APPENDIX I. URBAN FOREST ASSESSMENT METHODOLOGY

This appendix provides additional methodological details to support the findings reported in Chapter 3 of the Urban Forest Master Plan.

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Tree canopy assessment

In order to evaluate modern tree canopy cover, we used EarthDefine's 2018 urban tree canopy cover dataset for California (EarthDefine, 2018). This dataset has mapped urban tree canopy cover at 1-meter resolution based on 2018 National Agricultural Imagery Program (NAIP) aerial imagery and LiDAR data collected by the U.S. Geological Survey.

Public tree inventory update

As part of the development of the Urban Forest Master Plan, the project team gathered existing data to update the City's Public Tree Inventory. Overall, this update included data for 5,745 public trees from the following sources.

2013 inventory dataset

In 2013, ArborPro conducted a Tree Inventory for the City and collected data for 5,593 trees.

Currently, West Coast Arborist is contracted with the City to perform tree maintenance work. As they perform tree work in the city, they have been making updates to this inventory over time. Their current inventory has data for 5,386 trees. This is 207 fewer trees than in 2013 and is not a comprehensive update to the 2013 Inventory.

Canopy Tree Plotter dataset

Canopy is a local tree-planting nonprofit that has been planting and caring for trees in East Palo Alto since 2007. Canopy inventories the trees they plant in an online mapping tool called Tree Plotter (https://canopy.org/our-work/tree-plotter/). They shared data with the project team for 804 trees planted in East Palo Alto since 2015, including 445 private trees, which are not included in the public tree inventory summary.

Estimating canopy change over time

Historical 0.6-meter resolution aerial imagery from 1982 was collected from HistoricAerials.com. To conduct the point classification analysis used to estimate change over time, 750 randomly generated points were classified as "tree present" or "tree absent" in 1982 by viewing each point and visually determining whether or not it intersected a tree in the 1982 imagery. Where shadows obscured tree canopy extent, Google Earth imagery from 1948, 1991, and 2002 was used to support classification. To estimate 2018 tree canopy cover, the same 750 sample points were overlaid with the EarthDefine 2018 urban tree canopy cover extent and classified as overlapping tree canopy or not based on their intersection with this data layer (Parmehr et al., 2016). Once initially classified, the points were visually inspected and corrected as needed. Confidence intervals were calculated based on the number of points sampled and the estimated tree canopy cover value (Parmehr et al., 2016). For more information on the point classification method for measuring tree canopy cover, see Parmehr et al. 2016.

Tree benefit quantification with iTree Eco

The iTree Eco suite of software tools developed by the US Department of Agriculture Forest Service was used to assess the structure and composition of the city's urban forest resource (Nowak 2020). It was utilized as a companion resource with the canopy cover assessment to better understand the services and values provided by these trees and opportunities for growth.

Urban forest structure and compensatory value

The structural value of the City's tree inventory was calculated using the trunk formula method of the *Guide for Plant Appraisal*, Council of Tree & Landscape Appraisers (Council of Tree & Landscape Appraisers, 2019). It was based on the estimated cost of replacing each tree with a comparable tree with compensatory value.

The value of each tree was based on four factors: trunk diameter, species, condition, and location. Trunk area and species were used to determine basic tree value, which were then multiplied by condition and location factors to determine structural value.

Carbon sequestration and storage

Trees remove carbon and oxygen from the air through photosynthesis, storing the carbon in the tree structure and releasing the oxygen back into the atmosphere. This process is referred to as carbon sequestration and storage. The amount of carbon stored in the tree inventory was calculated by tree species data and iTree Eco factors (Nowak, 2020).

For instance, the average diameter of all the coast live oaks in the inventory measured at 4.5 feet from ground level, or Diameter at Standard Height (DSH), was multiplied by the total number of coast live oaks in the inventory to determine the total biomass of coast live oaks.

To convert to stored carbon, the total coast live oak biomass was multiplied by an iTree Eco urban tree factor of 0.5 (Nowak, 2020). To determine annual carbon sequestration, the average DSH of coast live oak was increased based on computer modeling of an annual estimated growth rate.

The same process was repeated for each tree species to determine the total annual amount of carbon sequestered and stored by the city’s trees.

The monetary value of carbon sequestration and storage was calculated based on the social cost of carbon or the economic damages created by incremental changes in carbon emissions globally in one year as reported by the Interagency Working Group on the Social Cost of Greenhouse Gases (2016).

Air pollution removal

Trees remove pollutants such as ozone, sulfur dioxide, nitrogen dioxide, and carbon monoxide and particulate matter from the air. These particles are intercepted by the leaves. Some particles are absorbed into the leaf tissue, though most are retained on the leaf surface.

Estimates of air pollution removal by the city’s trees were based on gas exchange and particulate matter interception modeling using iTree. The hourly deposits of pollutants were estimated based on canopy cover data.

The removal of these pollutants were based on national average measured values and adjusted with standardized local pollution removal rates. A 50% adjustment factor was used to account for particles washed off by rain or dropped to the ground by leaf or twig fall and re-suspended back into the atmosphere.

Health benefits and the economic value of these benefits from the removal of pollutants are based on standardized models developed by the U.S. Environmental Protection Agency's Environmental Benefits Mapping and Analysis Program (BenMAP). Following standard iTree Eco methods, the standardized values for each pollutant were multiplied by the city’s population and unique tree inventory to determine health impacts and associated dollar values (Nowak, 2020).

Oxygen production

As trees capture carbon dioxide during the photosynthesis process, they produce oxygen. If carbon uptake exceeds carbon dioxide release, the tree will accumulate carbon (carbon sequestration). A tree that has a net accumulation of carbon during a year (tree growth) also has a net production of oxygen.

The amount of oxygen produced, based on atomic weights, was estimated using the same required inputs as for carbon sequestration and storage.

Avoided stormwater runoff

By absorbing rainwater, trees intercept potential stormwater runoff. Avoided runoff in iTree Eco means the amount of surface runoff without trees minus the amount of surface area with current tree canopy cover (Nowak, 2020). The city's tree canopy area and local annual precipitation data were used to estimate annual avoided runoff.

The benefit of runoff reduction was estimated using costs of collection, conveyance and treatment calculated at the rate of $2.36 per cubic meter.

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