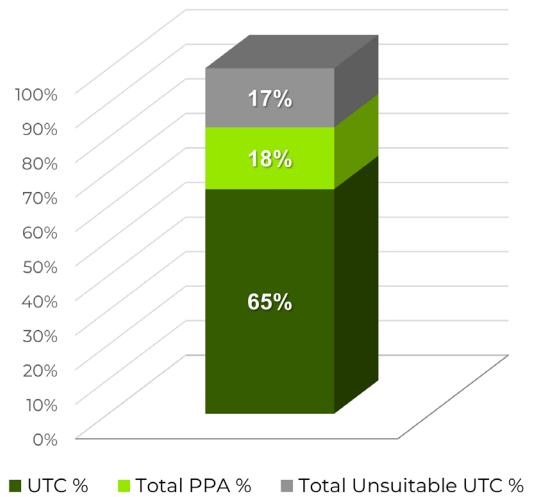


Figure 13. | Urban tree canopy and possible planting area in Bellevue's stream corridors.

Figure 14. | Urban tree canopy, possible planting area, and area unsuitable for UTC in Bellevue by stream corridors.

URBAN TREE CANOPY BY DRAINAGE BASINS

Because of their benefits for regulating runoff, reducing flooding, and maintaining a healthy water cycle, urban tree canopy metrics were also assessed by drainage basin. This assessment boundary extended beyond the city boundary to include additional areas that drain into the Bellevue's city limits (see Figure 15). A slightly higher canopy coverage was measured when including these areas outside of Bellevue. Tree canopy coverage was 42% as opposed to 39% within the city limits. PPA remained close to the citywide average of 22% while areas unsuitable for UTC dropped from the citywide average of 39% to 36% for the drainage basins.

Within the various drainage basins, there was significant variation in both UTC and PPA. UTC ranged from only 16% in Sturtevant Creek to 60% in Coal Creek, while PPA ranged from 11% in Sears Creek to 29% in the Redmond 400 basin. Coal Creek contributed the most to the drainage basin's overall UTC with 21% of the total UTC, while Coal Creek and Kelsey Creek offered the greatest opportunities for expanding the area's canopy, each containing 12% of the total PPA.

URBAN TREE CANOPY % BY DRAINAGE BASIN

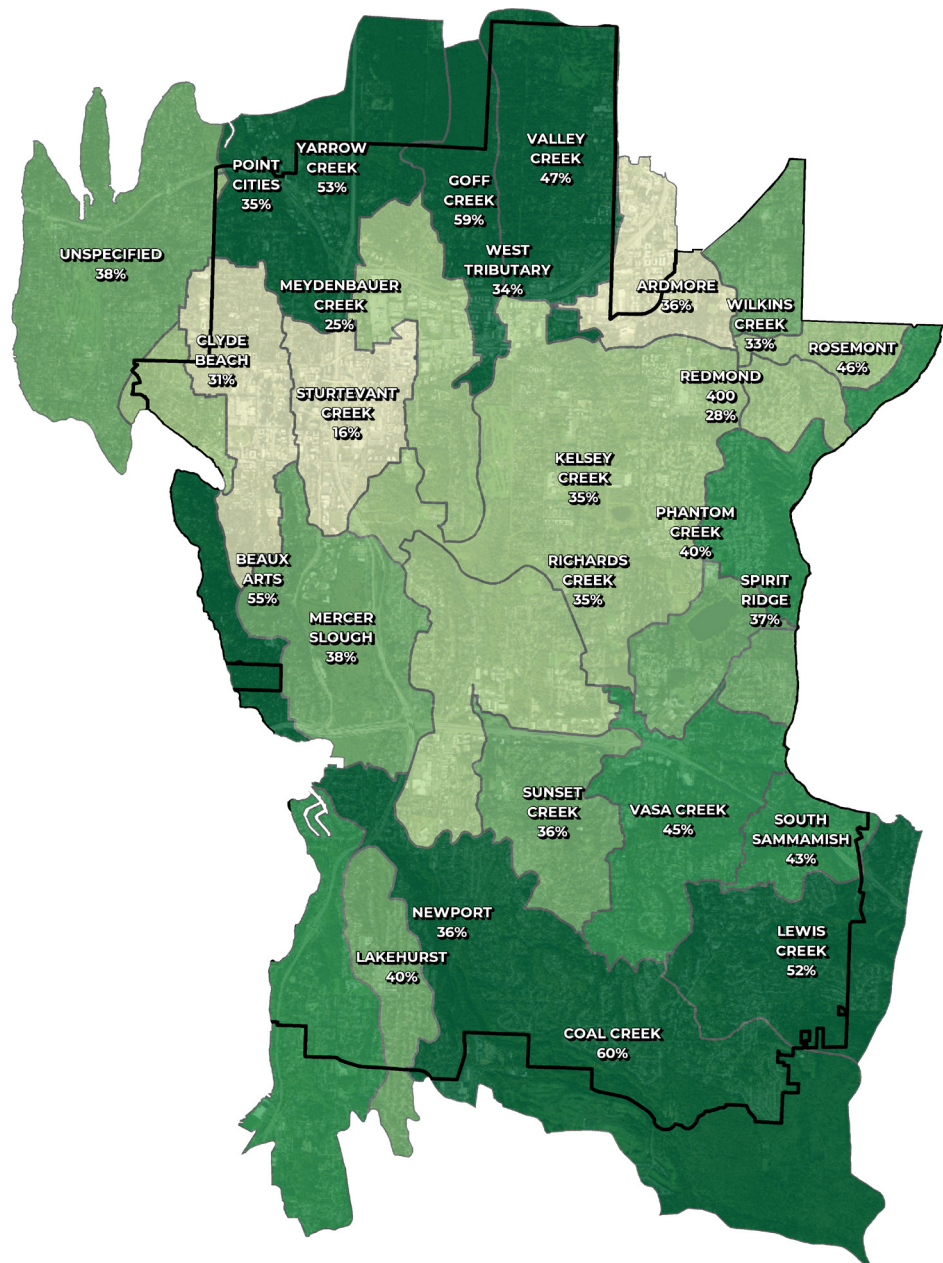
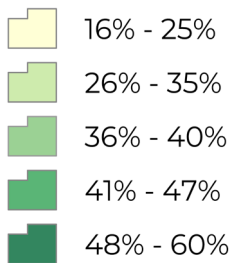


Figure 15. | Urban tree canopy in Bellevue and surrounding areas by drainage basin.

URBAN TREE CANOPY BY SCHOOLS

UTC was assessed for all 81 public and private school properties in Bellevue to determine how well the numerous benefits of the City’s urban forest are reaching its next generation of residents. Overall, tree canopy on school property was substantially lower than the citywide average, at 26% canopy compared to the City’s 39%. Canopy cover ranged from 0% at Seattle Voctech School to 94% at the Hillside Student Community School. The average PPA of 17% on school property was also significantly lower than the citywide average of 22%, revealing that while school properties are in need of additional tree canopy, there is less available space to plant trees.

Schools	UTC Acres	UTC %	Schools	UTC Acres	UTC %	Schools	UTC Acres	UTC %
America's Child	0.1	18%	Eastgate	2.4	30%	Northwest University	0.4	31%
Ardmore	3.0	29%	Eastside Academics	3.7	41%	Odle	2.7	14%
Asia Pacific	0.3	22%	Eastside Academy	3.7	37%	Open Window	1.5	20%
Bellevue College (Main Campus) - Landerholm	33.4	34%	Eastside Montessori	0.7	25%	Overlake Specialty	0.4	38%
Bellevue College (Main)	0.2	42%	Eastside Preparatory	0.0	0%	Phantom Lake	1.7	18%
Bellevue College (North Campus) - 29th Place	0.4	20%	Educational Service Center (East)	1.0	41%	Puesta Del Sol	4.2	31%
Bellevue College (Main Campus) - 145th Ave	0.2	35%	Educational Service Center (West)	1.1	42%	Ringdall	4.6	24%
Bellevue	12.7	32%	Emerald Heights	4.0	76%	Risdon	5.4	31%
Bellevue Big Picture	1.8	14%	Enatai	2.2	25%	Sacred Heart	2.4	25%
Bellevue Children's Academy (Lower Campus)	0.2	14%	Eton	0.8	55%	Sammamish	4.3	11%
Bellevue Children's Academy (Upper Campus)	0.3	10%	Forest Ridge	6.2	37%	Sarodgini Children's Academy	0.5	47%
Bellevue Christian School (Three Points Campus)	2.6	31%	French Immersion School	0.5	30%	Seattle Voctech	0.0	0%
Bellevue Christian School (Clyde Hill Campus)	1.0	11%	GIX	0.1	3%	Sherwood Forest	0.9	9%
Bellevue Management Support Ctr	0.9	15%	Hazelwood	4.6	33%	Somerset	4.2	41%
Bellevue Montessori School (Main Campus)	0.8	56%	Highland	4.3	20%	Spiritridge	3.0	33%
Bellevue Montessori School (Park Elementary Campus)	0.1	30%	Hillside	3.3	94%	St Louise	1.5	16%
Bellevue Montessori School (Rossano Campus)	0.2	24%	Interlake	10.5	27%	St Madeleine	2.5	24%
Bellewood	3.0	30%	International	5.8	30%	St Thomas	0.8	14%
Bel-Red Bilingual	0.2	61%	International Montessori	0.3	32%	Stevenson	0.9	10%
Bennett	2.4	24%	Jewish Day	0.9	14%	Sunset	3.7	27%
Cedar Crest	0.4	27%	Jing Mei	3.4	33%	Tillicum	2.3	13%
Cedar Park Christian	0.2	7%	Lake Hills	0.8	10%	Tyee	4.7	21%
Cherry Crest	6.1	60%	Little School	7.3	75%	Undeveloped	1.2	56%
Chestnut Hill	0.7	23%	Living Montessori	3.7	41%	Undeveloped	2.6	32%
Chinook	2.9	17%	Medina	0.9	15%	Wilburton	2.1	23%
Clyde Hill	1.3	19%	Newport	4.6	11%	Wilburton Instructional Service Ctr	0.5	9%
Cougar Ridge	2.8	28%	Newport Heights	2.4	26%	Woodridge	1.1	11%

Table 5. | Urban tree canopy by school.

URBAN TREE CANOPY BY CENSUS BLOCK GROUPS

Urban tree canopy and possible planting areas were assessed at the census block group level. This was the smallest geographic area unit analyzed that covered the entire City area and is particularly valuable for assessing the equitable distribution of tree canopy throughout the city as the block groups are linked to all demographic and socioeconomic U.S. census data. Results indicated that urban tree canopy varies substantially throughout the City, with one census block group containing only 4% cover and another containing as much as 90%. PPA also varied somewhat across the block groups, with one containing only 2% PPA and another as much as 36% PPA.

URBAN TREE CANOPY % BY CENSUS BLOCK GROUPS

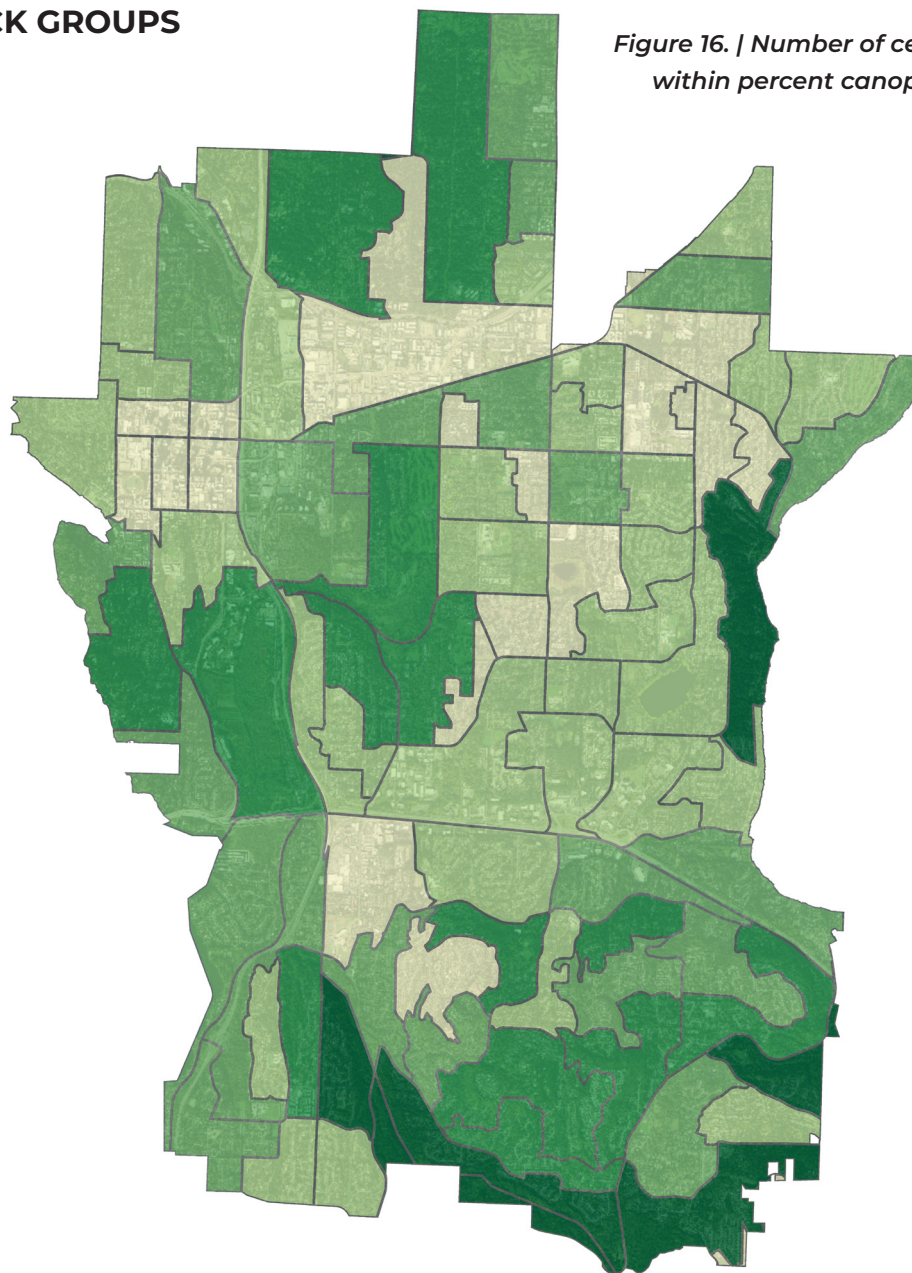
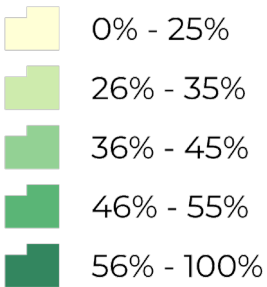


Figure 17. | Urban tree canopy in Bellevue by census block groups.

URBAN TREE CANOPY % BY CENSUS BLOCK GROUPS

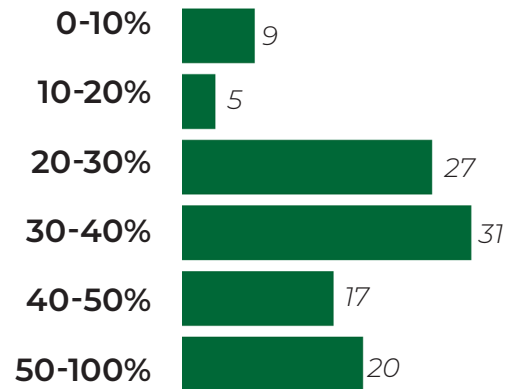


Figure 16. | Number of census block groups within percent canopy cover ranges.

URBAN TREE CANOPY BY RIGHT-OF-WAY BY CENSUS BLOCK GROUPS

In addition to being assessed throughout each census block group’s entire area, UTC was also assessed for the right-of-way areas within each census block group. Right-of-way areas include the City’s sidewalks, roadways, and medians that are publicly owned and maintained. This metric is helpful for quantifying the City’s street tree resources, as trees in this area provide an especially valuable service in terms of air pollution control and shading, while still tying it to a small and significant unit of measure (census block groups). On average, Bellevue’s rights-of-way had a UTC of 23%. This figure fell well below the citywide average of 39%, but did not vary to as extreme of a degree as some other assessment levels, ranging from 6% to 55%.

**URBAN TREE CANOPY %
IN RIGHT-OF-WAYS BY CENSUS
BLOCK GROUPS**

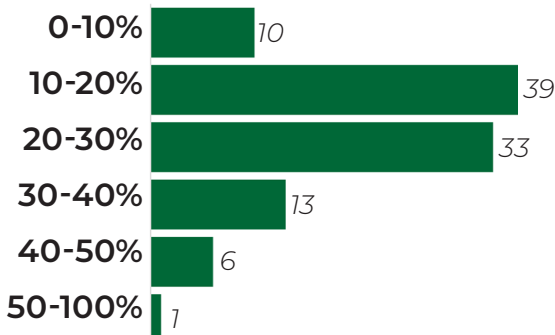


Figure 18. | Number of census block groups with rights-of-way within percent canopy cover ranges.

**POSSIBLE PLANTING AREA %
IN RIGHT-OF-WAYS BY CENSUS
BLOCK GROUPS**

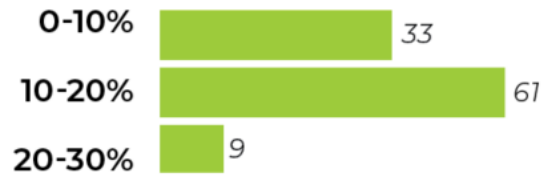


Figure 19. | Number of census block groups with rights-of-way within percent possible planting area ranges.



QUANTIFYING ECOSYSTEM BENEFITS

Using the best available science from i-Tree tools, values were calculated for some of the benefits and functions provided by trees and forests in Bellevue. The urban forest holds millions of dollars of savings in avoided infrastructure costs, pollution reduction, and stored carbon.

AIR QUALITY

Trees produce oxygen, capture air pollutants such as particulate matter directly on their leaves, improve public health, and reduce pollution indirectly by lowering air temperatures, reducing the formation of ozone. The existing tree canopy in Bellevue removes 259 tons of air pollution annually, valued at \$1,137,801.

STORMWATER AND WATER QUALITY

Trees and forests mitigate stormwater runoff which minimizes flood risk, stabilizes soil, reduces sedimentation in streams and marshland, and absorbs pollutants, thus improving water quality and habitats. On average, each acre of tree canopy in Bellevue absorbs over 697 million gallons of water. This benefit of avoided runoff is valued at roughly \$737 per acre/per year. Extrapolated citywide, this means that Bellevue’s existing tree canopy provides \$6,231,715 in stormwater runoff benefits.

CARBON STORAGE AND SEQUESTRATION

Trees accumulate carbon in their biomass; with most species in a temperate forest, the rate and amount increase with age. Bellevue’s trees store approximately 360,826 tons of carbon, valued at \$61,539,081, and each year the tree canopy absorbs and sequesters approximately 7,140 tons of carbon dioxide, valued at \$1,217,735.

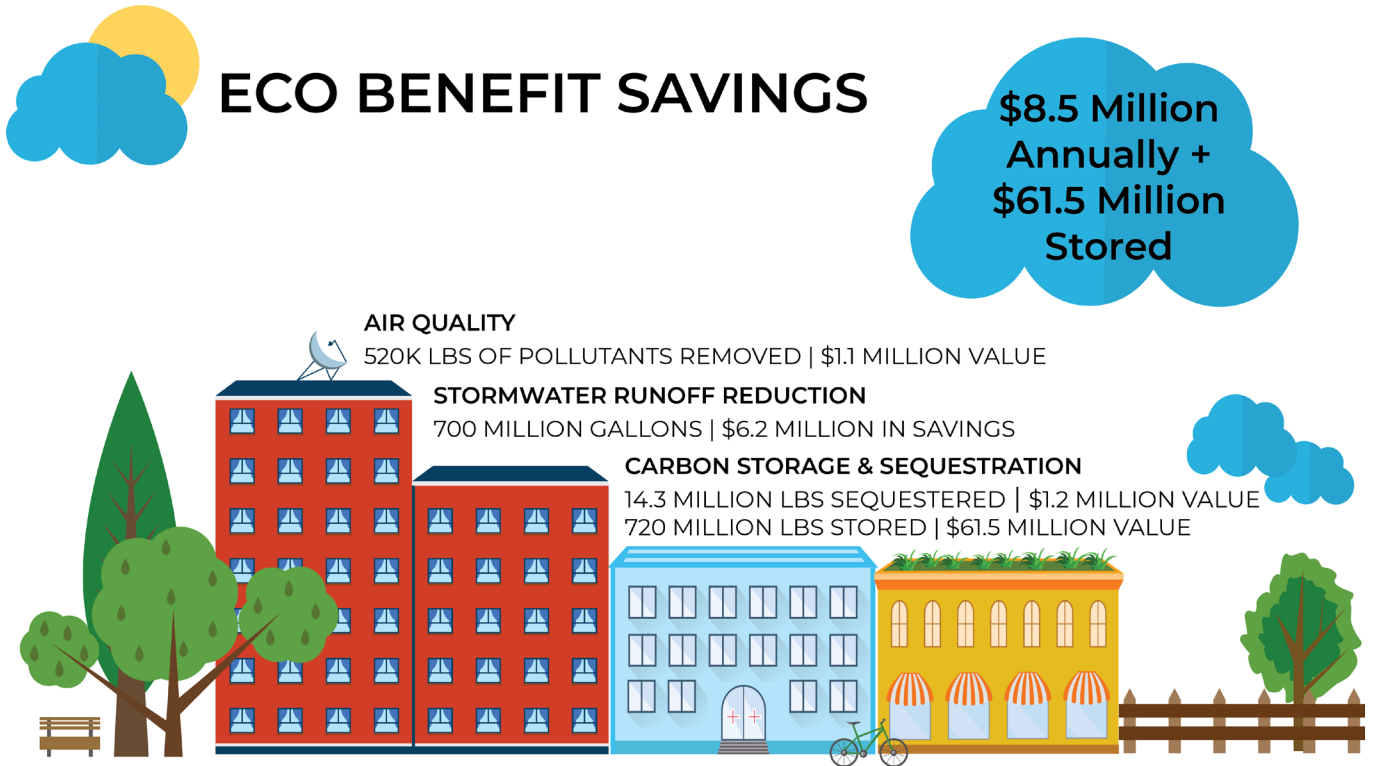


Figure 20. | Quantification of some of the monetary benefits of Bellevue’s urban forest ecosystem services (based on 39% citywide tree canopy cover).

URBAN TREE CANOPY CHANGE ANALYSIS



In addition to assessing Bellevue’s urban tree canopy using 2019 imagery, this study also quantified changes in urban tree canopy using 2011 imagery. Previous studies conducted in 1998 and 2008 by American Forests determined that the city was losing its valuable tree canopy and the associated ecosystem benefits that trees provide at alarming rates, with a 12% loss in canopy from 1986-1996 and another 9% loss in canopy from 1996-2006. However, the downward trend appears to have been reversed.

This study produced maps of land cover and urban tree canopy in 2019 and 2011 using the exact same classification methods. Both studies used machine learning techniques on high-resolution (60cm) color-infrared aerial imagery. Changes were assessed at all of the geographic assessment scales (citywide, land use, neighborhoods, stream buffers, drainage basins, schools, census block groups, and rights-of-way). The most current boundaries were assessed in both years despite the fact that several of the geographic assessment scales may have changed due to annexation, population changes, and other land use reconfigurations since 2011.

The following sections provide an explanation of changes in the Bellevue’s tree canopy cover and its distribution throughout the city.

CITYWIDE URBAN TREE CANOPY CHANGE

Overall, this change analysis revealed that the rapid loss of canopy which occurred in previous decades has reversed, as the tree canopy cover grew by nearly 2% from 2011 to 2019. This analysis measured Bellevue’s citywide tree canopy at 39% in 2019, a gain of 2% from the 2011 canopy cover of 37%. This is an increase of 411 acres of tree canopy, a dramatic improvement from the upwards of 20% that was lost between 1986 and 2006. However, continued efforts should be made to preserve the City’s existing urban forest through expanded and revised management actions.

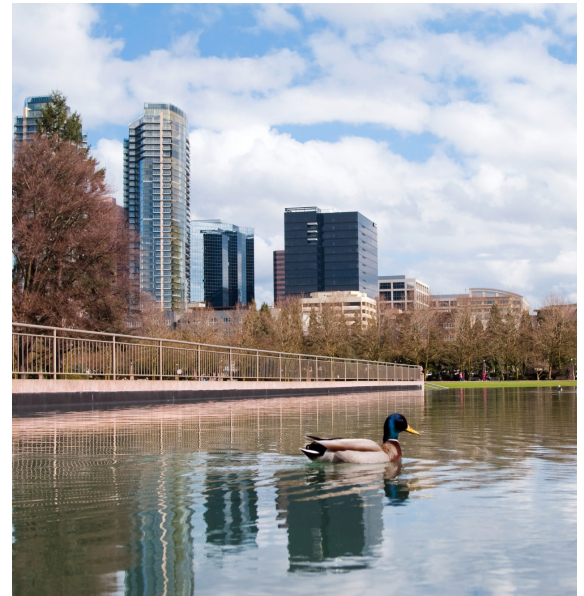
City of Bellevue	Land Area	UTC 2011		UTC 2019		UTC Change	
	Acres	Acres	%	Acres	%	Acres	%
Urban Tree Canopy	21,442	8,051	37%	8,461	39%	411	2%

Table 6. | Urban tree canopy change for the City of Bellevue.

URBAN TREE CANOPY CHANGE BY DESIGNATED LAND USE

Dividing the urban tree canopy change results by the City’s designated future land use categories offered some additional insights as to how Bellevue’s canopy has changed over time. Areas designated as park land use had the greatest individual reduction in canopy by acres but maintained the highest overall UTC %. Parks experienced a 2% (43 acres) loss from 74% (1,861 acres in 2011) to 72% (1,817 acres in 2019).

While areas designated for industrial land use only make up 1% of Bellevue’s total area, these areas also experienced canopy loss, from 30% (66 acres in 2011) to 27% (60 acres in 2019). Bellevue’s central business district and commercial/mixed use areas experienced slight increases in canopy (1% each). The largest changes occurred in suburban and urban residential areas, where there were increases of 3% each or 376 acres and 58 acres, respectively (a combined increase of 6% or 435 acres).



Designated Land Use	Land Area		UTC 2011		UTC 2019		UTC Change	
	Acres	Dist.	Acres	%	Acres	%	Acres	%
Central Business District	389	2%	25	6%	31	8%	5	1%
Commercial & Mixed Use	2592	12%	534	21%	554	21%	20	1%
Industrial	221	1%	66	30%	60	27%	-6	-3%
Parks	2515	12%	1,861	74%	1,817	72%	-43	-2%
Suburban Residential	14127	66%	5,148	36%	5,525	39%	376	3%
Urban Residential	1708	8%	507	30%	565	33%	58	3%
Totals	21552	100%	8,141	38%	8,552	40%	411	2%

Table 7. | Urban tree canopy change by City of Bellevue designated land uses. * Designated Land Use acreage includes the Urban Growth Area in Cougar Mountain, which is outside of city limits, but included in the Comprehensive Plan, along with a portion of Newcastle Park, which the City owns and maintains.

URBAN TREE CANOPY CHANGE BY LAND USE (ACRES)

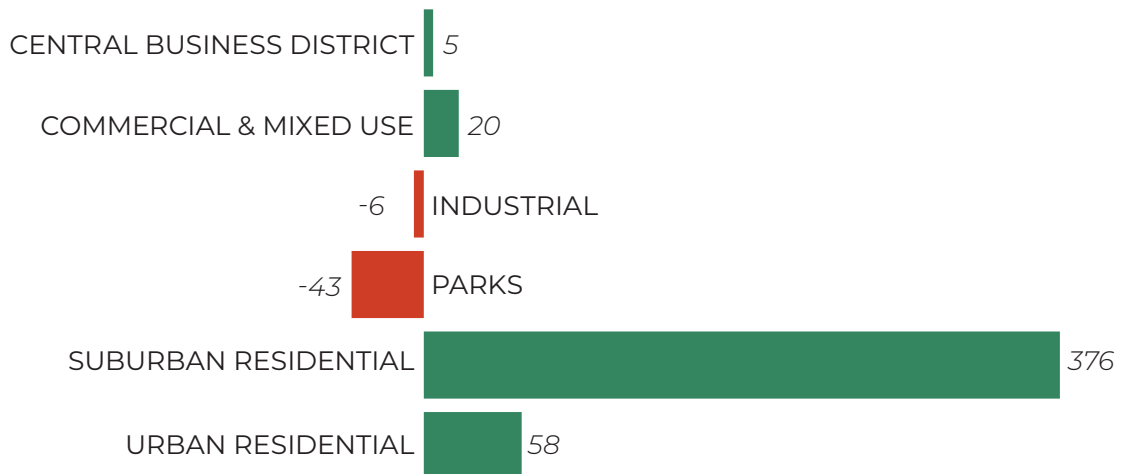


Figure 21. | Urban tree canopy change by designated land uses in Bellevue from 2011-2019.

URBAN TREE CANOPY CHANGE BY NEIGHBORHOODS

Subdividing the results by neighborhoods revealed that, cumulatively, almost all of the canopy loss occurred in four neighborhoods while the rest experienced increases. West Bellevue had the sharpest canopy decline of 3%, or 43 acres lost. The Lake Hills neighborhood gained the most canopy area, approximately 94 acres or 4%. The Cougar Mountain / Lakemont neighborhood contained the most tree canopy cover of any neighborhood in both study years and saw an increase of 3% canopy.

Neighborhood	Land Area		UTC 2011		UTC 2019		UTC Change	
	Acres	Dist.	Acres	%	Acres	%	Acres	%
BelRed	962	4%	139	14%	134	14%	-6	-1%
Bridle Trails	2,027	9%	954	47%	1,038	51%	84	4%
Cougar Mountain / Lakemont	2,369	11%	1,154	49%	1,230	52%	76	3%
Crossroads	815	4%	220	27%	251	31%	31	4%
Downtown	433	2%	32	7%	38	9%	5	1%
Eastgate	1,767	8%	602	34%	668	38%	66	4%
Factoria	389	2%	70	18%	78	20%	8	2%
Lake Hills	2,261	11%	707	31%	801	35%	94	4%
Newport	1,719	8%	740	43%	725	42%	-15	-1%
Northeast Bellevue	1,415	7%	432	31%	490	35%	58	4%
Northwest Bellevue	1,327	6%	445	34%	460	35%	15	1%
Somerset	1,313	6%	564	43%	585	45%	21	2%
West Bellevue	1,677	8%	737	44%	695	41%	-43	-3%
West Lake Sammamish	1,126	5%	499	44%	543	48%	44	4%
Wilburton	1,113	5%	459	41%	431	39%	-28	-3%
Woodridge	731	3%	293	40%	294	40%	1	0%
Totals	21,444	100%	8,049	38%	8,460	39%	411	2%

Table 8. | Urban tree canopy change by neighborhoods.

URBAN TREE CANOPY CHANGE BY NEIGHBORHOODS MINUS PARKS

Bellevue is fortunate to have an extensive parks system that includes some heavily forested areas. As part of the canopy cover analysis, parks were removed from the neighborhood areas in effort to demonstrate canopy growth (or decline) without the influence of these heavily forested areas. The results show that Bellevue's neighborhoods have a slightly higher rate of canopy gain without the parks included (2.4% UTC change without the parks as opposed to 1.9% UTC change with the parks).

Neighborhood Areas Minus Bellevue Parks	2011 % UTC	2019 % UTC	Change from 2011 to 2019
BelRed	14.3%	13.7%	-0.6%
Bridle Trails	47.6%	51.7%	4.1%
Cougar Mountain / Lakemont	39.3%	42.7%	3.4%
Crossroads	26.8%	30.4%	3.5%
Downtown	6.4%	7.7%	1.3%
Eastgate	33.6%	37.4%	3.8%
Factoria	18.1%	20.1%	2.0%
Lake Hills	28.6%	32.5%	3.9%
Newport	36.0%	35.7%	-0.3%
Northeast Bellevue	27.6%	31.7%	4.1%
Northwest Bellevue	33.0%	34.2%	1.2%
Somerset	32.2%	34.2%	2.0%
West Bellevue	37.4%	37.8%	0.4%
West Lake Sammamish	38.6%	43.0%	4.5%
Wilburton	30.2%	29.3%	-0.9%
Woodridge	33.9%	34.8%	0.8%
Totals	32.9%	35.3%	2.4%

Table 9. | Urban tree canopy change by neighborhoods minus park lands.

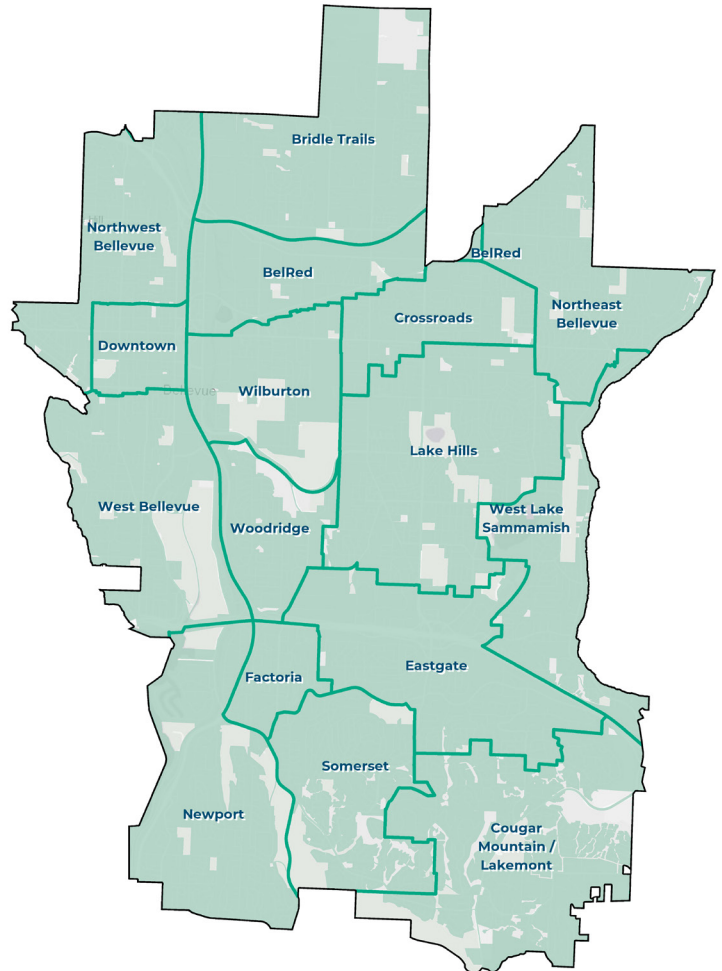


Figure 22. | Bellevue's neighborhoods minus parks.

URBAN TREE CANOPY CHANGE BY STREAM CORRIDORS

Within Bellevue's stream corridors, there was a slight decrease in tree canopy cover of 0.1% from 65.2% canopy cover in 2011 to 65.1% in 2019. These corridors provide a variety of important ecosystem services including, but not limited to, wildlife habitat, water quality, and stormwater runoff, so it is important to maintain the existing tree canopy in these areas.

URBAN TREE CANOPY CHANGE BY DRAINAGE BASINS

Of the city's 28 drainage basins, five experienced less than 1% of change in canopy, three experienced losses of greater than 1%, and 20 experienced gains greater than 1%. The most significant loss in canopy occurred in the Mercer Slough basin, which decreased by 5% (67 acres) over the eight-year period. The Valley Creek basin experienced the most significant canopy gain of 75 acres, or 5%.

URBAN TREE CANOPY CHANGE BY SCHOOLS

Urban tree canopy on Bellevue's 81 school properties experienced a gain of 14 acres, or 2% of the school properties' combined area. Wilburton Elementary School, which was built in 2017-2018, experienced the greatest reduction in canopy, losing five of its seven acres from 2011-2019 (equating to a 52% loss). Bellevue College's Main Campus (on Landerholm Circle SE) is the largest school property in Bellevue, and that campus experienced the largest increase of canopy acreage from 29 acres in 2011 to 33 acres in 2019, a gain of 4%. A majority of school properties (56 schools, or 69%) experienced increases in canopy cover over the eight year period.

URBAN TREE CANOPY CHANGE BY CENSUS BLOCK GROUPS

The most detailed unit of analysis for the change analysis was the census block groups. As the smallest geographic unit covering the entire city, this assessment revealed changes in canopy at the finest scale. Some block groups lost as much as 19% of their canopy while others gained 22%. Losses in canopy tended to be concentrated near the center of the city and along the I-405 corridor, while the eastern and western areas experienced more increases. See Figure 25 on the next page for a map of these changes.

URBAN TREE CANOPY CHANGE BY RIGHT-OF-WAY CENSUS BLOCK GROUPS

Changes in canopy cover within the rights-of-way of each census block group were assessed to gain insight on street trees citywide. These areas had an overall increase of 3% which was greater than the citywide average of 2%. Changes across census block groups varied with the greatest decrease at -15% and the greatest increase at 11%.

DISTRIBUTION OF CENSUS BLOCK GROUPS BY UTC CHANGE RANGES

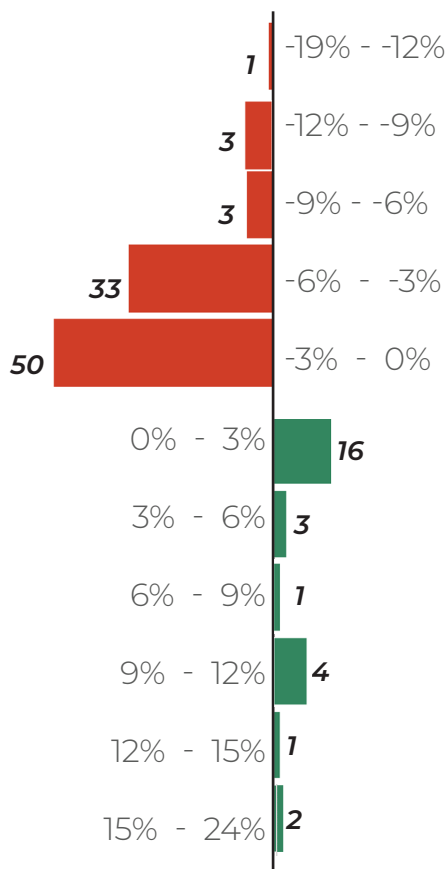


Figure 23. | Number of census block groups within percent canopy cover change ranges.

DISTRIBUTION OF CBG RIGHTS-OF-WAY BY UTC CHANGE RANGES

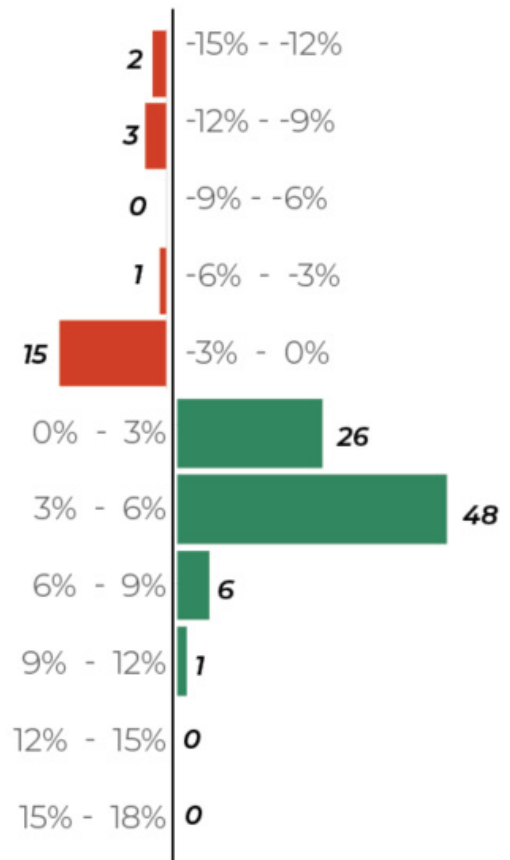


Figure 24. | Number of census block groups by right-of-way within percent canopy cover change ranges.

URBAN TREE CANOPY CHANGE BY CENSUS BLOCK GROUPS

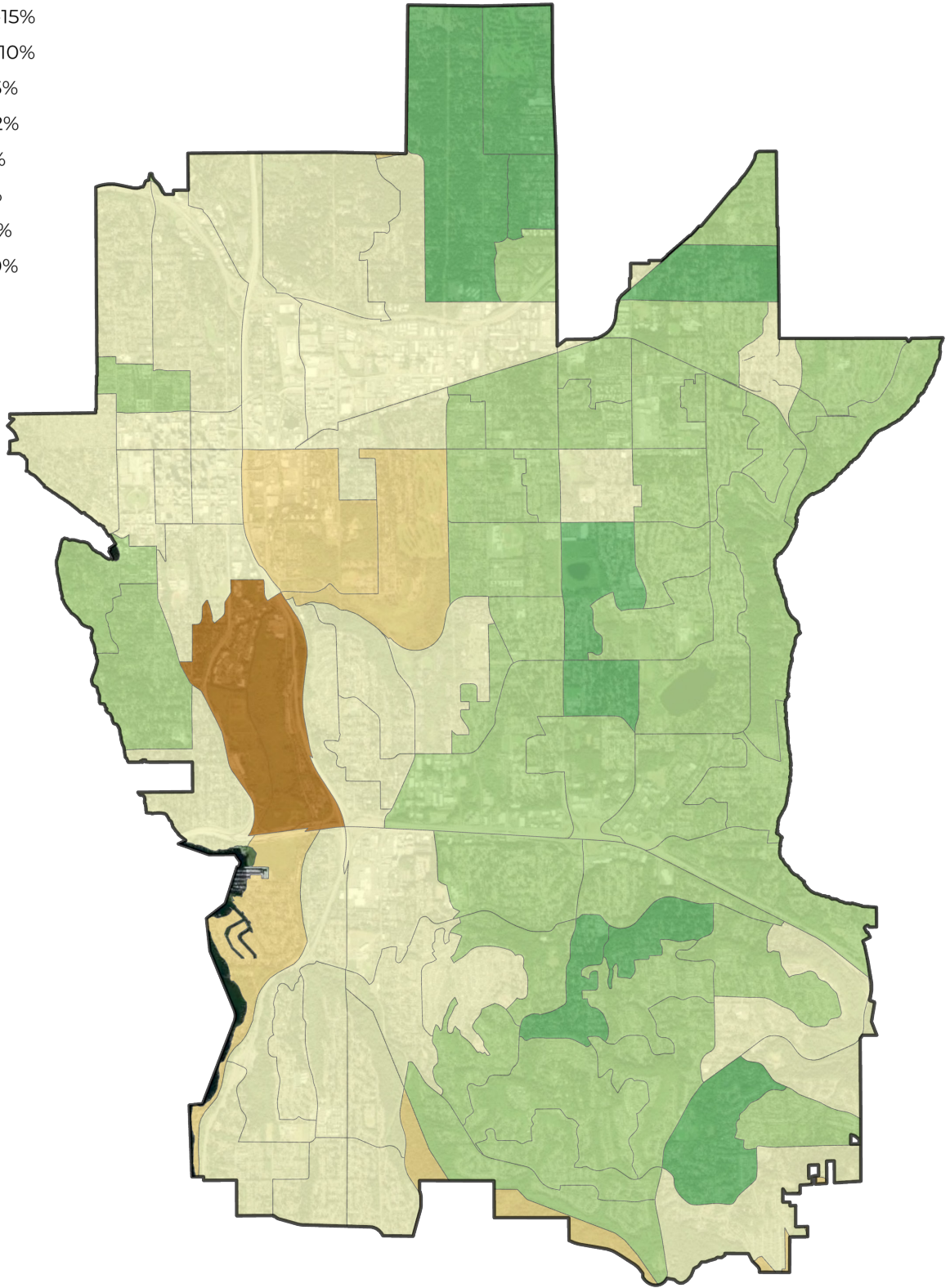
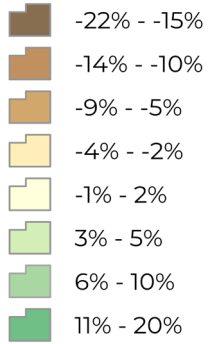
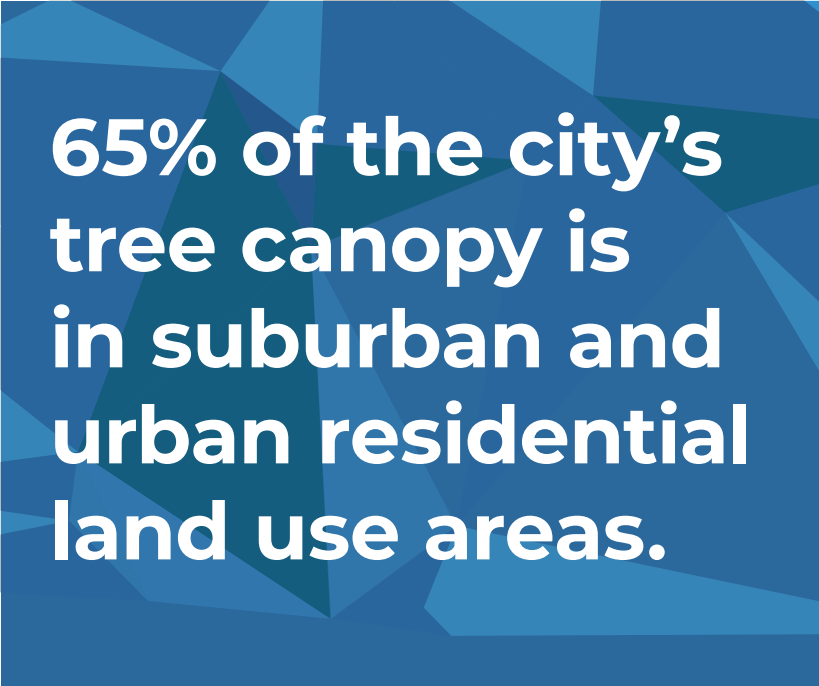


Figure 25 | Urban tree canopy change by census block groups from 2011-2019.

CONCLUSIONS AND RECOMMENDATIONS

The City of Bellevue has demonstrated that it values the urban forest and wants to maintain a healthy and sustainable urban environment. Recurring assessments of the City's tree canopy provides a basis for proactive management and data-driven work plans that strive for equitable canopy distribution and long-term health of the urban forest. A greater percent of canopy cover can be achieved with proper planning, investment, and care of existing trees. The City should continue to monitor the health of the urban forest and implement the following recommendations to ensure the urban forest is considered during future city planning and development to sustain and enhance the benefits that trees provide to the community.

To preserve, protect, and maintain Bellevue's tree canopy, the City should continue assessing the tree canopy on a regular interval. As the City changes, these recommendations can be used to ensure that urban forest policies and management practices prioritize maintenance, health, and growth. Bellevue's urban forest provides the City with a wealth of environmental, social, and even economic benefits which relate back to greater community interest in citywide initiatives and priorities. These updated results can be used to interpret where these gains have been felt most significantly and where there is still work to be done in accordance with the city's broader goals and vision for its future.



**65% of the city's
tree canopy is
in suburban and
urban residential
land use areas.**

The results of this assessment can and should be used to encourage investment in urban forest monitoring, maintenance, and management, to prepare supportive information for local budget requests/grant applications, and to develop targeted presentations for city leaders, planners, engineers, resource managers, and the public on the functional benefits of trees in addressing environmental issues. The land cover data should be disseminated to diverse partners for urban forestry and other applications while the data is current and most useful for decision-making and implementation planning.

Bellevue's 39% tree canopy falls short of the City's comprehensive plan goal of 40% tree canopy, but the latest 2019 results do show that the City is making progress towards the goal. In the 2007 study, American Forests provided the following recommendations for tree canopy in different land use types:

- Urban Residential: 35% (33% in 2019)
- Suburban Residential: 50% (39% in 2019)
- Central Business District: 15% (8% in 2019)
- Commercial and Mixed Use: 25% (21% in 2019)
- Industrial: 25% (27% in 2019)
- Parks: 25% (72% in 2019)
- Right-of-Way: 25% (23% in 2019)



Suburban Residential neighborhoods are prime areas for increasing tree canopy.

The City and its various stakeholders can utilize the results of the UTC, PPA, and change analyses to identify the best locations to focus future tree planting and canopy expansion efforts using their [TreePlotter CANOPY software subscription](#). While reductions in canopy coverage occurred city-wide in previous decades, breaking up the results by several different geographic boundaries demonstrated that the recent gains have not been evenly distributed. These results can be used as a guide to determine which areas would receive the greatest benefits from the investment of valuable time and resources into Bellevue's urban forest.

Urban residential designated land use areas saw an increase in tree canopy coverage of about 3.4% from 2011 – 2019, a gain of 58 acres. These areas have a higher population density than their suburban residential counterparts. Therefore, an increased tree canopy coverage in these areas will provide benefit to a larger number of residents. In 2007, American Forests recommended that Bellevue's urban residential areas should have a canopy goal of 35%. Tree canopy coverage in 2019 was estimated at over 33%. The city should continue to focus on these areas by making use of the available PPA (228 acres or 13%).

Suburban residential areas experienced growth in tree canopy coverage between 2011 and 2019, however, some neighborhoods experienced a greater loss of trees than others. American Forests recommended that tree canopy coverage expand to 50% in these areas, but that figure stands at about 39% currently. The city should focus on community outreach and education programs to better inform citizens and private land holders of the environmental, social, and financial benefits that trees provide and consider other strategies to help preserve and grow the tree canopy. Tree giveaways and tree planting programs can be developed to further promote new tree plantings. Since a majority of Bellevue is considered suburban residential land, these areas provide the greatest opportunity to increase tree canopy cover throughout the city. There is ample room for growth, with 26% of these areas (3,611 acres) being considered possible planting areas.

Schools within Bellevue are also prime areas for increasing tree canopy. In 2019, there was 26% tree canopy coverage. Since 2011, tree canopy coverage on all school properties has increased by 2%. There was also 17% PPA in open vegetated areas, even with sports fields and play areas being excluded from PPA. School tree planting programs are a great way to teach students why trees matter while also empowering them to take action and improve conditions in their neighborhood.

REPORT

APPENDIX

ACCURACY ASSESSMENT

The EarthDefine US Tree Map has an overall accuracy of 96.6%. In census defined urban areas the overall accuracy is higher at 97.3%. Accuracy was assessed using 48,000 random points (1,000 points/state). The state of Washington, specifically, has an accuracy of 98.3%.

GLOSSARY/KEY TERMS

Land Acres:

Total land area, in acres, of the assessment boundary (excludes water).

Other Vegetation:

Areas of grass and open space where tree canopy does not exist.

Possible Planting Area - Vegetation:

Areas of grass and open space where tree canopy does not exist, and it is biophysically possible to plant trees.

Shrub:

Areas of shrub or other leafy and woody vegetation that are not classified as tree canopy.

Soil/Dry Vegetation:

Areas of bare soil and/or dried, dead vegetation.

Total Acres:

Total area, in acres, of the assessment boundary (includes water).

Unsuitable Impervious:

Areas of impervious surfaces that are not suitable for tree planting. These include buildings and roads and all other types of impervious surfaces.

Unsuitable Planting Area:

Areas where it is not feasible to plant trees. Airports, ball fields, golf courses, etc. were manually defined as unsuitable planting areas.

Unsuitable Soil:

Areas of soil/dry vegetation considered unsuitable for tree planting. Irrigation and other modifiers may be required to keep a tree alive in these areas.

Unsuitable Vegetation:

Areas of non-canopy vegetation that are not suitable for tree planting due to their land use.

Urban Tree Canopy (UTC):

The “layer of leaves, branches and stems that cover the ground” (Raciti et al., 2006) when viewed from above; the metric used to quantify the extent, function, and value of the urban forest. Tree canopy was generally taller than 10-15 feet tall.

Water: Areas of open, surface water not including swimming pools.

JULY | 2022

URBAN TREE CANOPY
ASSESSMENT

BELLEVUE, WASHINGTON



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