

**ORDINANCE No.**

Amend Trees In Development Situations Code to remove zone exemptions from tree preservation and tree density and amend regulations for preservation of private trees (Ordinance; amend Code Chapter 11.50)

The City of Portland Ordains:

Section 1. The Council finds:

1. Portland' s urban forest is a unique community asset, providing a broad array of valuable ecological, social, and economic benefit, including cleaner air and water, reduced stormwater runoff, reduced landslide and flood impacts, carbon sequestration, neighborhood beauty and walkable streets, public health benefits, and enhanced property values.
2. The Bureau of Development Services (BDS) Director, together with the City Forester, administers Portland City Code (PCC) Title 11, Trees. The Bureau of Planning and Sustainability (BPS) is responsible for economic planning and analysis to maintain the City's compliance with Statewide Land Use Planning Goal 9, Economic Development.
3. Portland City Code (PCC) Chapter 11.50, Trees in Development Situations, regulates, in part, tree removal, tree preservation, and tree planting associated with development projects including when tree preservation or tree planting is required, and what mitigation is required when certain trees are not preserved or not planted.
4. Title 11 was adopted on April 13, 2011 (Ordinance No. 184522) and was amended by Ordinance Nos. 185448, 185654, and 186053 before it was effective. Title 11 was effective January 1, 2015.
5. On January 8, 2020, through Resolution 37473, the Portland City Council directed the Bureau of Development Services (BDS), together with the Bureau of Planning and Sustainability (BPS), and Portland Parks & Recreation (PP&R) to conduct an analysis, legal review and stakeholder engagement process of the Title 11 (Tree Code) amendments recommended by the PSC and UFC through a previous project that resulted in adoption of Ordinance 189795, effective December 12, 2019.
6. In fulfillment of the directives in Resolution 37473, staff from the three bureaus conducted analysis, stakeholder engagement and legal review regarding removing existing exemptions from the tree preservation and tree density standards in Heavy Industrial (IH), General Industrial 1 (IG1), EX (Central Employment), and CX (Central Commercial) zones on private and City-owned/managed property, reducing the threshold for required preservation of trees on private property from 36 inches to 20 inches in diameter at breast height

(dbh) wherever tree preservation is required, and reducing the threshold for inch-per-inch fee in lieu of preservation for trees on private property, from 36 inches dbh to 20 inches dbh. The scope of the project pertains to tree regulations that apply in development situations.

7. In March, 2020, individual interviews were held with stakeholders representing a variety of organizations and interests to gather feedback on the directives in Resolution 37473 and the Tree Code in general. Participants and results of the interviews are described in the staff proposal and staff proposal appendices in Exhibits F and G.
8. A community survey was open from April 14, through May 15, 2020 to gauge community values and priorities. Participation statistics and results of the survey are described in the staff proposal and staff proposal appendices in Exhibits F and G.
9. On July 15, 2020 a draft staff proposal was published on the BDS website and distributed electronically through various channels with a comment period through August 5, 2020.
10. An online community forum was held from July 15, 2020 through August 3, 2020 to present the draft staff proposal, general information, and gather community input. Participation and input on the draft staff proposal is described in the staff proposal and staff proposal appendices in Exhibits F and G.
11. Staff updated and sought input from Development Review Advisory Committee (DRAC) on January 16, 2020 and May 21, 2020. All electronic notices of project updates were sent to DRAC members. A member of DRAC also participated in the individual stakeholder interviews.
12. On August 7, 2020 notice of joint public hearing with the Planning and Sustainability Commission and Urban Forestry Commission was mailed to the recipients required by the notification requirements of Title 11. On August 9, 2020, notice of the joint hearing was published in the *Oregonian* as required by Title 11. Additional notices were published in the *Oregonian* and the *Daily Journal of Commerce*. Notice of the joint public hearing was also posted on the BDS website and distributed electronically through various channels.
13. The staff analysis, including community engagement is discussed in the staff proposal and appendices to the staff proposal. The staff proposal, dated August 14, 2020, was published on the on the BDS website on August 17, 2020, and distributed electronically through various channels. The staff proposal is attached as Exhibit F. Appendices to the staff proposal are attached as Exhibit G.
14. On August 20, 2020, staff briefed the Urban Forestry Commission on the staff proposal.

15. On August 25, 2020, staff briefed the Planning and Sustainability Commission on the staff proposal.
16. On September 8, 2020, the Planning and Sustainability Commission and Urban Forestry Commission held a joint hearing and invited oral and written testimony. The record for Planning and Sustainability Commission was held open until September 11, 2020. The Urban Forestry Commission hearing was continued until September 17, 2020.
17. On September 17, 2020, the Urban Forestry Commission continued its hearing, closed the record, and voted on a recommendation. The recommendation is consistent with the staff proposal in Exhibit F, except that the commission recommends to remove the exemptions from Tree Preservation and Tree Density in the IH, Heavy Industrial Zone. The recommendation is attached as Exhibit D.
18. On September 22, 2020, the Planning and Sustainability Commission voted on a recommendation. The recommendation is consistent with the staff proposal in Exhibit F. The Planning and Sustainability Commission also recommends that City Council direct, via ordinance, the Bureau of Planning and Sustainability to evaluate the Title 11 tree preservation and density exemptions for IH as part of the Economic Opportunities Analysis (EOA) update, consistent with City goals including those related to tree canopy, climate change and urban heat islands. The EOA should also consider equitable public health and environmental outcomes for BIPOC communities living adjacent to or employed within IH zone. This recommendation is attached as Exhibit E.
19. The city of Portland is landlocked. Current Statewide Planning Goal 9 requiring a perpetual twenty-year supply of available Industrial Lands is unsustainable. Unlike residential and commercial development that can add density by building up and Portland has successfully done so, industrial uses rely on surface development.
- ~~20~~19. There are two code change options associated with this ordinance. Exhibit A reflects the Planning and Sustainability Commission's recommendation. Exhibit B reflects the Urban Forestry Commission's recommendation.
- ~~21~~20. The recommendations of the Planning and Sustainability Commission and Urban Forestry Commission related to the amendment to reduce the existing threshold for certain tree preservation regulations for private trees from 36" dbh to 20" dbh requires a change to the Parks & Recreation Urban Forestry Title 11, Trees Fee Schedule, shown in Exhibit C.
- ~~22~~24. In accordance with the notification requirements of Title 11, on October 15, 2020, notice of the City Council hearing was mailed to those who testified at the Planning and Sustainability Commission and Urban Forestry Commission hearing, either in person or in writing, and those who requested such notice. On the same date, notice of the City Council hearing was published The *Oregonian*

and the *Daily Journal of Commerce* in accordance with the notification requirements of Title 11.

23. Due to COVID-19 budget constraints, the bureaus have lacked staffing to complete the third directive of Resolution 37473 to formulate by December 7, 2020 a Scope of Work for comprehensive review of Title 11. The directive stated, BE IT FURTHER RESOLVED, BDS and PP&R shall coordinate with BPS to develop a scope of work for additional updates to strengthen Title 11. BDS and PP&R shall bring a scope for Council for review no later than December 7, 2020.

NOW, THEREFORE, the Council directs:

- a. Chapter 11.50, Trees in Development Situations, is amended as shown in Exhibit A, as amended, ~~or Exhibit B.~~
- b. The Bureau of Planning and Sustainability will evaluate the Title 11 tree preservation and density exemptions for IH as part of the Economic Opportunities Analysis (EOA) update, consistent with City goals including those related to tree canopy, environmental health, climate change, and urban heat islands. The EOA shall also analyze equitable public health and environmental justice, especially for those who are essential workers, those who are Black, Indigenous, and People of Color, and community members working in or living adjacent to the IH zone. The Bureau of Planning and Sustainability, Bureau of Development Services, and Portland Parks & Recreation shall also bring to Council viable strategies to reduce the urban heat island effect and create and maintain a healthy urban tree canopy within the IH zone concurrent with completion of the updated EOA. The EOA update must be expedited as a priority for BPS. The Bureau of Planning and Sustainability will evaluate the Title 11 tree preservation and density exemptions for IH as part of the Economic Opportunities Analysis (EOA) update, consistent with City goals including those related to tree canopy, climate change and urban heat islands. The EOA should also consider equitable public health and environmental outcomes for BIPOC communities living adjacent to or employed within IH zone.
- c. Portland Parks & Recreation and affected bureaus are directed to complete Task 3 of Resolution 37473 by March 31, 2021. The Council will consider funding for the Scope of Work defined for the Title 11 update during the FY 2021-22 City Budget process.
- ~~d.~~ The Portland Parks & Recreation Urban Forestry Title 11 Fee Schedule is amended as shown in Exhibit C.

Passed by the Council:

Commissioner Dan Ryan  
Prepared by: Emily Sandy, BDS  
Date Prepared: October 28, 2020

**Mary Hull Caballero**  
Auditor of the City of Portland  
By

Deputy



**City of  
Portland, Oregon**  
**Bureau of Development Services**  
FROM CONCEPT TO CONSTRUCTION

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**Memorandum**

**Date:** October 29, 2020

**To:** Portland City Council

**From:** Rebecca Esau, Director, Bureau of Development Services

**Cc:** Andrea Durbin, Director, Bureau of Planning and Sustainability  
Adena Long, Director, Portland Parks & Recreation  
Jenn Cairo, City Forester, Portland Parks & Recreation

**Re:** Proposed Amendments to Title 11, Trees in Development Situations

Greetings,

It is my pleasure to submit to you the recommendations of the Portland Planning and Sustainability Commission (PSC) and Portland Urban Forestry Commission (UFC) regarding amendments to Title 11, Trees, Chapter 11.50, Trees in Development Situations.

**Project Background**

On January 8, 2020, through Resolution 37473, the Portland City Council directed the Bureau of Development Services (BDS), the Bureau of Planning and Sustainability (BPS), and Portland Parks and Recreation (PP&R) to conduct an analysis, legal review and stakeholder engagement process of the Title 11 (Tree Code) amendments recommended by the PSC and UFC. Staff from the three bureaus evaluated the following:

- Removing existing exemptions from the tree preservation and tree density standards in Heavy Industrial (IH), General Industrial 1 (IG1), EX (Central Employment), and CX (Central Commercial) zones on private and City-owned/managed property, in development situations.
- Reducing the threshold for required preservation of trees on private property from 36 inches to 20 inches in diameter at breast height (dbh), wherever tree preservation is required, in development situations.
- Reducing the threshold for inch-per-inch fee in lieu of preservation for trees on private property, during development situations, from 36 inches dbh to 20 inches dbh.

**Tree Canopy Analysis Summary**

*Industrial Zones (IH, IG1, IG2 and EG2)*

SWCA, an environmental consulting firm, was hired to estimate tree canopy on properties in industrial zones using GIS analysis. GIS models were calibrated based on on-site verification and existing PP&R tree inventories. It was originally expected that GIS analysis could be used for other zones as well but the challenge of identifying tree diameters without knowing species, and the requisite number of site visits need throughout the city to adequately characterize tree sizes based on canopy, required that the scope of the work be narrowed to only industrial properties.

*All Other Zones*

BDS, PP&R and BPS staff completed reviews of development permits for private tax lots of 5,000 square feet or more (tax lots less than 5,000 square feet are exempt from Title 11 tree preservation during development) from the last two years (2018-2019). On-site trees identified in tree and/or landscaping plans were inventoried and recorded for development permits in three zoning categories: single-dwelling residential, multi-dwelling residential and commercial and employment. Trees inventoried in residential permits were separated out by “market area” to coincide with the boundaries used by the Bureau of Planning and Sustainability to assess housing affordability throughout the city.

SWCA, an environmental consultant, estimated the average number of trees per canopy acre in four dbh categories: <20 inches; 20 to 27.9 inches; 28 to 35.9 inches; and 36 inches or greater. The permit review estimated the average number of trees per tax-lot acre on a typical site for each zoning designation and market area.

**Economic Analysis Summary**

Johnson Economics used a pro forma model to estimate development impacts from proposed tree code changes, based on tree canopy estimates and current fee-in-lieu costs for tree preservation (\$450 per inch dbh) and tree planting (\$675 per medium canopy tree).

*Goal 9*

Statewide Planning Goal 9 requires cities to designate a 20-year inventory of developable employment land by type in comprehensive plans. Per the Economic Opportunities Analysis (EOA), Portland’s Harbor Access Lands and Harbor & Airport Districts (2 employment geographies in the EOA) have a tight Goal 9 capacity, together meeting just 101% of forecast demand to 2035 with a surplus of only 10 acres. Removing the exemption from tree preservation and the exemption from tree density would reduce development capacity in the IH zone and these freight hub districts by approximately 12 acres each, exceeding the 10 acre current surplus. Staff can support removing the exemptions from tree preservation and tree density in the IG1 zone.

*Industrial Job Impacts*

Johnson Economics estimated that the combined tree code changes would reduce job growth by 1,130 jobs over 20 years in the freight-hub districts, including 840 fewer jobs from removing the IH exemptions.

*Uneven Development Impacts*

Johnson Economics estimated that the combined tree code changes would have minimal impacts on commercial and residential development markets overall, reducing expected development (sq ft) on affected development sites (buildable land inventory) by less than 1% in each market subarea over 20 years. But the estimated development reduction over 20 years would be 34 percent in Harbor Access Lands and a 17 percent reduction in the Harbor & Airport Districts, because of their relatively low development value (as freight-oriented density) and tight land supply.

**Community Engagement**

In addition to written comments submitted throughout the project, staff worked with Barney & Worth, Inc., to engage community members in a three-pronged approach. The approach included: interviews with stakeholders from a variety of environmental, business, identify, and geographic organization; an online survey which was publicly available for broad

community input during the development of this draft proposal; and an Online Community Forum, open continuously for almost three weeks, for community members to provide input and ask questions related to a draft staff proposal. The bureaus of Environmental Services, Housing, Management and Finance, Transportation, and Water were also engaged and provided early review and comment on the potential amendments.

#### *What We Heard*

- Overall, most community members expressed support for removing the exemptions in IG, CX and EX zones and raised continued concern with retaining IH exemptions, citing the disproportionate health impacts of climate change and low tree canopy on communities of color and low-income communities.
- Overall, tree advocates supported reducing the size threshold for required tree preservation or fee in lieu mitigation based on inch-per-inch calculations.
- Overall, development and business organizations are concerned about adding costs to housing development in a time of recession caused by COVID-19.
- Concerns were raised about calculations in the economic analysis which assumed that no trees could be preserved in industrial properties during development, and that no trees would be planted to meet tree density requirements.
- Concerns were expressed that tree preservation and job growth are being considered as mutually exclusive.

#### **Equity Considerations**

The proposed amendments address public and environmental health disparities due to the unequal distribution of tree canopy in Portland. Trees are important components of urban infrastructure and provide numerous public health and environmental services. Unfortunately, low income communities and communities of color often reside in or adjacent to low canopy areas of the city- particularly industrial areas, where tree preservation and tree planting are not required during development.

Concurrently, state mandated land use planning goals require a certain amount of developable land to support economic growth. Industrial areas- particularly, the Harbor Access and Airport & Harbor geographies, are a source for middle wage job opportunities for workers without bachelor's degrees. Data from BPS shows that jobs related to the Harbor Access sector provide greater opportunity for people of color and address polarized job growth resulting from regional wage income gaps (lack of middle wage jobs).

Removing exemptions to tree preservation and tree planting requirements in IG1, EX and CX zones provides an opportunity to the above, supporting climate, canopy and economic goals for Portland. Economic analysis also demonstrates that reducing the size threshold for tree preservation during development on private property also provides an opportunity for supporting more canopy throughout the city, without significantly increasing the cost of housing. Furthermore, when tree preservation cannot be accommodated, fees in lieu of mitigation paid into the Tree Preservation and Planting Fund allow for tree planting and preservation to occur where needed most, as identified in Urban Forestry's Growing a More Equitable Urban Forest Citywide Tree Planting Strategy.

Staff recommended further analysis of strengthening tree preservation and tree planting requirements while supporting economic development in the IH zones is recommended as a next step.

**Planning and Sustainability Recommendation**

The PSC recommendation is reflected in the Code Language in Exhibit A, and their transmittal letter to City Council is Exhibit E.

1. **Remove the exemption** from tree preservation and tree density in IG1 (General Industrial 1), EX (Central Employment), and CX (Central Commercial) zones on private or City-owned/managed property, during development situations.
2. **Retain the exemption from tree preservation and tree density in IH** (Heavy Industrial) zone on private and City-owned or managed property, during development situations.
3. **Reduce the threshold for required preservation of trees** on private property, in development situations, from 36 inches to 20 inches in dbh, wherever tree preservation is required.
4. **Reduce the threshold for inch-per-inch fee in lieu of preservation** for trees on private property, in development situations, from 36 inches dbh to 20 inches dbh.

The PSC also recommended that City Council must direct, via ordinance, BPS to evaluate the Title 11 tree preservation and density exemptions for IH as part of the upcoming Economic Opportunities Analysis (EOA) update, consistent with City goals including those related to tree canopy, climate change and urban heat islands. The EOA should also consider equitable public health and environmental outcomes for BIPOC communities living adjacent to or employed within IH zone. This directive is reflected in the ordinance.

**Urban Forestry Commission Recommendation**

The UFC recommendation is reflected in the Code Language in Exhibit B, and their transmittal letter to City Council is Exhibit D.

1. **Remove the exemption** from tree preservation and tree density in IH (Heavy Industrial), IG1 (General Industrial 1), EX (Central Employment), and CX (Central Commercial) zones on private or City-owned/managed property, during development situations.
2. **Reduce the threshold for required preservation of trees** on private property, in development situations, from 36 inches to 20 inches in dbh, wherever tree preservation is required.
3. **Reduce the threshold for inch-per-inch fee in lieu of preservation** for trees on private property, in development situations, from 36 inches dbh to 20 inches dbh.

Both the PSC and UFC expressed policy support for the entire proposal; and expressed understanding of the limitations of Statewide Planning Goal 9 on removing the exemptions in the IH zone. Ultimately, the PSC opted to recommend retaining the exemptions in the IH zone, while the UFC recommended removing the exemptions in the IH zone.

This project has been a highly collaborative team effort between the Bureau of Development Services, Portland Parks & Recreation-Urban Forestry division, and the Bureau of Planning and Sustainability, including Nik Desai and Brian Landoe from Portland Parks & Recreation-Urban Forestry division; Jeff Caudill, Sallie Edmunds, Steve Kountz and Tom Armstrong from the Bureau of Planning and Sustainability; and Kimberly Tallant, Ken Ray, and Emily Sandy from the Bureau of Development Services.

Please contact Emily Sandy, Analyst II, BDS, with questions.



## Exhibit A as amended

**CHAPTER 11.50 - TREES IN DEVELOPMENT  
SITUATIONS**

**Sections:**

- 11.50.010 Purpose.
- 11.50.020 When a Tree Plan is Required.
- 11.50.030 Development Impact Area Option for Large Sites and Streets.
- 11.50.040 Tree Preservation Standards.
- 11.50.050 On-Site Tree Density Standards.
- 11.50.060 Street Tree Planting Standards.
- 11.50.070 Tree Plan Submittal Requirements.
- 11.50.080 Changes to Approved Tree Plans and Emergency Tree Removal.
- 11.50.090 Administrative Review.
- 11.50.095 Appeals.

**11.50.010 Purpose.**

The regulations of this Chapter support and complement other City development requirements, with a focus on achieving baseline tree preservation and total tree capacity on a site, considering the anticipated use and level of development. This Chapter regulates the removal, protection and planting of trees through the development process to encourage development, where practicable, to incorporate existing trees, particularly high quality or larger trees and groves, into the site design, to retain sufficient space to plant new trees, and to ensure suitable tree replacement when trees are removed. It is the intent of these provisions to lessen the impact of tree removal and to ensure mitigation when tree preservation standards are not met.

**11.50.020 When a Tree Plan is Required.**

(Amended by Ordinance No. 188816, effective March 16, 2018.) A tree plan is required in conjunction with all development permits, unless there are no Private Trees 12 inches or more in diameter, no City Trees 6 inches or more in diameter, and/or no Street Trees 3 inches or more in diameter, and the site or activity is exempt from Section 11.50.050 On-Site Tree Density Standards; and Section 11.50.060 Street Tree Planting Standards. If multiple development permits are required for a development proposal, including demolitions and subsequent construction, the same Tree Plan shall be included with each permit. For tree removal when no development permit is required, following completion of the development permit, or when tree preservation does not apply per Subsection 11.50.040 A.1., see Chapter 11.40.

**11.50.030 Development Impact Area Option For Large Sites and Streets.**

(Amended by Ordinance No. 188278, effective April 14, 2017.) Where development is proposed on a site larger than one acre or where work is occurring in the street and is not associated with an adjacent development site, the applicant may choose to establish a development impact area. For sites using the development impact area option, tree preservation requirements shall be based on the trees within the development impact area and tree density will be based on meeting Option A as applied only to the area within the development impact area. Trees may be planted to meet tree density requirement elsewhere on the site

**11.50.040 Tree Preservation Standards.**

(Amended by Ordinance Nos. 187675, 188278, 188816, 188959, 189078 and 189795, effective December 12, 2019.)

**A. Where these regulations apply.**

1. This Section applies to trees within the City of Portland and trees on sites within the County Urban Pocket Areas in the following situations. On sites where these regulations do not apply, tree removal is subject to the requirements of Chapter 11.40, Tree Permit Requirements.
  - a. On sites. Development activities with any ground disturbance or a construction staging area greater than 100 square feet on unpaved portions of the site within the root protection zone, as defined in Subsection 11.60.030 C.1.a., of one or more Private Trees 12 or more inches in diameter and/or one or more City Trees 6 or more inches in diameter.
  - b. In streets. Development activities with any ground disturbance or construction staging not limited to existing paved surfaces where there are one or more Street Trees 3 or more inches in diameter.
2. Any Heritage Trees and trees required to be preserved through a land use condition of approval or tree preservation plan cannot be removed using the provisions in this Chapter, but may be counted toward the tree preservation requirements of this Section.

**B. Exemptions. The following are exempt from the tree preservation standards of this Section:**

1. Private trees ~~On~~ portions of sites located within an ~~IH, IG1, EX, or CX~~ zone.
2. On sites that are less than 5,000 square feet in area.
3. On sites that have existing or proposed building coverage of 85 percent or more.
4. Trees that are dead, dying, dangerous, or a nuisance species, as documented in a Tree Plan per Subsection 11.50.070 B. These are subtracted from the total number of trees to be addressed by the standards.
5. Trees exempted from this standard by a land use decision.
6. Tree preservation requirements approved in a land division or planned development review under Title 33, Planning and Zoning and the requirements of that review are still in effect.

7. Repair and replacement of existing fences and decks that are not changing in footprint or length when no trees are to be removed as a part of the project.
- C. Tree Preservation Requirement. Any trees preserved shall be protected in accordance with the specifications in Section 11.60.030. The regulations for Private Trees in Subsection 11.50.040 C.1. sunset after December 31, 2024. After December 31, 2024 the regulations in effect will be those in effect on January 1, 2015.
1. Private Trees.
    - a. General tree preservation.
      - (1) Retention. An applicant shall preserve and protect at least 1/3 of the non-exempt trees 12 inches and larger in diameter located completely or partially on the development site, unless mitigation occurs per Subsection 11.50.040 C.1.a.(2) below. Retaining trees at least 6 and less than 12 inches in diameter that are documented in a report prepared by an arborist or landscape professional to be Garry Oak (*Quercus garryana*), Pacific Madrone (*Arbutus menziesii*), Pacific Yew (*Taxus brevifolia*), Ponderosa Pine (*Pinus ponderosa*), or Western Flowering Dogwood (*Cornus nuttallii*) species are not included in the total count of trees on the site but may be used toward meeting the preservation standard.
      - (2) Mitigation. For each tree not preserved and protected below the 1/3 requirement, payment to the Tree Planting and Preservation Fund is required as shown in Table 50-1. For trees removed at least 12 inches and less than 20 inches in diameter the mitigation fee is the cost of (2) two-inch diameter replacement trees. For trees removed at least 20 inches in diameter or greater the mitigation fee is the cost per diameter inch of tree removed. The fee is calculated using the per-inch Restoration Fee for Tree Removal in the adopted fee schedule for Title 11. In cases where more than one tree is proposed for removal in excess of that allowed by Subsection 11.50.040 C.1.a.(1), the mitigation payment required to meet the 1/3 retention standard is based on the largest tree or trees proposed for removal.

**Table 50-1  
Required Mitigation**

<b>Size of Tree Removed (inches in diameter)</b>	<b>Required Mitigation</b>
At least 12 and less than 20	The cost of (2) two-inch diameter replacement trees
At least 20 and less than 36	The cost of (4) two-inch diameter replacement trees
At least <del>36</del> <u>20</u> or more	The cost per inch of tree removed

- b. Preservation of trees ~~36~~20 inches or greater.
- (1) Retention. An applicant shall preserve and protect all non-exempt trees ~~36~~20 inches in diameter or greater located completely or partially on the development site, unless mitigation and notice occurs per Subsections 11.50.040 C.1.b.(2) and 11.50.040 C.1.~~b.(3)~~c., below. Retention or mitigation of these trees may also be used to meet the standards for general tree preservation in Subsection 11.50.040 C.1.a. above.
  - (2) Mitigation. For each tree ~~36~~20 or more inches in diameter not preserved and protected, payment to the Tree Planting and Preservation Fund is required as shown in Table 50-1. The fee is calculated using the per-inch ~~Restoration Fee for Tree Removal~~Planting and Establishment Fee in Lieu for development in the adopted fee schedule for Title 11.
- ~~c.(3)~~ c. Notice for trees 36 inches or greater not preserved and protected. If a tree 36 inches or greater in diameter is not preserved and protected as allowed by Subsection 11.50.040 C.1.b.(2) above, the property owner or the property owner's representative must post a notice on the site and send a notice to the recognized Neighborhood Association and District Coalition in which the site is located. The notices are for notification purposes only. The notices do not provide for public comment on the proposal or for appeal of the proposal. The property owner or the property owner's representative must provide a signed certification to the Bureau of Development Services that a notice was posted on the site and a notice was sent to the Neighborhood Association and District Coalition. The development permit may not be issued until the business day following the day the notification period is completed.

(1)(a) The posted notice must:

- (a)(i) Be posted on the site for at least 45 calendar days prior to development permit issuance;
- (b)(ii) Be posted within 10 feet of the street lot line nearest the tree or trees to be removed;
- (c)(iii) Include the date of posting and the date of the end of the notification period;
- (d)(iv) Include a site plan at least 8.5 x 11 inches in size showing the location and description of the trees(s) to be removed including diameter inch size(s); and
- (e)(v) Include contact information for the property owner or the property owner's representative.

(2)(b) The notices to the Neighborhood Association and District Coalition must:

- (a)(i) Be e-mailed or mailed to the Neighborhood Association and District Coalition using the contact information maintained by the Office of Community & Civic Life. If mailed, the notice must be sent via certified or registered mail. The date of the e-mail or the mailing must be at least 45 calendar days prior to development permit issuance;
- (b)(ii) Include a description of the trees(s) to be removed including diameter inch size(s); and
- (c)(iii) Include contact information for the property owner or the property owner's representative.

d.(4) Exemption of tree preservation mitigation payments for affordable housing developments. Projects are exempt from the mitigation requirements in Subsection 11.50.040 C.1.b.(2) if the development will be an affordable housing development approved for system development charge exemptions under Section 30.01.095. The amount of the mitigation exemption shall be pro-rated to a percentage equal to the percentage of dwelling units on the development site that are approved for the systems development charge exemption in Section 30.01.095. The Director of the Portland Housing Bureau may adopt administrative rules for the administration of Subsection 11.50.040 C.1.d.b.(4).

~~e.e.~~ Exception for Capital Improvement Projects. Trees on private property that are part of a capital improvement project and within the development impact area are regulated as City and Street Trees.

2. City and Street Trees.

a. Retention. For development on City owned or managed sites, new public streets, or improvements to existing streets, applicants are required to consult with the City Forester at the preliminary project design phase if City or Street Tree removal is likely to occur to complete the project. The purpose of this consultation is to identify potential impacts and opportunities to retain existing trees, as well as any measures required to protect trees on site, on adjacent sites, or in the street.

b. Mitigation. Any required mitigation specified below shall occur on the site, in the street planter strip, or in the same watershed either by planting or a payment into the Tree Planting and Preservation Fund. The City Forester may reduce or waive the following mitigation requirements.

(1) Approved Street Tree removal in conjunction with improvements to partially or fully unimproved streets. Each tree at least 12 inches in diameter that is allowed to be removed shall be replaced with at least one tree. Trees planted to meet Street Tree Planting Standards will be credited toward meeting this requirement.

(2) Any other Street or City Tree allowed to be removed that is 6 or more inches in diameter shall be replaced with at least one tree in addition to trees required to meet required tree density or Street Tree planting standards.

**11.50.050 On-Site Tree Density Standards.**

(Amended by Ordinance Nos. 187675, 188278 and 188959, effective May 24, 2018.)

A. Where these Regulations Apply. This Section applies to sites within the City of Portland and the County Urban Pocket Areas. Unless exempted in Subsection 11.50.050 B., the following are subject to the On-Site Tree Density Standards:

1. New Development;

2. Exterior alterations to existing development with a project valuation that is more than the threshold stated in Subsection 33.258.070 D.2.a.

**B. Exemptions.**

1. The following development activities are exempt from the on-site tree density standards:
  - a. A specific condition of land use review approval exempts the site from these density standards;
  - b. The site is within the Portland International Airport Plan District or Cascade Station/Portland International Center Plan District and is subject to the Airport Landscape Standards; see Title 33, Planning and Zoning.
  - c. Private trees ~~On~~ portions of sites located within an ~~IH, IG1, EX,~~ ~~or CX~~ zone.
  - d. Work conducted under Demolition, Site Development, Septic, Plumbing or Zoning Permits.
2. Sites with the following primary uses are exempt from the on-site tree density standards:
  - a. Railroad Yards;
  - b. Waste Related;
  - c. Agriculture;
  - d. Aviation and Surface Passenger Terminals;
  - e. Detention Facilities;
  - f. Mining;
  - g. Radio Frequency Transmission Facilities; or
  - h. Rail Lines and Utility Corridors;

**C.** New development shall meet City specifications and standards in Chapter 11.60 and the on-site tree density requirements in Subsection D., below. Exterior alterations shall meet City specifications and standards in Chapter 11.60 and the on-site tree density requirements in Subsection D., below, but are only required to spend 10 percent of project value on the requirements in Subsection D. and the nonconforming upgrades required by Chapter 33.258, Nonconforming Situations.

**D.** On-Site Tree Density Requirements.

1. **Required Tree Area.** The required tree area is based on the size of the site and the type and size of proposed and existing development as shown in Table 50-2. Applicants may choose Option A or Option B for calculating required tree area except only Option A may be used to apply standards to a "Development Impact Area".

**Table 50-2  
Determining Required Tree Area**

Development Type	Option A	Option B
One and Two Family Residential	40 percent of site or development impact area	Site area minus building coverage of existing and proposed development
Multi Dwelling Residential	20 percent of site or development impact area	
Commercial/Office/Retail/Mixed Use	15 percent of site or development impact area	
Industrial	10 percent of site or development impact area	
Institutional	25 percent of site or development impact area	
Other	25 percent of site or development impact area	

2. **Required Tree Density.** The required tree area shall be planted with some combination of large, medium or small canopy trees at the following rates:

**Table 50-3  
Number of Required Trees and Minimum Planting Area**

Canopy size category (at maturity)	Number of trees required per size of tree area	Min. required planting area per tree (min. dimension)
Large	1 per 1,000 s.f.	150 s.f. (10' x 10')
Medium	1 per 500 s.f.	75 s.f. (5' x 5')
Small	1 per 300 s.f.	50 s.f. (3' x 3')

Refer to Chapter 11.60, Technical Specifications, to calculate tree canopy size categories. When the canopy size category of the tree species is not or cannot be determined, the tree will be considered a small canopy tree.

3. **Tree Density Credits**
  - a. Trees planted on site to meet any required stormwater or other landscaping requirement may be counted toward the On-site tree density requirements.



- b. Trees that are retained and protected, including trees preserved per Section 11.50.040, may be credited as follows:
  - (1) Trees between 1.5 and less than 6 inches in diameter count as one small canopy size tree.
  - (2) Trees 6 or more inches in diameter count as one medium canopy size tree for each full increment of 6 diameter inches.
- c. Payment in lieu of planting. The applicant may pay a fee to the Tree Planting and Preservation Fund per Section 11.15.010 equivalent to the cost of planting and establishing one 1.5-inch caliper tree. The fee per tree shall be credited at a rate of one medium canopy size tree.
- d. On sites less than or equal to 3,000 square feet, healthy non-nuisance species trees planted or retained in the street planting strip may be credited as described in this Subsection.

**11.50.060 Street Tree Planting Standards.**

[No change]

**11.50.070 Tree Plan Submittal Requirements.**

[No change]

**11.50.080 Changes to Approved Tree Plans and Emergency Tree Removal.**

[No change]

**11.50.090 Administrative Review.**

[No change]

**11.50.095 Appeals.**

[No change]

**CHAPTER 11.50 - TREES IN DEVELOPMENT SITUATIONS****Sections:**

- 11.50.010 Purpose.
- 11.50.020 When a Tree Plan is Required.
- 11.50.030 Development Impact Area Option for Large Sites and Streets.
- 11.50.040 Tree Preservation Standards.
- 11.50.050 On-Site Tree Density Standards.
- 11.50.060 Street Tree Planting Standards.
- 11.50.070 Tree Plan Submittal Requirements.
- 11.50.080 Changes to Approved Tree Plans and Emergency Tree Removal.
- 11.50.090 Administrative Review.
- 11.50.095 Appeals.

**11.50.010 Purpose.**

The regulations of this Chapter support and complement other City development requirements, with a focus on achieving baseline tree preservation and total tree capacity on a site, considering the anticipated use and level of development. This Chapter regulates the removal, protection and planting of trees through the development process to encourage development, where practicable, to incorporate existing trees, particularly high quality or larger trees and groves, into the site design, to retain sufficient space to plant new trees, and to ensure suitable tree replacement when trees are removed. It is the intent of these provisions to lessen the impact of tree removal and to ensure mitigation when tree preservation standards are not met.

**11.50.020 When a Tree Plan is Required.**

(Amended by Ordinance No. 188816, effective March 16, 2018.) A tree plan is required in conjunction with all development permits, unless there are no Private Trees 12 inches or more in diameter, no City Trees 6 inches or more in diameter, and/or no Street Trees 3 inches or more in diameter, and the site or activity is exempt from Section 11.50.050 On-Site Tree Density Standards; and Section 11.50.060 Street Tree Planting Standards. If multiple development permits are required for a development proposal, including demolitions and subsequent construction, the same Tree Plan shall be included with each permit. For tree removal when no development permit is required, following completion of the development permit, or when tree preservation does not apply per Subsection 11.50.040 A.1., see Chapter 11.40.

**11.50.030 Development Impact Area Option For Large Sites and Streets.**

(Amended by Ordinance No. 188278, effective April 14, 2017.) Where development is proposed on a site larger than one acre or where work is occurring in the street and is not associated with an adjacent development site, the applicant may choose to establish a development impact area. For sites using the development impact area option, tree preservation requirements shall be based on the trees within the development impact area and tree density will be based on meeting Option A as applied only to the area within the development impact area. Trees may be planted to meet tree density requirement elsewhere on the site.

**11.50.040 Tree Preservation Standards.**

(Amended by Ordinance Nos. 187675, 188278, 188816, 188959, 189078 and 189795, effective December 12, 2019.)

- A. Where these regulations apply.
1. This Section applies to trees within the City of Portland and trees on sites within the County Urban Pocket Areas in the following situations. On sites where these regulations do not apply, tree removal is subject to the requirements of Chapter 11.40, Tree Permit Requirements.
    - a. On sites. Development activities with any ground disturbance or a construction staging area greater than 100 square feet on unpaved portions of the site within the root protection zone, as defined in Subsection 11.60.030 C.1.a., of one or more Private Trees 12 or more inches in diameter and/or one or more City Trees 6 or more inches in diameter.
    - b. In streets. Development activities with any ground disturbance or construction staging not limited to existing paved surfaces where there are one or more Street Trees 3 or more inches in diameter.
  2. Any Heritage Trees and trees required to be preserved through a land use condition of approval or tree preservation plan cannot be removed using the provisions in this Chapter, but may be counted toward the tree preservation requirements of this Section.
- B. Exemptions. The following are exempt from the tree preservation standards of this Section:
- ~~1.~~ On portions of sites located within an IH, IG1, EX, or CX zone.
  12. On sites that are less than 5,000 square feet in area.
  23. On sites that have existing or proposed building coverage of 85 percent or more.
  34. Trees that are dead, dying, dangerous, or a nuisance species, as documented in a Tree Plan per Subsection 11.50.070 B. These are subtracted from the total number of trees to be addressed by the standards.
  45. Trees exempted from this standard by a land use decision.
  56. Tree preservation requirements approved in a land division or planned development review under Title 33, Planning and Zoning and the requirements of that review are still in effect.

- 67.** Repair and replacement of existing fences and decks that are not changing in footprint or length when no trees are to be removed as a part of the project.

**C.** Tree Preservation Requirement. Any trees preserved shall be protected in accordance with the specifications in Section 11.60.030. The regulations for Private Trees in Subsection 11.50.040 C.1. sunset after December 31, 2024. After December 31, 2024 the regulations in effect will be those in effect on January 1, 2015.

**1.** Private Trees.

**a.** General tree preservation.

- (1)** Retention. An applicant shall preserve and protect at least 1/3 of the non-exempt trees 12 inches and larger in diameter located completely or partially on the development site, unless mitigation occurs per Subsection 11.50.040 C.1.a.(2) below. Retaining trees at least 6 and less than 12 inches in diameter that are documented in a report prepared by an arborist or landscape professional to be Garry Oak (*Quercus garryana*), Pacific Madrone (*Arbutus menziesii*), Pacific Yew (*Taxus brevifolia*), Ponderosa Pine (*Pinus ponderosa*), or Western Flowering Dogwood (*Cornus nuttallii*) species are not included in the total count of trees on the site but may be used toward meeting the preservation standard.
- (2)** Mitigation. For each tree not preserved and protected below the 1/3 requirement, payment to the Tree Planting and Preservation Fund is required as shown in Table 50-1. For trees removed at least 12 inches and less than 20 inches in diameter the mitigation fee is the cost of (2) two-inch diameter replacement trees. For trees removed at least 20 inches in diameter or greater the mitigation fee is the cost per diameter inch of tree removed. The fee is calculated using the per-inch Restoration Fee for Tree Removal in the adopted fee schedule for Title 11. In cases where more than one tree is proposed for removal in excess of that allowed by Subsection 11.50.040 C.1.a.(1), the mitigation payment required to meet the 1/3 retention standard is based on the largest tree or trees proposed for removal.

**Table 50-1  
Required Mitigation**

<b>Size of Tree Removed (inches in diameter)</b>	<b>Required Mitigation</b>
At least 12 and less than 20	The cost of (2) two-inch diameter replacement trees
<del>At least 20 and less than 36</del>	<del>The cost of (4) two-inch diameter replacement trees</del>
At least <u>20</u> 36 or more	The cost per inch of tree removed

- b. Preservation of trees ~~36~~20 inches or greater.
- (1) Retention. An applicant shall preserve and protect all non-exempt trees ~~36~~20 inches in diameter or greater located completely or partially on the development site, unless mitigation and notice occurs per Subsections 11.50.040 C.1.b.(2) and 11.50.040 C.1.~~b.(3)~~c., below. Retention or mitigation of these trees may also be used to meet the standards for general tree preservation in Subsection 11.50.040 C.1.a. above.
  - (2) Mitigation. For each tree ~~36~~20 or more inches in diameter not preserved and protected, payment to the Tree Planting and Preservation Fund is required as shown in Table 50-1. The fee is calculated using the per-inch ~~Restoration Fee for Tree Removal~~Planting and Establishment Fee in Lieu for development in the adopted fee schedule for Title 11.
- ~~c.(3)~~ c. Notice for trees 36 inches or greater not preserved and protected. If a tree 36 inches or greater in diameter is not preserved and protected as allowed by Subsection 11.50.040 C.1.b.(2) above, the property owner or the property owner's representative must post a notice on the site and send a notice to the recognized Neighborhood Association and District Coalition in which the site is located. The notices are for notification purposes only. The notices do not provide for public comment on the proposal or for appeal of the proposal. The property owner or the property owner's representative must provide a signed certification to the Bureau of Development Services that a notice was posted on the site and a notice was sent to the Neighborhood Association and District Coalition. The development permit may not be issued until the business day following the day the notification period is completed.

(1)(a) The posted notice must:

- (a)(i) Be posted on the site for at least 45 calendar days prior to development permit issuance;
- (b)(ii) Be posted within 10 feet of the street lot line nearest the tree or trees to be removed;
- (c)(iii) Include the date of posting and the date of the end of the notification period;
- (d)(iv) Include a site plan at least 8.5 x 11 inches in size showing the location and description of the trees(s) to be removed including diameter inch size(s); and
- (e)(v) Include contact information for the property owner or the property owner's representative.

(2)(b) The notices to the Neighborhood Association and District Coalition must:

- (a)(i) Be e-mailed or mailed to the Neighborhood Association and District Coalition using the contact information maintained by the Office of Community & Civic Life. If mailed, the notice must be sent via certified or registered mail. The date of the e-mail or the mailing must be at least 45 calendar days prior to development permit issuance;
- (b)(ii) Include a description of the trees(s) to be removed including diameter inch size(s); and
- (c)(iii) Include contact information for the property owner or the property owner's representative.

d.(4) Exemption of tree preservation mitigation payments for affordable housing developments. Projects are exempt from the mitigation requirements in Subsection 11.50.040 C.1.b.(2) if the development will be an affordable housing development approved for system development charge exemptions under Section 30.01.095. The amount of the mitigation exemption shall be pro-rated to a percentage equal to the percentage of dwelling units on the development site that are approved for the systems development charge exemption in Section 30.01.095. The Director of the Portland Housing Bureau may adopt administrative rules for the administration of Subsection 11.50.040 C.1.d.b.(4).

~~e.e.~~ Exception for Capital Improvement Projects. Trees on private property that are part of a capital improvement project and within the development impact area are regulated as City and Street Trees.

2. City and Street Trees.

a. Retention. For development on City owned or managed sites, new public streets, or improvements to existing streets, applicants are required to consult with the City Forester at the preliminary project design phase if City or Street Tree removal is likely to occur to complete the project. The purpose of this consultation is to identify potential impacts and opportunities to retain existing trees, as well as any measures required to protect trees on site, on adjacent sites, or in the street.

b. Mitigation. Any required mitigation specified below shall occur on the site, in the street planter strip, or in the same watershed either by planting or a payment into the Tree Planting and Preservation Fund. The City Forester may reduce or waive the following mitigation requirements.

(1) Approved Street Tree removal in conjunction with improvements to partially or fully unimproved streets. Each tree at least 12 inches in diameter that is allowed to be removed shall be replaced with at least one tree. Trees planted to meet Street Tree Planting Standards will be credited toward meeting this requirement.

(2) Any other Street or City Tree allowed to be removed that is 6 or more inches in diameter shall be replaced with at least one tree in addition to trees required to meet required tree density or Street Tree planting standards.

**11.50.050 On-Site Tree Density Standards.**

(Amended by Ordinance Nos. 187675, 188278 and 188959, effective May 24, 2018.)

A. Where these Regulations Apply. This Section applies to sites within the City of Portland and the County Urban Pocket Areas. Unless exempted in Subsection 11.50.050 B., the following are subject to the On-Site Tree Density Standards:

1. New Development;

2. Exterior alterations to existing development with a project valuation that is more than the threshold stated in Subsection 33.258.070 D.2.a.

**B. Exemptions.**

1. The following development activities are exempt from the on-site tree density standards:
  - a. A specific condition of land use review approval exempts the site from these density standards;
  - b. The site is within the Portland International Airport Plan District or Cascade Station/Portland International Center Plan District and is subject to the Airport Landscape Standards; see Title 33, Planning and Zoning.
  - ~~c. On portions of sites located within an IH, IG1, EX, or CX zone.~~
  - cd. Work conducted under Demolition, Site Development, Septic, Plumbing or Zoning Permits.
2. Sites with the following primary uses are exempt from the on-site tree density standards:
  - a. Railroad Yards;
  - b. Waste Related;
  - c. Agriculture;
  - d. Aviation and Surface Passenger Terminals;
  - e. Detention Facilities;
  - f. Mining;
  - g. Radio Frequency Transmission Facilities; or
  - h. Rail Lines and Utility Corridors;

**C.** New development shall meet City specifications and standards in Chapter 11.60 and the on-site tree density requirements in Subsection D., below. Exterior alterations shall meet City specifications and standards in Chapter 11.60 and the on-site tree density requirements in Subsection D., below, but are only required to spend 10 percent of project value on the requirements in Subsection D. and the nonconforming upgrades required by Chapter 33.258, Nonconforming Situations.

**D.** On-Site Tree Density Requirements.



1. **Required Tree Area.** The required tree area is based on the size of the site and the type and size of proposed and existing development as shown in Table 50-2. Applicants may choose Option A or Option B for calculating required tree area except only Option A may be used to apply standards to a "Development Impact Area".

**Table 50-2  
Determining Required Tree Area**

<b>Development Type</b>	<b>Option A</b>	<b>Option B</b>
One and Two Family Residential	40 percent of site or development impact area	Site area minus building coverage of existing and proposed development
Multi Dwelling Residential	20 percent of site or development impact area	
Commercial/Office/Retail/Mixed Use	15 percent of site or development impact area	
Industrial	10 percent of site or development impact area	
Institutional	25 percent of site or development impact area	
Other	25 percent of site or development impact area	

2. **Required Tree Density.** The required tree area shall be planted with some combination of large, medium or small canopy trees at the following rates:

**Table 50-3  
Number of Required Trees and Minimum Planting Area**

<b>Canopy size category (at maturity)</b>	<b>Number of trees required per size of tree area</b>	<b>Min. required planting area per tree (min. dimension)</b>
Large	1 per 1,000 s.f.	150 s.f. (10' x 10')
Medium	1 per 500 s.f.	75 s.f. (5' x 5')
Small	1 per 300 s.f.	50 s.f. (3' x 3')

Refer to Chapter 11.60, Technical Specifications, to calculate tree canopy size categories. When the canopy size category of the tree species is not or cannot be determined, the tree will be considered a small canopy tree.

3. **Tree Density Credits**
  - a. Trees planted on site to meet any required stormwater or other landscaping requirement may be counted toward the On-site tree density requirements.

- b. Trees that are retained and protected, including trees preserved per Section 11.50.040, may be credited as follows:
  - (1) Trees between 1.5 and less than 6 inches in diameter count as one small canopy size tree.
  - (2) Trees 6 or more inches in diameter count as one medium canopy size tree for each full increment of 6 diameter inches.
- c. Payment in lieu of planting. The applicant may pay a fee to the Tree Planting and Preservation Fund per Section 11.15.010 equivalent to the cost of planting and establishing one 1.5-inch caliper tree. The fee per tree shall be credited at a rate of one medium canopy size tree.
- d. On sites less than or equal to 3,000 square feet, healthy non-nuisance species trees planted or retained in the street planting strip may be credited as described in this Subsection.

**11.50.060 Street Tree Planting Standards.**

[No change]

**11.50.070 Tree Plan Submittal Requirements.**

[No change]

**11.50.080 Changes to Approved Tree Plans and Emergency Tree Removal.**

[No change]

**11.50.090 Administrative Review.**

[No change]

**11.50.095 Appeals.**

[No change]

City of Portland  
Portland Parks & Recreation Urban Forestry  
**Title 11, Trees Fee Schedule**  
*effective December 4, 2020*

DEVELOPMENT		
Commercial Remodel ≥ \$25,000 valuation	\$	516.00
Commercial Construction	\$	516.00
Commercial Demolition Review	\$	516.00
Residential Remodel ≥ \$25,000 valuation	\$	516.00
Residential Construction	\$	516.00
Residential Demolition Review	\$	516.00
Public Works	\$	918.00
Land Use Review	\$	344.00
Early Assistance Written Info	\$	344.00
Early Assistance Meeting & Written	\$	574.00
Pre-Application Conference	\$	574.00
Preservation Inspection	\$	287.00
Preservation Re-inspection	\$	287.00
Final Planting Inspection	\$	229.00
Root Inspection	\$	164.00
Preservation, Fee in Lieu (Private Trees)		
Trees ≥12 and <20 inches diameter	\$	1,800.00 per tree
<del>Trees ≥20 and &lt;26 inches diameter</del>	<del>\$</del>	<del>3,600.00 per tree</del>
<del>Trees ≥26 inches diameter</del>	<del>\$</del>	<del>450.00 per inch</del>
Trees ≥20 inches diameter	\$	450.00 per inch
Planting and Establishment, Fee in Lieu	\$	675.00 per tree
Planting and Establishment, Fee in Lieu	\$	450.00 per inch
Hourly Rate for Urban Forestry	\$	109.43
NON-DEVELOPMENT		
Removal Application (1-3 trees)	\$	100.00
≥4 trees, Additional Fee	\$	25.00 per tree
Density Inspection	\$	100.00
Root Inspection	\$	164.00
Online Pruning Application		no charge
Pruning Application (Inspection Required)	\$	50.00
Planting Application		no charge
Chemical Treatment Application	\$	150.00
Appeal	\$	200.00
Attaching Permanent Objects Application	\$	300.00
Attaching Permanent Object Annual Inspection	\$	109.43 per hour
Attaching Permanent Objects Reissuance	\$	100.00
Ornamental Lighting Application (1-10 trees)	\$	35.00
11-50 trees, Additional Fee	\$	45.00
51-100 trees, Additional Fee	\$	75.00
101-200 trees, Additional Fee	\$	100.00
201-500 trees, Additional Fee	\$	175.00
>500 trees, Additional Fee	\$	250.00
Planting and Establishment, Fee in Lieu	\$	450.00 per inch
Hourly Rate for Urban Forestry	\$	109.43
PROGRAMMATIC PERMIT		
Programmatic Permit Application	\$	6,500.00
ENFORCEMENT		
Violation Review	\$	350.00
Administrative Review	\$	200.00
Enforcement Penalty	\$	250.00
Violation Inspection	\$	274.00
Civil Penalty	\$	1,000.00 per tree/ per day
Restoration Fee		
Damaged	\$	225.00 per inch
Removed	\$	450.00 per inch
Damaged Heritage Tree	\$	450.00 per inch
Removed Heritage Tree	\$	900.00 per inch
Nuisance Abatement Charges		Cost to remove the nuisance
Nuisance Abatement Administrative Charge		40% of abatement cost (min. \$257)

September 21, 2020

Mr. Ted Wheeler, Mayor  
Portland City Council  
1221 SW 4th Avenue, Room 130  
Portland, OR 97204

Dear Mayor Wheeler and members of the City Council,

Last Thursday, September 17, 2020, the Urban Forestry Commission (UFC) completed its public hearing on proposed changes to Title 11, Trees, that began during our two commissions' joint hearing on September 8.

After closing the public comment period at our September 17 hearing, the UFC (joined by several PSC members and City staff), had a discussion that weighed city goals, centering social justice and the long-term environmental health of the City. We then voted to approve City staff's proposal with one exception as noted below. The City staff proposal was delineated in a letter from Emily Sandy, Bureau of Development Services, to the PSC and UFC on August 14.

Specifically, the UFC voted on September 17 to make the following recommendations to the Portland City Council.

- “1. Remove the exemptions from tree preservation and tree density in IG1 (General Industrial 1), EX (Central Employment), CX (Central Commercial) and IH (Heavy Industrial) zone, on private or City-owned/managed property, during development situations, and*
- 2) Reduce the threshold for required preservation of trees on private property, in development situations, from 36 inches to 20 inches in dbh<sup>1</sup>, wherever tree preservation is required, and*
- 3) Reduce the threshold for inch-per-inch fee in lieu of preservation for trees on private property, in development situations, from 36 inches dbh to 20 inches dbh.”*

**The UFC's vote differs only from the City staff proposal in the treatment of exemptions for IH-zoned lands: The staff proposal is to retain this exemption. The UFC voted to remove this exemption.**

We understand staff's rationale for retaining the IH exemption, including consideration of the City's 2016 Economic Opportunity Analysis (EOA) -- a required component of the City's compliance with statewide Goal 9 -- that claims that retaining large trees on IH land will increase development costs on this land. However, the UFC respectfully disagrees with the City staff conclusion. The analysis concludes that such costs would limit development, which would

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<sup>1</sup> 'dbh' refers to Diameter at Breast Height, and reflects a standard measure used in the field of forestry science to describe the physical size of a tree.

in turn shrink the future supply of developable industrial land (and thus limit the number of industrial jobs).

However, the UFC believes this analysis is far too narrow upon which to base this important decision. In fact, the staff report itself states that the economic analysis did not take into account the potential benefits of improvements to public and ecological health that would likely offset the projected negative impacts.

Absent in the EOA methodology is consideration of many other City goals and policies, including those calling for aggressive action to mitigate and prepare for climate change and its inequitable impacts on low-income, mainly BIPOC, communities. In particular, a City policy that facilitates the removal of large trees in areas such as the IH zone will amplify ambient temperatures, exacerbating the already disproportionate heat island effects on employees working within those areas, and on adjacent communities. The extensive amounts of impervious surfaces in all these land use categories, though especially in the heavy industrial zone, retains the heat and increases temperatures on nearby communities by upwards of 15-degrees Fahrenheit, which could be the difference between life and death for many in historically marginalized communities.

Cities around the country are actively addressing these urban heat islands, and Portland should be no exception. Removing these exemptions on all the zones under consideration will provide a stronger incentive to both preserve valuable shade from existing trees and to plant new trees which over time will reduce temperatures as future heat waves increase in frequency and intensity.

Our recommendation also aligns with the City's climate emergency declared earlier this year and that describes the importance of advancing climate equity and environmental justice. Allowing the exemption for IH-zoned land to remain is a step backwards on both fronts. We believe that the City Council must take bold action to ensure that the responsibility to preserve and enhance tree canopy infrastructure is borne equitably. **The UFC also recommends that the City evaluate these climate and equity considerations in the next Economic Opportunity Analysis, which is scheduled for 2021.** Following our recommendations would be an important step in that direction.

Thank you for the opportunity to collaborate on this issue and for consideration of our recommendations.



Vivek Shandas, Chair  
Urban Forestry Commission

cc: Planning and Sustainability Commission, Bureau of Development Services



Bureau of Planning and Sustainability  
Innovation. Collaboration. Practical Solutions.

Portland Planning and Sustainability Commission

Eli Spevak, Chair

Chris Smith  
Jeff Bachrach  
Ben Bortolazzo

Mike Houck  
Katie Larsell  
Oriana Magnera

Daisy Quiñonez  
Steph Routh, Vice Chair  
Katherine Schultz, Vice Chair

October 6, 2020

Portland City Council  
1221 SW 4th Avenue  
Portland, Oregon 97204

Dear Mayor Wheeler and City Commissioners:

On September 8, 2020, the Planning and Sustainability Commission (PSC) held a public hearing on a proposed amendment to Title 11, Trees, Tree Preservation in Development Situations (PCC 11.50.040). The proposal was presented by staff in response to directives in [Resolution 37473](#).

### Recommendation

By unanimous vote, the PSC supports amendments to the Tree Code (Title 11), as proposed in the 2020 Tree Code Amendments Staff Proposal, dated August 14, 2020, which:

- Remove the exemption from tree preservation and tree density in IG1 (General Industrial 1), EX (Central Employment), and CX (Central Commercial) zones on private or City-owned/managed property.
- Retain the exemption from tree preservation and tree density in IH (Heavy Industrial) zone on private and City-owned or managed property.
- Reduce the threshold for required preservation of trees on private property from 36 inches to 20 inches in diameter, wherever tree preservation is required.
- Reduce the threshold for inch-per-inch fee in lieu of preservation for trees on private property from 36 inches to 20 inches in diameter.

**In addition**, the PSC unanimously recommends that City Council Direct, via ordinance, the Bureau of Planning and Sustainability to evaluate the Title 11 tree preservation and density exemptions for IH as part of the Economic Opportunities Analysis (EOA) update, consistent with City goals including those related to tree canopy, climate change and urban heat islands. The EOA should also consider equitable public health and environmental outcomes for BIPOC communities living adjacent to or employed within IH zone.



City of Portland, Oregon | Bureau of Planning and Sustainability | [www.portlandoregon.gov/bps](http://www.portlandoregon.gov/bps)  
1900 SW 4th Avenue, Suite 7100, Portland, OR 97201 | phone: 503-823-7700 | fax: 503-823-7800 | tty: 503-823-6868

## Comments

1. **Testimony.** Commission received testimony regarding the urgency of strengthening the Tree Code, particularly in light of the effects of climate change. More specifically, much of the testimony expressed desire to remove the exemptions in the IH zone as well as the IG1, EX, and CX zones.
2. **Environmental, Community health and public health.** Peer-reviewed studies have demonstrated that low income communities and communities of color living adjacent to, or working in industrial zones are adversely affected by urban heat island effect, poor air quality, and numerous other negative public, community, and environmental health outcomes due to lack of canopy. The amendments will likely result in increased tree canopy in these areas, with the exception of areas adjacent to IH, and increase revenue to the Tree Planting and Preservation Fund which will be used to more equitably invest in tree canopy throughout the city. Public health studies have found that income and other socioeconomic factors play a major role in determining public health outcomes; middle wage job growth in IH can contribute to this by providing opportunities for reducing income inequality.
3. **Compliance with Statewide Land Use Planning Goal 9.** Removing exemptions to tree preservation and/or tree planting requirements in IH, IG1, EX, and CX must not reduce Portland's 20-year Buildable Land Inventory (BLI) for industrial development, job growth and corresponding economic opportunities required by Goal 9. Increased development cost is estimated to reduce acreage of BLI rendering the city out of compliance with Goal 9. The commission generally supports removing the exemptions in IH zone and struggled with this limitation. Ultimately, the commission felt that removing the exemptions should be evaluated through the upcoming EOA undertaken by BPS. The commission opted to express specific expectations for the EOA, as described above in our recommendations.
4. **The PSC discussed at length the framework of the current EOA, and the framework of the current Statewide Land Use Planning Goal 9.** The commission feels there are opportunities to update Goal 9 and the EOA framework to incorporate elements of the Green New Deal. The PSC looks forward to hearing and providing a recommendation to City Council on the upcoming update to the EOA.

Sincerely,

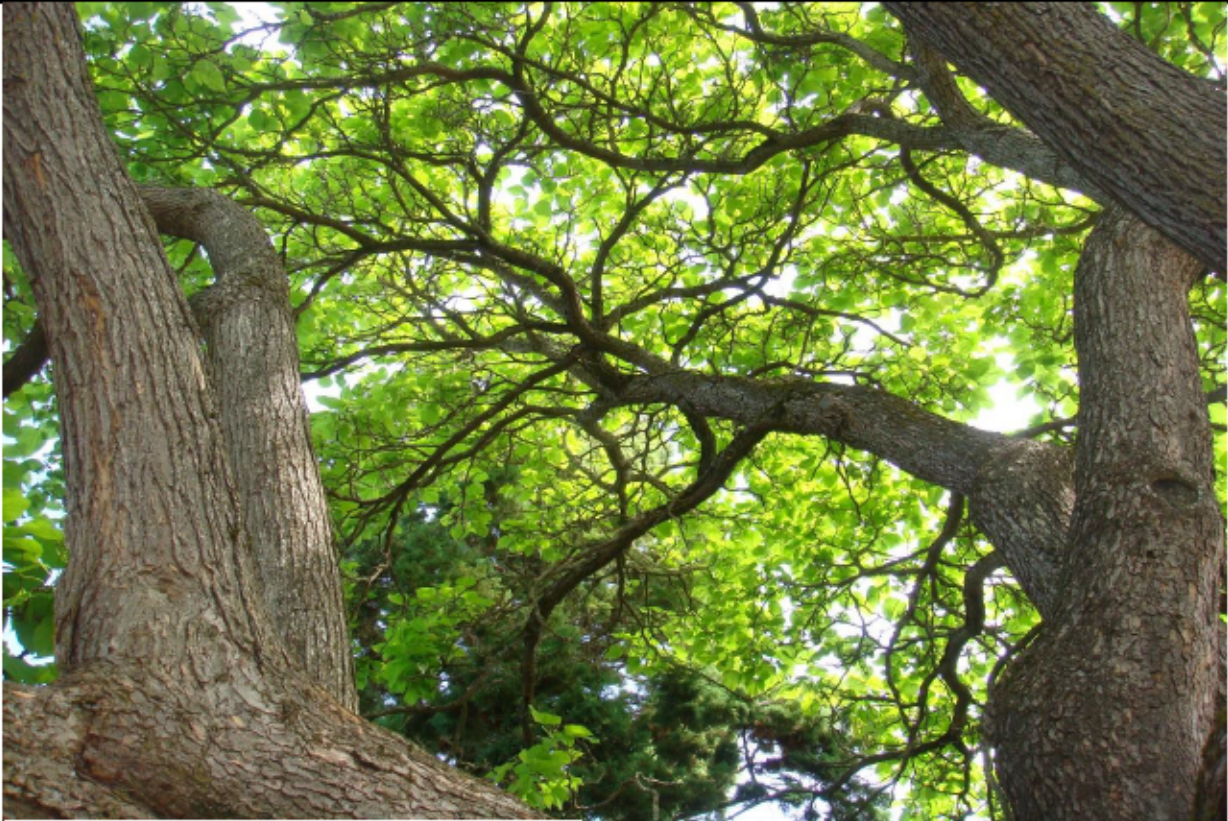


Eli Spevak  
Chair

Cc: Urban Forestry Commission



# Proposed Amendments to Title 11, Trees: Trees in Development Situations



Source: Portland Parks & Recreation Urban  
Forestry Division

Bureau of Development  
Services, with Portland Parks  
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Planning and Sustainability

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## 2020 Tree Code Amendments Staff Proposal

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## EXECUTIVE SUMMARY

On January 8, 2020, through Resolution 37473, the Portland City Council directed the Bureau of Development Services, the Bureau of Planning and Sustainability, and Portland Parks & Recreation to conduct an analysis, legal review and stakeholder engagement process of the proposals recommended by the PSC and UFC. This Staff Proposal is the result of that resolution, specifically the project evaluates:

- Removing the exemptions from tree preservation and tree density in IH (Heavy Industrial), IG1 (General Industrial 1), EX (Central Employment), and CX (Central Commercial) zones on private and City-owned/managed property.
- Reducing the threshold for required preservation of trees on private property from 36 inches to 20 inches in diameter at breast height (dbh), wherever tree preservation is required.
- Reducing the threshold for inch-per-inch fee in lieu of preservation for trees on private property from 36 inches dbh to 20 inches dbh.

Staff from the three named bureaus conducted community engagement strategies through interviews with key stakeholders to obtain input on the initial scope of work, a community survey to gauge community values and priorities, and an online community forum to present a draft proposal and gather input on the draft proposal.

Staff also engaged a consultant and conducted research to estimate the tree size composition of the existing tree canopy in affected areas of the city to inform an economic analysis to determine impacts of changing the regulations on industrial land supply to verify compliance with Statewide Planning Goal 9, Economic Development. The analysis also quantified additional impacts to housing production and housing costs. Staff also estimated potential outcomes on the rate of tree preservation and fees-in-lieu of preservation assessed if the proposed amendments are adopted.

Finally, staff considered the environmental and economic benefits of trees and economic considerations associated with impacts on industrial land supply available for job growth. Based on the outcomes of the economic analysis, community engagement, equity considerations and economic considerations, project staff propose the following amendments to Portland City Code Chapter 11.50, Trees in Development Situations:

- **Remove** the exemption from tree preservation and tree density in IG1 (General Industrial 1), EX (Central Employment), and CX (Central Commercial) zones on private and City-owned/managed property.
- **Retain** the exemption from tree preservation and tree density in IH (Heavy Industrial) zone on private and City-owned or managed property.
- **Reduce** the threshold for required preservation of trees on private property from 36 inches to 20 inches in diameter at breast height (dbh), wherever tree preservation is required.
- **Reduce** the threshold for inch-per-inch fee in lieu of preservation for trees on private property from 36 inches dbh to 20 inches dbh.

The staff proposal does not:

- Change any of the other existing exemptions from tree preservation or tree density.
- Change anything else about the rules for tree preservation or tree density in development situations.

Staff also proposes to re-examine the exemptions from tree preservation and tree density in the IH zone through the 5-year update to the Economic Opportunities Analysis (EOA) required by the State of Oregon to demonstrate compliance with Statewide Planning Goal 9, undertaken by the Bureau of Planning and Sustainability as part of its regular work program. The last EOA was adopted in 2016. Public engagement for the 5-year update is anticipated to begin in early 2021. In that forum, mitigating strategies may be established to offset the development constraints presented by adding tree preservation and tree density regulations in the IH zone.

## I. Introduction

### A. Project Background

In 2011, Portland adopted its first unified Tree Code to regulate the preservation, removal, planting and pruning of trees. The Tree Code took effect January 1, 2015. Several amendments have been made to the Tree Code over time and are described below.

#### 1. Large Tree Stop Gap Amendment, 2016

Shortly after the Tree Code went into effect, public concern emerged about the removal of especially large diameter trees during development. As a result, Ordinance 187685 was adopted to strengthen the regulations for tree preservation of especially large diameter trees. This was commonly known as the “Large Tree Amendment” or the “Stop-Gap” amendment. Acknowledging that the amendment was an emergency ordinance that was a “fast track” project with limited opportunity for public comment and staff analysis, a sunset date of December 31, 2019, was added to the amended regulations. The amendments were effective in May 2016. Those amendments are summarized as follows:

- The pre-existing standard for tree preservation was not changed. This standard requires that at least one-third of all healthy, non-nuisance trees on private property be preserved during development situations, or a fee must be paid in lieu of preservation into the Tree Planting and Preservation Fund.
- A new requirement was added that all healthy, non-nuisance trees on private property 36 inches diameter at breast height (dbh) and larger must be preserved or a fee paid in lieu of preservation is required. These trees may be used to meet the one-third preservation standard. In addition, for trees over 36 inches dbh, fees are calculated on an inch-by-inch basis when those trees are removed.
- A new requirement was added that requires an on-site posted notice and mailed notice to some parties when a tree 36 inches dbh or larger is to be removed, and that this notice be given at least 45 days prior to issuance of the related building permit. Certain affordable housing projects are exempt from the fee in lieu of preservation for trees 36 inches dbh or larger.

#### 2. Sunset Date Extension of Large-Tree Stop Gap Amendment, 2019

In 2019, staff initiated a project to extend the sunset date of the 2016 amendments to provide for additional time to review those amendments and the regulations for tree preservation in development more generally. As part of the legislative adoption process of that extension, the Planning and Sustainability Commission (PSC) and the Urban Forestry Commission (UFC) recommended that the City further strengthen tree preservation by removing the existing industrial and commercial zone exemptions for private trees and trees on city-owned sites. The UFC also recommended decreasing the key inch-for-inch mitigation fee threshold for tree removal on private property from 36 inches dbh to 20 inches dbh. Portland City Council adopted an extension of the sunset date to December 31, 2024, but did not act on the additional recommendations made by the PSC and the UFC. Instead, City Council passed a resolution that directed staff from the Bureau of Development Services (BDS), together with Portland Parks & Recreation (PP&R) and the Bureau of Planning and Sustainability (BPS), to initiate a project addressing the additional recommendations of the PSC and UFC.

### 3. City Council Resolution, 2020

Through Resolution 37473, the Portland City Council directed the Bureau of Development Services, the Bureau of Planning and Sustainability, and Portland Parks & Recreation to conduct an analysis, legal review and stakeholder engagement process of the proposals recommended by the PSC and UFC. This Staff Proposal is the result of that resolution, specifically:

“BE IT FURTHER RESOLVED that BDS, BPS, and PP&R shall immediately prepare a proposal to address the exemption from regulations for certain zones. BDS, BPS, and PP&R, shall conduct technical analysis and coordinate legal review to develop an analysis that addresses the exemption from preservation and density regulations in IH, IG1, EX, and CX zones. Based on this initial analysis, stakeholder feedback, and legal review, BDS, in coordination with BPS and PP&R, shall develop a proposal to remove the exemption and submit it to City Council no later than July 7, 2020, if the analysis and legal review allow for removal of the exemption.

BE IT FURTHER RESOLVED, concurrently with the first proposal, BDS and PP&R, in coordination with BPS, shall prepare a proposal to amend the regulations for tree preservation adopted by Ordinance 187675, including evaluating reduction of critical tree size threshold for inch-for-inch mitigation from 36-inches to 20-inches. BDS and PP&R shall return to Council with this second proposal no later than July 7, 2020.”

#### B. Effects of COVID-19 on Project Schedule

The uncertainties presented by the COVID-19 crisis beginning in mid-March 2020, including federal, state and local “state of emergency” declarations, caused disruption to the project schedule. The public engagement plan for the project was underway but needed to be re-worked to accommodate remote participation and uncertainties related to the ability of the community to effectively participate at the time. Among other things, staff revised the public engagement windows to a time when experts had projected the COVID-19 peak to have passed and people might be more inclined to participate.

In addition, in the early stages of the crisis, there was a high level of uncertainty of when the City Council, the Urban Forestry Commission, and the Planning and Sustainability Commission would be able to effectively run meetings virtually, how much of the City Council's time would need to be devoted to public health and economic priorities, and consequently how backed up their dockets would become.

Finally, the crisis presented impacts to project staff and consultant time, including required furlough and altered work schedules to accommodate dependents or other COVID-19 related impacts.

With support of City Council offices, the project timeline was extended to bring a proposal to the City Council the end of October 2020.

## II. Project Process

### A. Policy Direction and Project Goals

The goals of this project were developed by staff and originate from the existing purpose of the Tree Code, direction from the PSC and UFC provided in their recommendations in 2019, and direction from the City Council provided in Resolution 37473.

#### 1. Purpose of the Regulations in Title 11, Trees

Title 11, Trees, has an adopted overall purpose statement that considers the entirety of the Tree Code. This purpose considers the balance of the regulations that apply to development situations and non-development situations. It also considers the balance of the regulations that applies to trees on private property, trees on City-owned or managed sites, and street trees. Title 11 also has a purpose statement that considers the subject of this proposal, trees in development situations. Both the overall purpose statement and the purpose for the regulations of trees in development situations are discussed here.

#### *Purpose of Title 11, Trees*

The purpose of Title 11, Trees, is to enhance the quality of the urban forest and optimize the benefits that trees provide. Section 11.05.010, Purpose states:

“A. The Tree Code is one of the implementation measures of the Urban Forest Plan. Together with education and other initiatives, these regulations protect the health, safety, and general welfare of the citizens of Portland and are consistent with other plans and policies of the City. In so doing, the appearance of the City is enhanced and important ecological, cultural, and economic resources are protected for the benefit of the City’s residents and visitors.

B. The chapters within this Title address trees in both development and non-development situations and seek to enhance the quality of the urban forest and optimize the benefits that trees provide. Desired tree benefits include:

1. Providing oxygen and capturing air pollutants and carbon dioxide;
2. Maintaining slope stability and preventing erosion;
3. Filtering stormwater and reducing stormwater runoff;
4. Reducing energy demand and urban heat island through shading of buildings and impervious areas;
5. Providing visual screening and buffering from wind, storms and noise;
6. Sustaining habitat for birds and other wildlife;
7. Providing a source of food for wildlife and people;
8. Maintaining property values and the beauty, character and natural heritage of the City; and
9. Meeting the multi-purposed objectives of the Urban Forest Plan, including reaching and sustaining canopy targets for various urban land environments.”



*Purpose of Chapter 11.50, Trees in Development Situations*

The purpose of Chapter 11.50, Trees in Development Situations, takes into account the overall purpose of Title 11 while balancing the desire to accommodate planned development and ensuring mitigation when tree preservation standards are not met. Section 11.50.010, Purpose states:

“The regulations of this Chapter support and complement other City development requirements, with a focus on achieving baseline tree preservation and total tree capacity on a site, considering the anticipated use and level of development. This Chapter regulates the removal, protection and planting of trees through the development process to encourage development, where practicable, to incorporate existing trees, particularly high quality or larger trees and groves, into the site design, to retain sufficient space to plant new trees, and to ensure suitable tree replacement when trees are removed. It is the intent of these provisions to lessen the impact of tree removal and to ensure mitigation when tree preservation standards are not met.”

**2. Tree Canopy Equity**

In its recommendation to the City Council during the 2019 sunset date extension project, the PSC noted potential equity implications related to disparities in tree canopy and its corresponding environmental and public health services to low income residents and communities of color.

From the PSC recommendation dated October 10, 2019:

“In addition to the initial proposal, the Commission deliberated specifically on removing the exemption for tree preservation in development situations for certain industrially and commercially zoned sites (those in IH, IG1, CX and EX). Though staff has not done a thorough analysis to confirm, members of the commission noted that commercial and industrial lands often abut neighborhoods with lower income residents and communities of color – such that loss of tree canopy in these zones would have disproportionate impacts.”

The UFC’s recommendation to the City Council during the same project offered a similar perspective related to the potential equity implications of disparities in tree canopy and its corresponding environmental and public health services to low income residents and communities of color. From the UFC recommendation dated October 21, 2019:

“The Commission was in full agreement that trees provide multiple ecosystem services, including climate comfort, clean air, wildlife habitat, genetic resources, cultural and social values. In addition, the additional time will allow the Commission to evaluate potential implications of the code and develop an equitable solution before the next sunset date.

The public also expects that all zone classes follow the same regulations regarding Title 11 to maintain the distribution of ecosystem services along the city. Additional testimony by the PSC underscored the importance of social equity in removing current exemptions for sites zoned IH, IG1, EX and CX because many abut lower income households who face the harshest effects of increasing temperatures and persistent urban flooding-both climate induced events that are expected to rise in frequency and intensity over the coming years.”

### **3. Job Growth**

Job growth in industrial districts has an inclusive-prosperity role in the regional labor market as higher-paying alternatives to low-wage jobs are accessible to workers without college degrees. These job opportunities on average can be expected to moderate the region’s increasing income inequality, poverty (lack of income self-sufficiency), and income-related health impacts. Harbor-dependent sectors of the regional economy can also provide higher median incomes as compared to other sectors, particularly for people of color.

### **4. Statewide Planning Goal 9-Economic Development**

Statewide Planning Goal 9 requires local governments to demonstrate that there is an adequate inventory of developable industrial and employment land to accommodate forecasted economic growth. The Goal 9 rule (660-09-015 and 660-09-025) requires that comprehensive plans identify adequate 20-year and short-term land supply to fully meet forecast demand of industrial and other employment use types as analyzed in an Economic Opportunities Analysis (EOA; BPS 2016b).

The City of Portland’s EOA was most recently updated as a part of the 2035 Comprehensive Plan, originally adopted in 2016. The EOA estimates the 20-year supply and demand for employment land in the city by geography and land use types and includes a Buildable Land Inventory (BLI) that identifies specific properties that are most likely to redevelop over the 20-year period. To estimate the supply of employment land available, development constraints, including physical barriers (such as brownfields, steep slopes and other hazards, etc.) and regulations and their associated costs, are incorporated into the analysis.

Once the 20-year land supply is identified, local governments must monitor the availability of that land to ensure that the projected demand can still be met. If the land supply is reduced to a level below the 20-year demand projected in the EOA, the local government then becomes out of compliance with Goal 9.

## 5. Project Goals

Given the various contributions described above, project staff developed the following project goals:

- a. To support and implement the forest infrastructure goals of the Urban Forest Management Plan for various urban land environments.** In development situations, this means encouraging development, where practicable, to incorporate existing trees, particularly high quality or larger trees and groves, into the site design, to retain sufficient space to plant new trees, and to ensure suitable tree replacement when trees are removed.
- b. To improve equitable outcomes of regulation,** by preserving and protecting tree canopy and affiliated public health services, in and near places where low income residents and communities of color work and live. Members of the Planning and Sustainability Commission noted that commercial and industrial lands often abut neighborhoods with lower-income residents and communities of color such that loss of tree canopy in these zones has disproportionate impacts. Lowering the size threshold expands tree preservation requirements to include a greater percentage of trees distributed across more neighborhoods, as compared to only requiring preservation of trees 36 inches dbh.
- c. To evaluate the benefits and costs of the proposals** using the best available science.
- d. To engage community members** to inform the analyses that will support the final proposal, inform goals for future work on Title 11, and identify other opportunities and constraints related to the proposals. In addition to stakeholders, there should be a focus on engagement with communities of color, low income communities, and other communities that disproportionately bear the impacts of reduced tree canopy.
- e. To put forth a legally defensible staff proposal** to ensure that the outcome of the project meets Statewide Planning Goal 9, which requires local governments to demonstrate that there is an adequate inventory of developable industrial and employment land to accommodate forecasted economic growth.

## B. Community Engagement

In addition to written comments submitted throughout the project, staff worked with Barney & Worth, Inc., to engage community members in a three-pronged approach. The approach included interviews with stakeholders, an online survey publicly available for broad community input during the development of this proposal, and an Online Community Forum, open continuously for almost three weeks, for community members to provide input and ask questions related to the draft staff proposal. Finally, there will be opportunities to provide input to the recommending bodies, the PSC and UFC, and the City Council. Staff from other City bureaus - Environmental Services, Housing,

Management and Finance, Transportation, and Water --were also engaged and provided early review and comment on the potential amendments.

### 1. Stakeholder interviews

A series of interviews with 27 individuals representing 23 affiliations were conducted in March and April 2020. Stakeholders were identified by interest in the process leading up to the adoption of Resolution 37473 in January 2020. Individuals represented a spectrum of interest advocacy groups, community groups, geographic-based or neighborhood groups, City staff who implement the Tree Code, and private design professionals that frequently work with the Tree Code. A discussion guide, list of interviewees, and explanation of major themes that emerged from these interviews are shown in Appendix C. Major themes that emerged from these interviews were:

- a. Trees are valued by Portlanders for their contributions to livability, beauty and “sense of place.”
- b. It is broadly recognized that trees are not evenly or equitably distributed throughout the City.
- c. There is widespread agreement the current Tree Code is not working well.
- d. Portland’s Tree Code conflicts with other City codes and policies.
- e. The Tree Code fails to clarify “what we want to protect.”
- f. Stakeholders are left guessing about how mitigation funds are used.
- g. Participants have sharply contrasting views on the proposed removal of some industrial and commercial lands from tree preservation and planting requirements.
- h. Perspectives differ significantly on the proposed reduction of the threshold for the inch-per-inch mitigation fee from 36” to 20” diameter.
- i. Most stakeholders acknowledge increased urban density, affordable housing and tree preservation are competing goals and that more work/creative thinking is needed to address this problem.
- j. There is strong support for a comprehensive update of the Portland Tree Code, and participants suggest a rich treasure of topics to be addressed.

### 2. Community Survey

An online survey was conducted from April 16 to May 15, 2020. The intent of the survey was to gauge priorities of a broad range of community members. The topics were presented in a way that allowed them to be rated independently of one another so that they were not mutually exclusive. The survey also provided an opportunity to provide comments on issues to examine in a potential future comprehensive Tree Code project. Surveys were distributed to those interviewed in March and April, to other community partner organizations identified by project staff and equity staff from the Bureau of Development Services and Portland Parks & Recreation, to general distribution lists of Bureau of Development Services, Portland Parks & Recreation, and the Bureau of Planning and Sustainability, and through social media platforms such as Twitter, Facebook, and Next Door.

A total of 2,064 surveys were completed and 1,277 written comments submitted through this process. More detail on the outcomes of the survey are shown in Appendix D, though a brief summary is provided as follows:

**a. Interests represented**

Survey respondents reported a variety of interest identities. Respondents could choose more than one interest. General community interest was indicated by the most respondents, while representatives who work for a construction or development firm comprise the fewest respondents. Respondents were from every Portland zip code, ranging from 1 responded to 165 respondents. Other demographic information was collected and is shown in Appendix D.

- 90% - Interested community member
- 53% - Own or manage property in Portland
- 16% - Work for or member of an environmental/climate advocacy group
- 14% - Work for or member of community-based organization
- 11% - Another affiliation
- 11% - Work for or member of tree/wildlife advocacy group
- 6% - Work for a government agency
- 4% - Local tree care provider or arborist
- 4% - Work for or member of business or industry group
- 3% - Work for a development or construction firm

**b. Highest priorities for code amendments (% very important/important)**

There is near-consensus among survey respondents on priorities for Tree Code amendments.

- 95% – Preserving and planting more trees in industrial areas in close proximity to the Willamette River, Columbia Slough, the Columbia River, or other environmentally sensitive natural areas.
- 92% – Preserving trees in certain industrial and commercial sites, when possible.
- 92% – Preserving and planting trees in industrial areas in close proximity to low-income communities and communities of color.
- 86% – Collecting fees paid into the tree planting and preservation fund when trees must be removed.
- 82% – Ensuring all industrial, commercial, and residential areas are subject to the same tree preservation requirements.

**c. Lower priorities for code amendments (% very important/important)**

- 29% – Minimizing the cost of developing industrial sites.
- 29% – Maximizing the amount of land available for industrial uses to accommodate middle-income job growth.

d. **Highest priorities for mitigation fee (% very important/important)**

Likewise, there is strong agreement on objectives for the mitigation fee.

91% – Improving environmental and health outcomes.

87% – Preserving more trees when construction occurs on private property.

78% – Increasing mitigation fees enabling more trees to be planted and preserved elsewhere.

77% – Minimizing the cost of housing, including affordable housing.

e. **Lower priorities for mitigation fee (% very important/important)**

32% – Minimizing the cost of development.

### **3. Online Community Forum**

The Online Community Forum was open continuously for nearly three weeks, from July 14 to August 3, 2020. Prior to COVID-19, this forum was to be held via in-person open house sessions. As this was not possible without risking human health, the Online Community Forum was developed as way to present information about the project, the processes for analysis, draft staff proposal and proposed amendments, to the public.

Content was presented in a narrated PowerPoint Presentation and also through text accompanied by photos. Frequently Asked Questions provided supplemental information, a short survey collected feedback from the public regarding the specific proposed amendments (inclusive of open-ended questions), and a separate comment field offered an opportunity for the public to provide further feedback with a request for response. A representative from the Mayor's Office, BDS, PP&R and BPS researched and responded to most public comments within a few days. More information can be found in the summary highlights for the Online Community Forum in Appendix E.

**Survey Results:** A total of 591 surveys were completed. Survey respondents indicated a high level of support for all of the proposed amendments, and only 14% supported retaining the exemptions from tree preservation and tree density in IH zones. However, there is no analysis of the demographics or interests of the survey respondents.

***Q#1 – Do you support the proposal to remove the exemption from tree preservation in CX and EX and IG1 zones?***

83% – Yes

16% – No

***Q#2 – Do you support the proposal to remove the exemption from tree density in the CX and EX and IG1 zones?***

83% – Yes

17% – No

**Q#3 – Do you support the proposal to retain the exemption from tree preservation in the IH zone?**

14% – Yes

85% – No

**Q#4 – Do you support the proposal to retain the exemption from tree density in the IH zone?**

14% – Yes

86% – No

**Q#5 – Do you support the proposal to reduce the tree diameter threshold from 36" to 20" for private trees wherever tree preservation is required?**

81% – Yes

18% – No

#### **4. City Bureau Comments**

The Bureau of Environmental Services, Portland Housing Bureau, Portland Office of Management and Finance, Bureau of Transportation, and Portland Water Bureau were engaged prior to development of the draft staff proposal based on the initial scope of work, and following the draft staff proposal. With the exception of the Bureau of Environmental Services, the bureaus or offices responded with no concerns regarding the initial scope of work or the draft staff proposal.

The Bureau of Environmental Services (BES) responded to the initial scope of work with some concerns related to an ongoing question of how trees on private property within public easements are regulated; if they are regulated as private trees or city trees. BES acknowledges that this issue is out of the scope of this project, but both the Bureau of Development Services and Portland Parks & Recreation –Urban Forestry will continue to work through this question; and possibly refer it to clarification through a future broader Title 11 amendment project. BES expressed support for the initial scope of work and acknowledgement of the rationale for the staff proposal; indicating the proposal to remove exemptions from tree preservation and tree density compliments their stormwater management goals. From their letter dated June 12, 2020:

BES supports the proposed deletions of current exemptions from development-related tree preservation and tree density requirements for sites in IH, IG1, EX, and CX zones, which are low-tree-canopy zones. BES anticipates that the proposed elimination of the zoning-based exemptions will have only a modest impact on a small subset of BES CIP projects, and it could have important equity and stormwater management benefits for the City. The proposed deletion of zoning-based exemptions is an important step in supporting equitable tree canopy and associated health, stormwater management, and other benefits for Portlanders, by applying the same tree preservation and tree density regulatory structures to development projects regardless of zone. BES notes that the benefits associated with tree canopy are greatest for mature trees, which provide a level of service that, once lost, may take decades for mitigation trees to match.

### 5. Remaining Opportunities for Engagement

There are several additional opportunities to provide input to project staff, the PSC and UFC, and City Council.

- **Provide live Testimony at a PSC and UFC joint hearing** on the final staff proposal currently scheduled for September 8, 2020. A link to sign up to testify at the hearing is posted online at [www.portland.gov/80501](http://www.portland.gov/80501).
- **Submit written comments on the PSC and UFC recommendations** to City Council prior to the City Council hearing. A link to submit written comments is posted online at [www.portland.gov/bds/80501](http://www.portland.gov/bds/80501).
- **Provide live testimony at the City Council hearing** currently scheduled for October 29, 2020.

## III. About Title 11, Trees

### A. Title 11, Trees and Chapter 11.50, Trees in Development Situations

#### 1. Framework of Title 11, Trees

The City's Tree Code is broadly divided between non-development and development activities, and additionally between trees on private property, trees on City property, and street trees.

Title 11 places the responsibility for implementing to Title 11 to either PP&R Urban Forestry or BDS based on the type of tree and situation (Table 1). Each bureau is responsible for leading amendments of the sections of code they implement. However, any amendment to Title 11 is conducted in consultation with Bureaus of Planning and Sustainability, Parks and Recreation, Development Services, Environmental Services, Transportation and Water.

*Table 1. Title 11 implementation matrix.*

Situation	City & Street Trees	Private Trees
Non-Development	PP&R Urban Forestry	PP&R Urban Forestry
Development	PP&R Urban Forestry	BDS

The scope of this project is limited to development situations and does not include regulations for street trees which are required to be planted with development projects.

#### 2. Chapter 11.50, Trees in Development Situations

Chapter 11.50 of the Tree Code is generally divided into regulations for Tree Preservation, Tree Density, and Street Trees. The scope of this project is limited to Tree Preservation and Tree Density. For each Tree Preservation and Tree Density, the code first states when the regulations apply; and then when sites or trees are exempt from the regulations. Within the regulations for Tree Preservation, there are separate requirements for trees on private property, and trees on City-owned or managed



property and street trees. Tree Density regulations are not distinguished between trees on private property and trees on City-owned or managed property.

### *Tree Preservation Requirements*

**Tree preservation requirements are triggered** when there are any trees over 12 inches dbh that are not dead, dying, dangerous, or a nuisance species, and where there is ground disturbance into the root protection zone of any of those trees. However, some sites are exempt from tree preservation requirements, including those locations within some of the higher intensity Commercial, Industrial and Employment Zones (CX, IH, IG1, and EX), on sites less than 5,000 square feet in area, or on sites with 85 percent current or proposed building coverage or more. Within those parameters tree preservation requirements are triggered for all project types and sizes; not only new development projects. This could include a new commercial development, a new apartment complex, re-development of a site with a single dwelling unit, a new accessory dwelling unit (ADU), a detached garage on a lot with an existing single dwelling unit, or a small kitchen or family room addition to an existing dwelling.

**For private trees in development situations**, the basic tree preservation standard is that one-third of subject trees must be preserved or a fee paid in lieu of preservation. Prior to the large tree stop-gap amendment in 2016, all trees were treated the same in terms of both preservation priority and mitigation fees. All non-exempt trees were uniformly subject to the one-third preservation requirement, regardless of size. An applicant could choose to remove the largest sized trees over the smallest sized trees with no differentiation in fees paid-in-lieu. The mitigation requirement adopted in 2016 is more responsive to the size of the tree not designated to be preserved and protected, and provides an incentive to preserve especially large diameter trees; those 36 inches dbh or greater (Table 2). The current code provides for tiers of tree sizes and corresponding mitigation, expressed in the number of two-inch diameter replacement trees required. For especially large diameter trees (36 inches dbh or greater), the mitigation fee is based on the cost per inch (based on dbh) of the tree removed, as stated in the annually adopted Urban Forestry fee schedule. The rate is currently \$450.00 per inch.

*Table 2. Current fee structure for fee in lieu of preservation.*

Size of Tree Removed (inches in diameter)	Required Mitigation per tree removed	Associated Cost per tree removed
At least 12 and less than 20	The cost of (2) two-inch diameter replacement trees	\$1,800
At least 20 and less than 36	The cost of (4) two-inch diameter replacement trees	\$3,600
At least 36 or more	The cost per inch of tree removed	\$16,200 and up

There is an additional incentive for preserving trees 36 inches dbh or greater in that these trees can be used to meet the basic one-third preservation standard. Therefore, if a permit applicant is choosing what trees to preserve on their site, they are incentivized to choose the larger diameter tree over the smaller diameter tree.

**For city trees, those on City-owned or managed property,** the tree preservation requirements are different and require consultation with Urban Forestry. City-owned or managed properties are subject to the same exemptions as private properties; though if trees are removed, the replacement of those trees is regulated by an administrative rule PRK 2.04, Replanting Requirements for Tree Removal.

- (1) Approved Street Tree removal in conjunction with improvements to partially or fully unimproved streets. Each tree at least 12 inches in diameter that is allowed to be removed shall be replaced with at least one tree. Trees planted to meet Street Tree Planting Standards will be credited toward meeting this requirement.
- (2) Any other Street or City Tree allowed to be removed that is 6 or more inches in diameter shall be replaced with at least one tree in addition to trees required to meet required tree density or Street Tree Planting Standards.

#### *Tree Density Requirements*

**Tree density requirements for private trees and trees on City-owned or managed sites** ensure that a baseline amount of tree canopy is either planted or retained on the site or development impact area. The number of required trees is determined by the type of development and the site area. Sites that are zoned IH, IG1, EX, and CX projects reviewed under Demolition, Site Development, Septic, Plumbing or Zoning permits, and sites subject to Airport Landscape standards are exempt from meeting tree density standards. Unless exempt, all new development projects and exterior alterations with valuations greater than the Portland Zoning Code Non-conforming Upgrade threshold of Chapter 33.258 are required to meet tree density standards.

Applicants may preserve, plant, pay a fee-in-lieu, or a combination thereof to meet these standards. Trees planted to meet other landscaping standards, such as those required by Title 33, Planning and Zoning, may be used to meet the tree density requirements. As such, trees in parking areas or other landscaped areas may be used to meet the requirement.

The number and canopy size of trees required to be planted or preserved is a function of the site or development impact area, and whether one is choosing to plant or preserve small, medium, or large canopy sized trees (defined by tree species). This percentage represents the required “tree area,” with different percentages required of different development types, as shown in Title 11 Subsection 11.50.050.D. The actual “planting area” required is much less than the required “tree area.”

A simple example for a **100,000 square foot industrial site using medium canopy trees** follows:

- The required tree area is 10% of the site area, or 10,000 square feet.
- 1 medium tree is required per 500 square feet of the 10,000 square feet of required tree area
- $10,000 \text{ square feet} / 500 \text{ square feet} = 20$  medium canopy trees
- Each of the 20 medium trees requires a minimum planting area of 75 square feet
- $20 \text{ trees} \times 75 \text{ square feet} = \mathbf{1,500 \text{ square feet planting area}}$

There are several exemptions to tree preservation and tree density requirements. This project only affects the exemptions in CX, EX, IG1 and IH zones; other exemptions still apply and have not been examined in this project. Tree Planting and Preservation Fund

Fees in lieu of preservation or planting used to meet the tree preservation requirements or tree density requirements go to the Tree Planting and Preservation Fund. The Tree Planting and Preservation Fund is used to support the [Citywide Tree Planting Strategy: Growing a More Equitable Forest \(PP&R 2018a\)](#). The strategy was completed and accepted by City Council in 2018 following nearly two years of planning, [data analysis](#), and outreach. The strategy identifies high-priority neighborhoods where tree planting is needed most, rather than watershed or zone. PP&R Urban Forestry also produces a [planting performance report](#) which is publicly available. As required by Title 11, PP&R Urban Forestry submits an annual report to City Council on the revenue, expenses, and use of the fund.

## IV. Analysis

### A. Introduction

There are two primary components of this analysis; an overview of the importance of urban trees in providing public health and environmental services and how the inequitable distribution of urban canopy disproportionately affects communities of color and low income communities; and, an economic analysis to determine how the potential tree code changes might affect cost of development of private property, job growth and middle wage economic opportunities. A tree canopy analysis provided data inputs into the economic analysis.

### B. Services and Benefits of Urban Trees

City of Portland Ordinance 184522, which established Title 11, recognizes “trees as a fundamental component of the City’s green infrastructure and a basic site development requirement similar to stormwater management and erosion control.”

With approximately 5-6 million trees on private property (UFIA, unpublished), 1-2 million trees in parks (UFIA, unpublished) and approximately 218,000 street trees (PP&R 2017b), the estimated replacement value\* (<https://www.itreetools.org/about>), of our urban forest is \$5 billion (Ordinance 184522). Our urban forest is not only valuable, monetarily, but in providing important environmental and public health services. Indeed, ensuring that all communities benefit from the services provided by trees is one of the main goals of the Urban Forest Management Plan (PP&R 2004).

*\*Replacement value is an estimate of the full cost of replacing a tree at its current size and condition, should it be removed for some reason. Replacement value is calculated using the tree's current size, along with information on regional species ratings, trunk diameter, and replacement costs.*

### 1. Tree Canopy Goals and Existing Tree Canopy

The adopted Portland Plan 2012 set a citywide canopy target of 33.3 percent, and a 15 percent canopy cover in commercial and industrial zones (PP&R Urban Forest Management Plan 2004).

As of 2015, Portland's urban canopy covered 30.7 percent of the City. However, the distribution of tree canopy is not equitable. West of the Willamette River, canopy coverage is 56 percent (44 percent, excluding Forest Park), while just 21 percent on the east side, where 80 percent of Portlanders reside. For comparison, the Los Angeles has overall canopy coverage of 25 percent.

Additionally, Portland's Tree Canopy Varies by land use type:

- Industrial: 9.7 percent canopy coverage
- Commercial: 13.3 percent canopy coverage
- Open Space: 54.4 percent canopy coverage
- Residential: 34 percent canopy coverage

### 2. Tree Services

As essential infrastructure, urban trees provide a multitude of well researched and established environmental and public health services:

- mitigating the effects of climate change by absorbing greenhouse gases, improving air quality, reducing urban heat island effect, and sequestering carbon (Nowak et al 2002);
- reducing heat related illnesses (Nowak 2014; Voelkel et al 2018);
- reducing rates of asthma and other respiratory illnesses (Lovasi et al. 2008);
- improving cardiovascular health and reducing blood pressure (Sullivan 2014);
- improving mental health (Kuo and Taylor 2004; Maas et al 2009);
- improving people's coping mechanisms to stress (Thompson et al 2012);
- reducing hospital stays for patients (Ulrich 1984);
- improving healthy birth outcomes for pregnant women (Dzhambov, Dimitrova and Dimitrakov 2014);
- calming traffic for safer streets (Mok et al 2006);

- reducing crime (Donovan and Prestemon 2016);
- improving academic performance of students (Tennessen and Cimprich 1995);
- reducing stormwater runoff and sewage overflow (Kuehler et al 2017);
- increasing commercial business profits (Wolf 2005);
- reducing building heating and cooling costs (Nowak et al 2017);
- shading streets and decreasing maintenance costs for asphalt (Mcpherson 2005);
- and providing wildlife habitat for birds and pollinators.

### 3. Inequities in Tree Canopy

As previously described, tree canopy and the important public health and environmental services provided by trees are not equitably distributed in Portland (Figure 1). In a recent Portland State University study, households with the top 20% highest incomes, had an average of 20% more canopy than those in the lowest 20% of incomes (Voelkel 2017). PP&R's Growing a More Equitable Urban Forest: Portland's Citywide Tree Planting Strategy (PP&R 2018a) also found a high correlation between low canopy neighborhoods and communities of color and immigrant or refugee communities.

Exacerbating the effects of low canopy, communities of color and immigrant and refugee communities are often located adjacent to transportation corridors and industrial or commercial properties (Figures 2 and 3). Less tree canopy coupled with lower elevations, greater proportions of impermeable surfaces, and greater vehicular traffic, result in urban heat islands (Figure 4) and disproportionate heat exposure for people living and working in these areas (Voelkel et al 2018). This results in numerous adverse effects, including: increased rates of respiratory illness, increased susceptibility to heat related injuries, and decreased physical and mental health outcomes (Sullivan 2014).

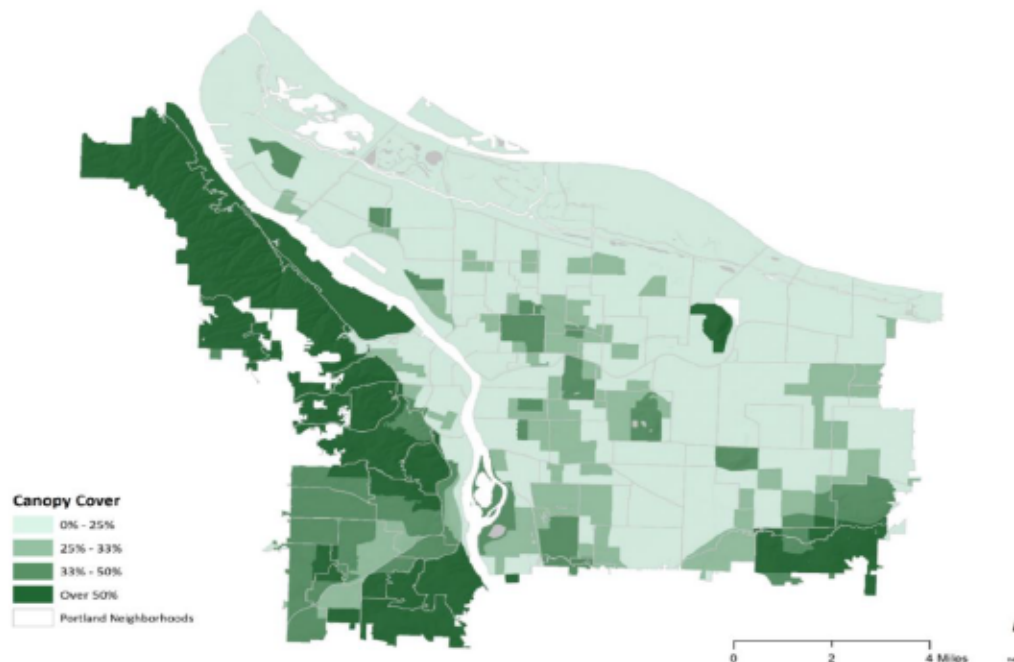
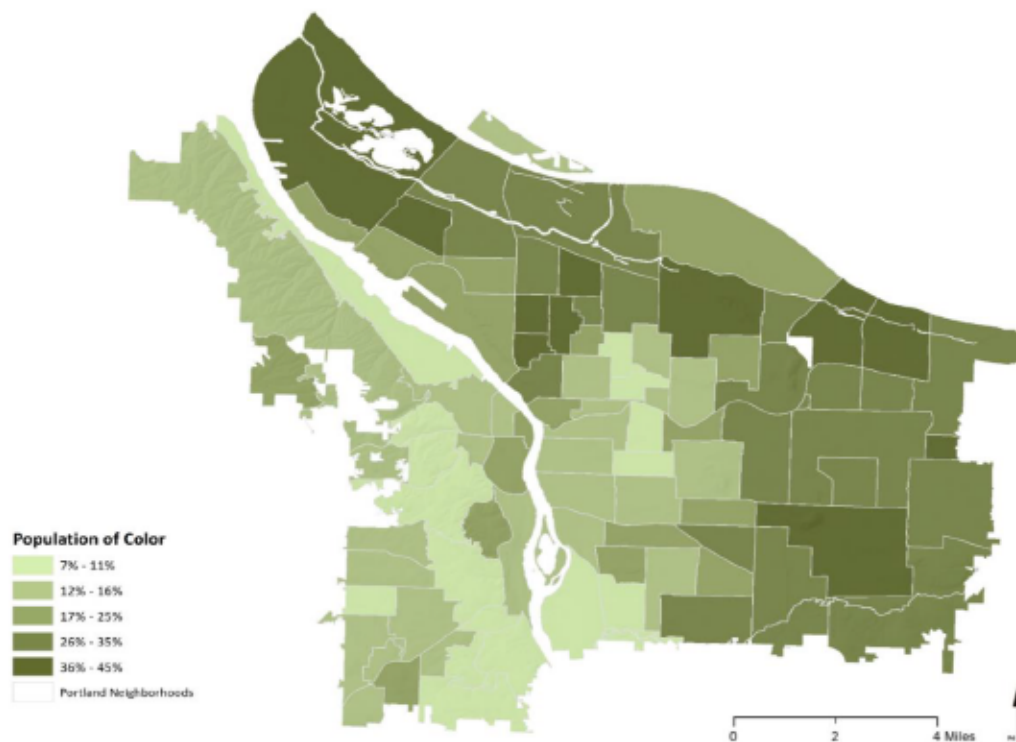
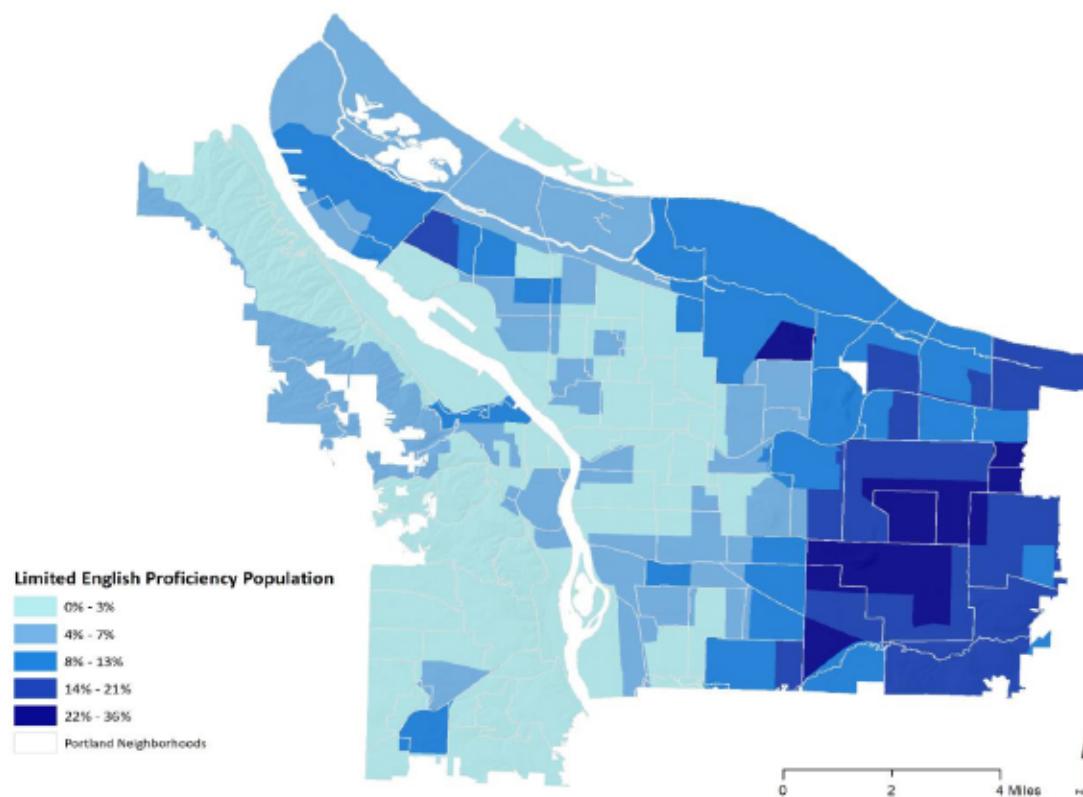


Figure 1. Tree canopy in Portland (Metro 2016)



*Figure 2. Populations of color in Portland (Office of Community and Civic Life 2010). Note that census tract data is represented on the neighborhood level. Portland's industrial zones do not allow housing; however, housing may be adjacent to industrial zones.*



*Figure 3. Limited English Proficiency (LEP) population in Portland (BPS 2016). Individuals with limited English proficiency are described as those whose primary language is not English and have a limited ability to read, write, speak, or understand the English language. This serves as a proxy for immigrant and refugee communities. Note that census tract data is represented on the neighborhood level. Portland's industrial zones do not allow housing; however, housing may be adjacent to industrial zones.*

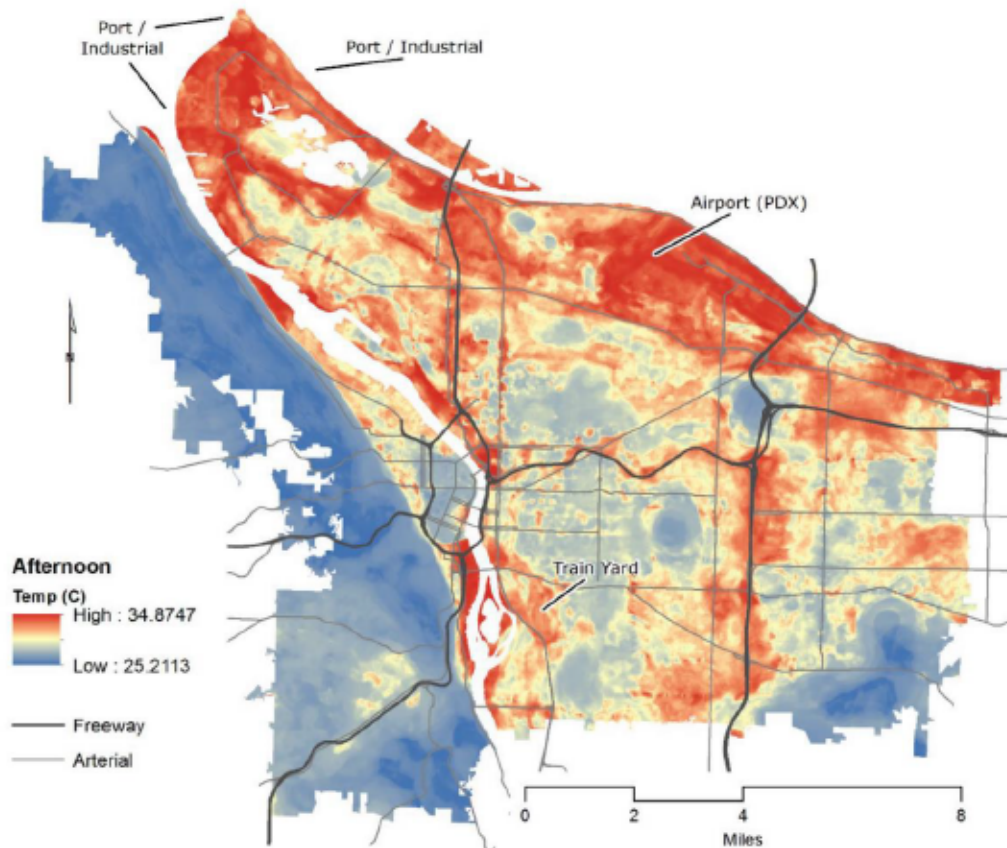


Figure 4. Afternoon temperatures in Portland, measured in August 2014 (Voelkel et al 2018)

Recognizing these disparities, PP&R and the City of Portland are committed to reducing these inequities through several actionable items. The Urban Forest Management Plan (PP&R 2004) sets a goal to “provide equitable urban forest benefits for all residents of the city” and the PP&R Five-Year Racial Equity Plan (2017a) identifies “improving urban forest services to low-income, low canopy neighborhoods” as an action item and performance measure. Recognizing that the effects of climate change disproportionately impact low-income communities and communities of color, the city of Portland and Multnomah County jointly adopted a Climate Action Plan in 2015 (BPS 2015), which identifies increasing green infrastructure, inclusive of tree planting and preservation, as a primary tool for mitigating against and preparing for climate change.

Underscoring the importance of the urban forest, canopy cover is cited as an important environmental indicator in Portland’s Urban Forest Management Plan (PP&R 2004), the Urban Forest Action Plan (PP&R 2007), the Climate Action

Plan (BPS 2015), the Portland Plan (BPS 2012), and the 2035 Comprehensive Plan (BPS 2016).



As future planning occurs in the context of Covid-19 and the anticipated economic recession, it is imperative that we prioritize long term investments towards protecting vulnerable communities from the disproportionate effects of climate change, while balancing investments in economic growth.

#### 4. Value of Proposed Amendments

Large, mature trees provide a functional level of service that will take decades to replace if these trees are removed and replaced with smaller trees. With current exemptions to tree preservation, further canopy loss in industrial and commercial zones would have serious and long-lasting public health and environmental consequences. By requiring tree preservation and tree planting in these zones, we maintain the services provided by existing trees and develop opportunities for canopy growth as these lands are developed.

Assigning a functional value to a tree's services is dependent on the tree species, tree size and site conditions and provides only a partial estimate of a tree's value. Estimates may be generated for carbon sequestration (removal of carbon dioxide from the atmosphere), carbon storage (carbon bound in belowground and aboveground biomass), stormwater mitigation (gallons of water diverted from stormwater facilities), energy savings (savings in heating and cooling buildings), reduced emissions as a result of reduced energy usage, air quality improvements (absorption of pollutants and release of oxygen), shading of other infrastructure, and lowering urban air temperatures. Human physical, mental and community health services are more difficult to quantify, as are the combined value of future environmental and public health functions.

Calculating the structural value (Nowak et al. 2008) of a tree provides an estimate of replacement cost, while using site location as a proxy for accounting an aspect of function. Four tree/site characteristics are considered: trunk area (cross-sectional area at dbh), species, condition, and location to estimate the cost of removing and replacing the tree and the services provided. The rating for industrial/commercial locations is slightly higher than that of residential, partially because there are fewer trees (so each individual tree is that much more valuable). and also because the topography is different as compared to residential (i.e., impermeable vs. permeable surfaces).

Table 3 illustrates the annual structural value of a mature broadleaf deciduous tree in three different size categories, comparing the difference in value of infrastructure provided when these trees are located in residential and industrial zones. The value of larger trees and their importance in industrial zoning is demonstrated by noting that in residential zones, a 40" dbh tree is estimated to have over twice the structural value\* of a 24" dbh tree; whereas in industrial zones, a 40" dbh tree has almost three times the structural value of a 24" dbh tree.

Table 3. Comparison of structural value of trees in different zoning categories and size classes.

Zoning	dbh	Annual Structural Value (\$)	One-time Fee in Lieu of Preservation with Amendment Reducing Size Threshold(\$)
Residential	24.0	9,368.77	10,800
Residential	32.0	16,155.95	14,400
Residential	40.0	23,475.11	18,000
Industrial	24.0	11,710.96	10,800
Industrial	32.0	20,194.94	14,400
Industrial	40.0	29,343.89	18,000

In instances where tree preservation is not possible, the fee in lieu collected would contribute to the tree planting and preservation fund which prioritizes tree planting and preservation where needed most- in low income and low canopy areas of the city.

However, it is important to note even while reducing the size threshold for increased mitigation, for all size/zone categories except 24 inch dbh/residential, the one-time fee in lieu of preservation would still be less than the annual structural value of the tree. Reducing the size threshold for inch per inch mitigation from 36 inches dbh to 20 inches dbh brings the cost of mitigation *closer* to the structural value of the tree but does not match the monetary investment retained with large tree preservation.

Analysis of permit data (Sub-section IV.C) demonstrates that current requirements for preservation of trees 36 inches dbh and greater are working. A greater proportion of these trees are preserved than in other size classes. If the goal is to further increase tree preservation, reducing the size threshold would increase the number of trees preserved, with the added benefit of ensuring that those species of trees that have the capacity to grow to be 36 inches in diameter, have the opportunity to do so. Reducing the size threshold, saves space for larger trees and the important environmental and public health services that they provide.

With current requirements at 36 inches dbh, we are losing a substantial number of trees in lower size classes. By lowering the threshold, we assign a more accurate value for the loss of these trees, while allowing a 20-inch tree to grow into a 36-inch tree (if appropriate for the species), and investing in our future.

### C. Existing Tree Canopy Analysis

To evaluate the potential effects of the proposed tree code amendments, the first step was to characterize the tree canopy on tax lots where the amendments would apply. The proposed changes fall into two categories: (1) the removal of exemptions for properties in four industrial, employment and commercial zones (IH, IG1, ECX and CX) from tree

preservation (Title 11.50.040) and on-site tree density standards (Title 11.50.050); and (2) the reduction of the size of trees triggering an inch-for-inch mitigation fee from 36 inches to 20 inches dbh. This reduction in tree size would affect properties in all zoning designations throughout the city.

As a result of the variation in the properties affected, their locations and the implications on developable land (specifically, industrial land) of the different proposals, the methodology used to characterize tree canopy on properties subject to the proposed amendments varied based on the proposal and zoning type. Additionally, the methodology took into account the challenges associated with accurately characterizing tree composition, defined as size class (dbh), using geographic information systems (GIS) technology. Characterization of tree species composition was not possible with this technology.

The methodologies used and results of the tree canopy analyses completed are described below.

#### **1. Tree Canopy Analysis in Industrial Zones (IH, IG1, IG2 and EG2)**

The first step in the tree canopy analysis focused on developing an estimate of tree composition within industrial zones: General Industrial 2 (IG2), Heavy Industrial (IH), General Industrial 1 (IG1), and General Employment 2 (EG2). Figure 5 shows the location of these zones.

Given the recognition that estimates of currently-available industrial land were close to the minimum needed to meet the City's estimated Statewide Planning Goal 9 needs and the limited tree data included in past permits for these land uses, GIS modeling was used to estimate the composition of tree canopy in these zones. The focused scope of this analysis allowed for an adequate number of site visits to be completed to calibrate the GIS model for increased accuracy.

A summary of the industrial lands methodology and results is provided below. The full report, including the complete methodology and results, of this analysis can be found in Appendix F.

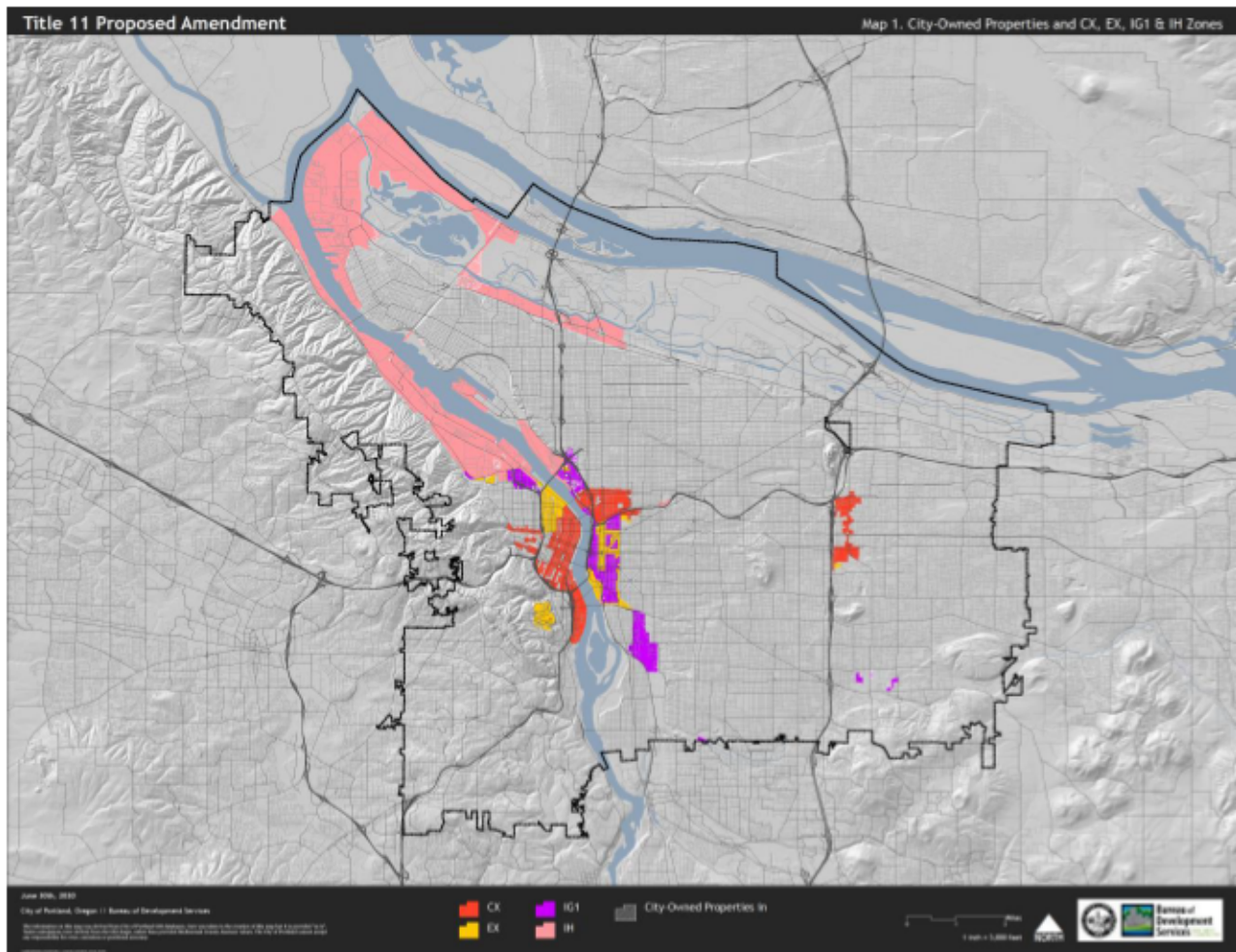


Figure 5. Proposed amendments address tree preservation and tree planting exemptions in four land use zones: commercial (CX; red), employment (EX; yellow), general industrial (IG1; purple), and heavy industrial (IH, pink).

## 2. Methodology Summary for Tree Canopy Analysis in Industrial Zones

The goal of this analysis was to develop an estimate of tree canopy characteristics for land in industrial zones by analyzing GIS data using object-based image analysis (OBIA) techniques and regression analysis to develop equations for estimating, to the extent possible, dbh from individual tree crowns. The dbh estimates were then grouped into four categories: less than 20 inches; 20 to 27.9 inches; 28 to 35.9 inches; and 36 inches or greater.

Two publicly-available datasets served as baseline data for the analysis: 1) a 3-foot resolution canopy height surface model (CHM) using 2014 LiDAR and normalized difference vegetation index (NDVI) data derived from four-band imagery and 2) a 3-foot resolution, classification model, delineating the CHM into coniferous and broadleaf (or, deciduous) trees. Both datasets were obtained from the Regional Land Information System (RLIS) developed by Metro.

To derive tree sizes from estimated crown widths, City of Portland Park Tree Inventory data were used in a regression analysis to develop equations of best fit by general structure, one set for coniferous trees and another for broadleaf trees. These equations were applied to individual tree crowns and the predicted dbh values were plotted versus the measured dbh values in an independent dataset — the City of Portland Street Tree Inventory (PP&R 2017b). The Park Tree Inventory data provides data on tree species, mapped location, dbh, tree height, canopy dimensions and tree condition rating. Data in the Street Tree Inventory is similar but without canopy dimensions or tree height.

Based on the number of modeled individual tree crowns within the study area, site visits were conducted on six public and two Port of Portland properties, wherein all trees within a 150-foot-diameter plot were catalogued and geolocated. For each tree greater than 12 inches dbh, the height, crown width, dbh, species, and general condition (living, dead, or stressed) were assessed and recorded. These tree measurements were used to further evaluate the performance of the modelled results by capturing locations with growing conditions different from the sort encountered in the park and street tree inventories, i.e., dense copses or stands and/or trees in natural or semi-natural conditions (in contrast to the groomed and regulated planting conditions of the trees within the tree inventories).

The second phase of the analysis involved using the modelled object-based image analysis outputs to estimate the dbh value for each individual tree crown. To generate the equations needed to derive these estimates, the preponderance of forestry research has determined that the strongest allometric relationship for dbh is with a tree's crown width, most specifically when the species is known. However, classifying trees by species was not possible, given the scope and lack of available high-resolution hyperspectral or multispectral imagery for this project. Therefore, it was necessary to develop other means of estimating dbh from available data. City of Portland Park Tree Inventory data were separated and grouped into coniferous and broadleaf data subsets. Regression analyses were applied to these subsets to generate equations of best fit (a linear function and a power function).

The last phase of the analysis assessed the performance of the model's predicted number of individual tree crowns and dbh values. Each model result was compared with independent datasets not used in the development of the model, the Portland Street Tree Inventory data, and tree measurement data collected during site visits. These point-based data layers were then intersected with the tree segments to evaluate the accuracy of the count of actual versus modelled trees. The measured dbh values were plotted versus predicted dbh values in a regression analysis to assess the amount of variance in the model.

A linear trendline and a power trendline were applied in an effort to achieve the highest correlation ( $R^2$ ) possible. Both of these regressions apply a line fitted to the plot of data to minimize the amount of variance at any point between crown width (x-axis) and dbh (y-axis). The difference between the two equations is that the linear trendline uses a

linear equation to produce a simple straight line of best fit while the power trendline uses an exponential function that produces a slightly curved line of best fit.

The results of this analysis are provided in the Results section below.

### **3. Model Limitations and Assessment of Error for Tree Canopy Analysis for Industrial Zones**

There are a variety of potential sources of error and discrepancy inherent to remotely sensed data. These limitations include, but are not limited to, seasonal and/or yearly variability for acquisition times of the various data products, resolution limitations in the CHM, possible classification errors in the coniferous-deciduous data layer, temporal variability of park and street tree inventory data and the limitations of image segmentation, which creates hard breaks between objects—in this case, trees—which may not accurately model the landscape, particularly in areas with dense stands of trees with heavily overlapped tree crowns. These potential sources of error (and others) were evaluated and minimized, to the extent possible, throughout the analysis.

One area where it was identified that the model did not perform well was in dense stands of tightly-clustered trees. Comparison of the results of fieldwork with the model output revealed that the segmentation protocol did a poorer job of delineating individual tree crowns for stands dominated by black cottonwood due to their unique structure – i.e., densely packed stands with intermingled crowns and generally very tall crown heights compared to relatively narrow, asymmetrical crown widths. In these cases, the model underestimated the number of individual trees within the stand. Because of this recognized issue with the model, a separate analysis was completed with the nine tax lots characterized by dense stands of black cottonwood removed. These tax lots comprised 224.9 acres, or 1.8 percent of the total area (12,182.8 acres) analyzed.

A more detailed of model limitations and potential sources of error can be found in the full report in Appendix F.

### **4. Results of Tree Canopy Analysis for Industrial Zones**

The results of the industrial lands analysis (including both the linear and power trendlines) are provided in Tables 4 and 5. These data, which were used in the economic analysis, present the tree canopy estimates with the nine poor performing tax lots discussed above removed. Similar tables showing the results when all of the tax lots were assessed (including the nine poor performing tax lots) can be found in the full report (see Appendix F).

Table 4. Diameter at breast height categories by power function\*

Tax Lots by Zone <sup>1</sup>	<20"		≥20" to <28"		≥28" to <36"		≥36"		Total Trees	Tree Canopy Acres	Avg Trees/Canopy-Acre
	# of Trees (% of total)	Trees/canopy-acre	# of Trees (% of total)	Trees/canopy-acre	# of Trees (% of total)	Trees/canopy-acre	# of Trees (% of total)	Trees/canopy-acre			
EG2	9,491 (90.2%)	70.15	663 (6.3%)	4.90	244 (2.3%)	1.80	122 (1.2%)	0.90	10,520	135.3	77.8
IG1	2,029 (90.9%)	72.46	115 (5.2%)	4.11	42 (1.9%)	1.50	46 (2.1%)	1.64	2,232	28.0	79.7
IG2	25,078 (89.7)	67.04	1,890 (6.8%)	5.05	628 (2.2%)	1.68	359 (1.3%)	0.96	27,955	374.1	74.7
IH	13,814 (89.0%)	61.45	1,060 (6.8%)	4.72	365 (2.4%)	1.62	274 (1.8%)	1.22	15,513	224.8	69.0
All Tax Lots	50,412 (89.6%)	66.14	3,728 (6.6%)	4.89	1,279 (2.3%)	1.68	801 (1.4%)	1.05	56,220	762.2	73.8

*Needleleaf: DBH = 0.3286 \* CD<sup>1.2225</sup>, Broadleaf: DBH=0.1802 \* CD<sup>1.2307</sup>*

**Model Accuracy Statistics:** measured DBH – Predicted DBH, where total industrial and EG2 model outputs intersect park and street tree inventory data); **Residuals:** mean 1.9 inches, median 1.6 inches, std deviation 8.2 inches, SE=0.1113 inches; **Model Correlation:** R<sup>2</sup> = 0.4022

<sup>1</sup>Omitted lots: 7 IH lots: Property IDs: R239681, R256362, R325506, R323385, R256223, R323445, and R256242 (207.7 acres); 2 IG2 lots: Property IDs: R171715, and R237851 (17.2 acres).

Table 5. Diameter at breast height categories by linear function\*

Tax Lots by Zone <sup>1</sup>	<20"		≥20" to <28"		≥28" to <36"		≥36"		Total Trees	Tree Canopy Acres	Avg Trees/Canopy-Acre
	# of Trees (% of total)	Trees/canopy-acre	# of Trees (% of total)	Trees/canopy-acre	# of Trees (% of total)	Trees/canopy-acre	# of Trees (% of total)	Trees/canopy-acre			
EG2	9,184 (87.3%)	67.9	938 (8.9%)	6.9	295 (2.8%)	2.2	103 (1.2%)	0.8	10,520	135.3	77.8
IG1	1,971 (88.3%)	70.4	169 (7.6%)	6.0	49 (2.2%)	1.8	43 (1.9%)	1.5	2,232	28.0	79.7
IG2	24,262 (89.8%)	64.9	2,640 (9.4%)	7.1	762 (2.7%)	2.0	291 (1.0%)	0.8	27,955	374.1	74.7
IH	13,359 (86.1%)	59.4	1,469 (9.5%)	6.5	457 (2.9%)	2.0	228 (1.5%)	1.0	15,513	224.8	69.0
All Tax Lots	48,776 (86.7%)	64.0	5,216 (9.3%)	6.8	1,563 (2.8%)	2.0	665 (1.2%)	0.9	56,220	762.2	73.8

<sup>1</sup>Omitted lots: 7 IH lots: Property IDs: R239681, R256362, R325506, R323385, R256223, R323445, and R256242 (207.7 acres); 2 IG2 lots: Property IDs: R171715, and R237851 (17.2 acres).

**\*Needleleaf: DBH = 0.7595 \* CD, Broadleaf: DBH=0.4816 \* CD**

**Model Accuracy Statistics:** measured DBH – Predicted DBH, where total industrial and EG2 model outputs intersect park and street tree inventory data); **Residuals:** mean 0.2 inches, median 0.4 inches, std deviation 7.9 inches, standard error 0.1073 inches; **Model Correlation:** R<sup>2</sup> = 0.4036

The linear trendline was determined to be the more accurate of the two analysis and was characterized by lower mean and median error estimates, standard deviation and standard error. Therefore, the tree estimates provided by the linear trendline (Table 5) were used in the subsequent economic analysis.

#### 5. Tree Canopy Analysis in All Other Zones

The use of GIS analysis to determine estimates of tree composition in all other zones in the city was not feasible, given the time that would be needed to complete enough site visits to achieve the necessary model accuracy. Therefore, staff utilized a different approach to characterize the tree composition in commercial and employment, multi-dwelling residential and single-dwelling residential zones. In contrast to industrial zones (especially those currently exempted from the tree preservation and tree density requirement), property owners in these zones are generally required to submit a tree plan as a part of any development proposal. In these tree plans, all trees on site must be shown and any trees to be removed must be identified. Staff used these tree plans to estimate the average number of trees per tax lot acre that could be expected.

A summary of the methodology used is provided below.

#### 6. Methodology Summary for Tree Canopy Analysis in All Other Zones

As stated above, because non-industrial sites are frequently already required to provide tree plans showing all trees on site, the City's permit database provides an excellent record of the number and type of trees on sites in the various zoning designations. As a first step, the Bureau of Development Services compiled permit information for private tax lots of 5,000 square feet or more (tax lots less than 5,000 square feet are exempt from Title 11.50.040) from the last two years (2018-2019) in each of the following land use categories: commercial and employment, multi-dwelling residential and single-dwelling residential zones. Table 6 lists the zoning designations grouped in each of the three land use categories and provides the total number of permits compiled for each category. The group of permits in each land use category were split into residential "market areas" to coincide with the boundaries used by the Bureau of Planning and Sustainability to assess housing affordability throughout the city (Table 6). Grouping permits into these market areas allowed the economic consultant to more specifically assess impacts in each of the areas, rather than simply at the citywide level.



Table 6. Summary of staff permit review components.

Land Use Category	Zoning Designations	Market Area	Total Permits	Tree Plans Reviewed
Multi-dwelling Residential <sup>1</sup>	Commercial/Mixed Use 1 (CM1)	Inner	204	100
	Commercial/Mixed Use 2 (CM2)			
	Commercial/Mixed Use 3 (CM3)	Middle	273	99
	Commercial Employment (CE)			
	Commercial Residential (CR)			
	Residential 1,000 (R1)	Outer	149	48
	Residential 2,000 (R2)			
	Residential 3,000 (R3)			
	High-Density Residential (RH)			
Central Residential (RX)				
Single-dwelling Residential	Residential Farm/Forest (RF)	Inner	533	200
	Residential 20,000 (R20)	Middle	1,008	206
	Residential 10,000 (R10)	Outer	544	199
	Residential 7,000 (R7)			
	Residential 5,000 (R5)			
Commercial and Employment (Central City)	Central Commercial (CX)	Inner	61	41
	Central Employment (EX)			

<sup>1</sup> Note: Identified zones are those in effect prior to the changes implemented by the Better Housing by Design (adopted Jan 2020)

In the market areas within each of the land use categories a sample of permits were reviewed by staff. The size of these samples varied depending on the total number of permits submitted over the previous two years and availability of a tree plan. To ensure a random sample was reviewed, each permit in the individual market areas was assigned a random number that was then sorted from smallest to largest. In reviewing the permits, staff started with the permit assigned the lowest number and then continued through each subsequent permit until at least an established minimum of permits had been reviewed (or there were no more permits). During staff review, permits were removed if no tree plan was provided or if they were permits associated with a previously reviewed permit (e.g., updates to previous plans, permits for different trades, etc.). Table 6 includes the number permits reviewed in each market area for the three land use categories.

During tree plan review, a variety of key information was recorded. The actual size of all trees was entered into a spreadsheet. For trees 20 inches dbh or greater, whether the tree was preserved or removed as a part of the project was also recorded. Trees below 20 inches dbh were documented but whether an individual tree was removed or preserved was not recorded since the proposed amendments would apply only to trees 20 inches or greater in diameter. Additionally, if the site was vacant it was indicated in the spreadsheet. This allowed for the differences in tree composition between vacant and redeveloped sites to be captured. (Note: the large majority of tax lots were redevelopment sites.)

With all of the data above compiled, the average number of trees per tax lot-acre was calculated. Similar to the industrial land analysis, averages were calculated for four tree size categories: less than 20 inches; 20 to 27.9 inches; 28 to 35.9 inches; and 36 inches or greater.

#### 7. Permit Review Limitations for Tree Canopy Analysis in All Other Zones

Currently exempted zones, including Heavy Industrial (IH), General Industrial 1 (IG1), Central Commercial (CX) and Central Employment (EX), are not required to provide tree plans. However, due to landscape and other requirements in the CX and EX zones, a site plan showing existing vegetation, including trees, is frequently provided. Staff reviewed CX and EX permits but determined that, in most cases, landscape plans showing existing trees were not submitted or, when they were, specific tree size information was not provided. Therefore, the data from the review of CX and EX permits was not used in the economic analysis. Instead, the general extent of tree canopy was used to estimate the potential impacts of the proposed amendments in these zones.

#### 8. Results of Tree Canopy Analysis in All Other Zones

Tables 7 and 8 summarize the data obtained through permit research as described above.

*Table 7. Summary of multi-dwelling residential permit review tree size estimates.*

Market Area	Lot Acres, Total	% Vacant	<20"		≥20" - <28"		≥28" - <36"		≥36"	
			Trees	Trees/ lot-acre	Total (% Preserved)	Trees/ lot acre	Total (% Preserved)	Trees/ lot acre	Total (% Preserved)	Trees/ lot acre
Inner	27.6	8.0	92	3.3	41 (34.1%)	1.5	8 (50%)	0.3	10 (60%)	0.4
Middle	29.7	3.0	195	6.6	36 (27.7%)	1.2	12 (25%)	0.4	10 (40%)	0.3
Outer	41.7	2.1	523	12.6	130 (83.8%)	3.1	81 (88.9%)	1.9	34 (94.1%)	0.8
<b>Total</b>	<b>247.0</b>	<b>4.9</b>	<b>810</b>	<b>8.2</b>	<b>207 (64.3%)</b>	<b>2.1</b>	<b>101 (78.2%)</b>	<b>1.0</b>	<b>54 (77.8%)</b>	<b>0.5</b>

Table 8. Summary of single-dwelling residential permit review tree size estimates.

Market Area	Lot Acres, Total	% Vacant	<20"		≥20" - <28"		≥28" - <36"		≥36"	
			Trees	Trees/ lot-acre	Total (% Preserved)	Trees/ lot-acre	Total (% Preserved)	Trees/ lot-acre	Total (% Preserved)	Trees
Inner	28.5	0.5%	326	11.4	49 (71.4%)	1.7	25 (84.0%)	0.9	23 (87.0%)	0.8
Middle	43.6	3.9%	412	9.5	97 (77.3%)	2.2	66 (75.7%)	1.5	45 (91.1%)	1.0
Outer	77.8	7.0%	834	10.7	203 (88.2%)	2.6	120 (81.6%)	1.5	88 (95.5%)	1.1
<b>Total</b>	<b>149.9</b>		<b>1,572</b>	<b>10.5</b>	<b>349 (82.8%)</b>	<b>2.3</b>	<b>211 (80.1%)</b>	<b>1.4</b>	<b>156 (92.9%)</b>	<b>1.0</b>

## B. Economic Analysis-Costs and Development Impacts

Tree Code requirements are an example of regulations that may impact the developability of employment lands. The proposed Tree Code amendments evaluated in this report are expected to reduce the city's available employment land capacity. Specifically, the removal of the current exemptions of four industrial, commercial and employment zones (IH, IG1, CX and EX) from the tree preservation and tree density requirements are expected to reduce land capacity. A primary goal of this project is to evaluate the potential land capacity reduction and determine whether that reduction would result in a deficit in the adopted 20-year land capacity within established EOA geographies.

Though Title 11, Trees, is not considered a land use regulation, Title 11 requirements are considered development constraints in that they reduce the buildable land inventory and must be factored into the EOA. A number of other development constraints not considered land use regulations are included in the assessment of lands in the EOA, such as land constrained by steep slopes or other hazards, the cost of brownfield remediation, which can preclude conversion of these lands to more productive use, and the cost to extend adequate infrastructure, such as streets and sewers to facilitate a site's development. Development constraints may be physical constraints that reduce the physical land available for development. They may also be financial constraints that may affect the market in a way that reduces the probability that the land will be developed.

## 1. Overview

With the number of trees in the different size categories determined through the Tree Canopy Analysis, an analysis of the potential impacts of the proposed Tree Code amendments on development costs and land capacity was completed. As previously stated, local jurisdictions in Oregon must demonstrate continued compliance with Statewide Planning Goal 9, Economic Development, whenever changes are proposed that may affect the availability of 20-year and short-term growth capacity to fully meet forecasted demand for industrial and other employment use types, as determined in an adopted EOA.

### *Effects on Industrial Land Supply and Statewide Planning Goal 9, Economic Development*

The City of Portland's EOA was most recently updated as a part of the 2035 Comprehensive Plan. The EOA estimates the 20-year supply and demand for employment land in the city by geography and land use types and includes a Buildable Land Inventory (BLI) that identifies specific properties that are most likely to redevelop over the 20-year period.

To characterize the locations, sites and types of spaces needed for various employment lands, the EOA identified ten categories of employment areas (locations, sites and types of space), referred to in the report as "employment geographies". The EOA employment geographies included Central City Commercial, Central City Industrial, Harbor and Airport Districts, Harbor Access Lands, Columbia East, and Dispersed Employment areas, along with town and neighborhood centers and corridors and other commercially-focused geographies. Institutions and residential employment were also identified. Figure 6 shows the location of the ten employment geographies.

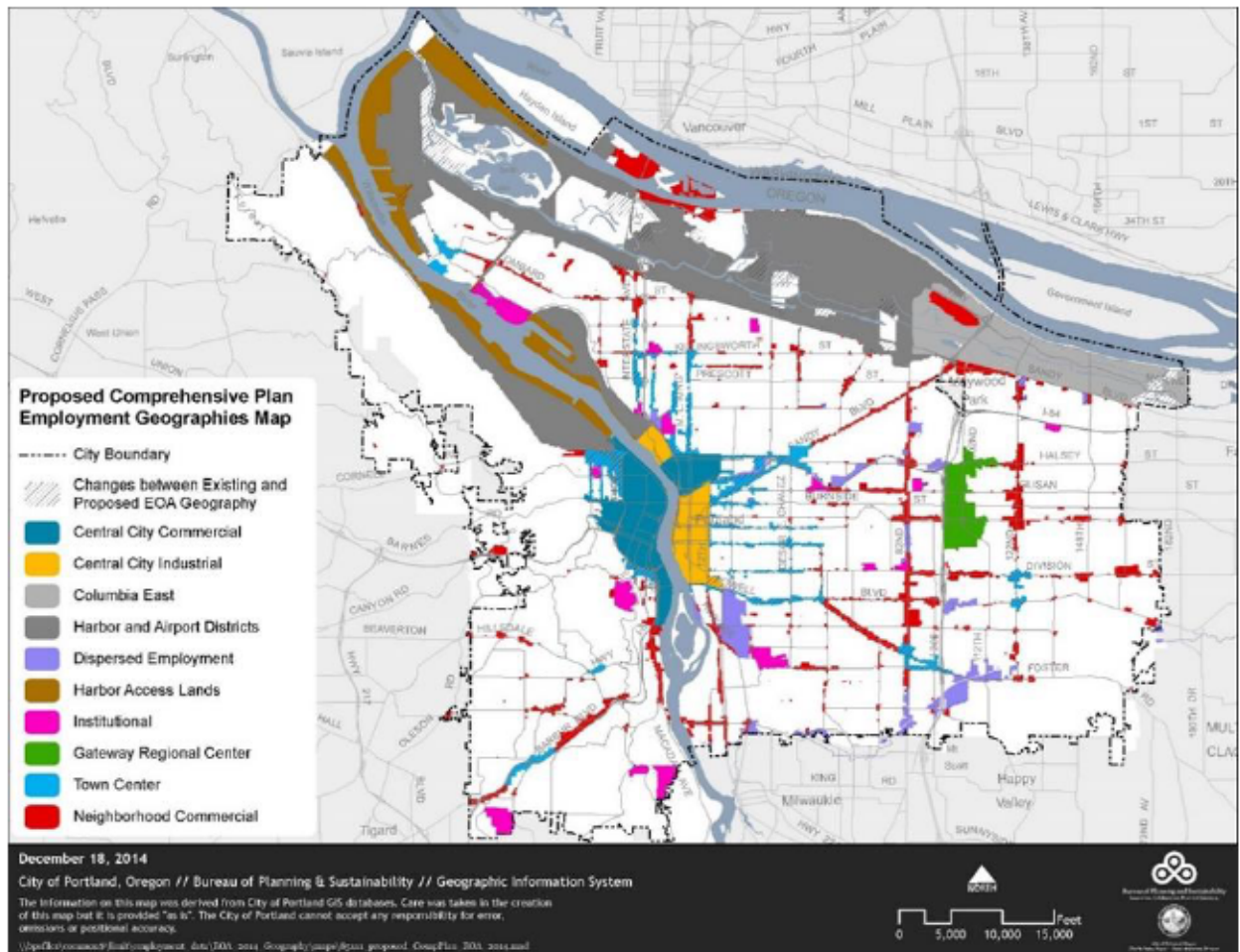


Figure 6. Comprehensive Plan employment geography boundaries

The two employment geographies where the proposed tree code changes pose significant issues for adequate growth capacity are Harbor Access Lands (HAL) and Harbor and Airport Districts (HAD). These ‘freight hub’ industrial districts are where Oregon’s largest marine port, largest airport, two Class 1 railroads, and two interstate highways converge. The 2035 Comprehensive Plan designated ample growth capacity in residential and commercial areas, typically meeting over 200% of forecast land needs, but the currently planned growth capacity in these two industrial geographies meet only 101% of forecast land needs. The Harbor Access Lands geography is particularly specialized, consisting of river-frontage sites along the deepwater shipping channel where the River Industrial overlay zone reserves land for development of river-dependent and river-related use where feasible.

The EOA estimated a 54-acre surplus of 20-year development capacity in the HAD geography (meeting 105 percent of forecast land needs to 2035) and a 25-acre shortfall in the HAL geography (meeting 87 percent of forecast land needs). The EOA explained that the HAL shortfall could be met in the nearby HAD geography and showed examples of where that has occurred. Thus, the growth capacity of these two geographies are evaluated together in the EOA, where HAL has no effective surplus capacity and HAD is

estimated to have a capacity of 29 acres. Collectively, these districts were estimated to provide development capacity to meet just 102 percent of forecast demand.

Since the adoption of the 2035 Comprehensive Plan, two manufactured dwelling parks in the HAD geography were rezoned to RMP, Residential Manufactured Dwelling Park, a zone designed to protect them as affordable housing in response to Portland's identified housing emergency. These zone changes were a part of the Manufactured Dwelling Parks Zoning project (Ordinance 189137, 8/22/2018) and Fox Run Manufactured Dwelling Park Map Changes (Ordinance 189301, 12/12/2018). These combined zone changes reduced the effective buildable land inventory (after deduction for constraints) in HAD by 18.5 acres, reducing the current surplus capacity in the combined HAD/HAL geographies to 10 acres.

### *Effects on Residential Development Costs*

Housing supply does not present the same narrow development capacity considerations that industrial supply does, according to the adopted 2016 EOA. However, to inform a policy decision, it is important to estimate the potential impacts of the proposed amendments on cost and development yield to better understand the potential impact on housing affordability in the city.

## 2. Methodology Summary

Johnson Economics was contracted to analyze the potential development impacts of the proposed Tree Code changes. This section summarizes the methodology used to analyze these potential impacts and the next section summarizes the results. Additional detail on the analysis can be found in the full Johnson Economics report in Appendix G.

To assess the anticipated magnitude and character of impacts on development outcomes associated with the proposed code changes, a predictive development model was used to forecast development outcomes with and without the proposed changes. The model is designed to predict the magnitude and form of likely development or redevelopment activity over an assumed time frame, in this case 20 years. Three proposed code changes were evaluated:

- Remove the exemption from the Tree Preservation Standards for private trees in development situations for zoning designations – IH, IG1, CX, and EX; and
- Remove the exemption from tree density standards from zoning designations IH, IG1, CX and EX
- Reduce the Tree Preservation size threshold that triggers an inch-for-inch mitigation fee for private trees in development in all zones from 36 inches diameter-at-breast height (dbh) to 20 inches dbh for all zones.

Impacts were assessed in into six geographic subareas:

- Harbor Access Lands
- Harbor & Airport
- Columbia East
- Inner Residential
- Middle Residential
- Outer Residential

The primary metric used to predict likely development patterns is the relationship between the supportable residual land value for prospective uses and the current value of the property (including land and improvements, if any). Residual land value is essentially the supportable purchase price of the property for new development. The underlying assumption is that when the value of a property for new development is high relative to the current value of the property, it will be more likely to see development or redevelopment over a defined time period.

The model is designed to generate an estimated ratio between the current value of a parcel and the underlying value of the parcel under potential development scenarios. This ratio is used as the primary indicator of the likelihood of development or redevelopment. Within the model, Real Market Value (RMV) from the assessors' office is used as a proxy for the value of the site. The residual land value is determined using a series of simplified pro formas that represent potential development forms. The resulting ratio between current and residual value has proven to be a strong predictor of the likelihood of development or redevelopment at the parcel level. The model solves for a development solution that represents the highest and best use at the parcel level under the assumptions used. The model also generates an associated residual property value.

For this analysis, the model evaluated a total of 30 prototypical development programs which cover the range of residential and employment development forms allowed under the current and proposed code in the study area. Each development prototype has a predicted employment density, or development square feet per job. Then, the allowed uses and development prototypes are narrowed to reflect what is allowed under existing and proposed zoning.

The probability of development/redevelopment activity is predicted by the model at the parcel level based on the ratio generated by dividing the current value (RMV) by the indicated residual land value. A shift in assumptions that increases the value of the property under a new development scenario, such as a higher achievable price or less restrictive entitlements, will increase the likelihood of development or redevelopment. Sites with relatively high current values resulting from significant physical improvements (e.g., buildings) are expected to be significantly less likely to redevelop.

The model evaluates the likelihood of development at the parcel level, although the results are expressed in aggregated geographies. The model estimates the probability of redevelopment, as well as anticipated development forms, and the results reflect the expected value of development/redevelopment. The model will not indicate that a specific parcel will or will not redevelop, but rather estimates the probability of development/redevelopment based on market factors.

The analysis focused on the marginal impact of the ordinance, and as a result, the analysis of tree preservation impacts only included BLI parcels identified as having existing tree canopy on site. The incremental cost of tree removal was calculated using an assumed distribution of trees by size and a mapping of impacted tree canopy. This was based on work completed by SWCA and the Portland Bureau of Planning and Sustainability. The impact of the removal of the tree density exemption was estimated all BLI parcels, regardless of whether they had existing tree canopy or not. Any new development, either on vacant or already-developed sites, would be required to meet the tree density standards. To estimate the cost and development impacts of the tree density requirement, it was assumed that the fee-in-lieu option would be utilized instead of planting. The model excluded sites that currently are within an environmental overlay, as the existing overlay requirements would continue to supersede Title 11 requirements and therefore the new ordinance would not substantively change development requirements.

Key variables were the estimated cost to mitigate the tree impacts on site development, as well as the underlying value of the property in a development scenario. As a general rule, land uses that support relatively high underlying land values can more easily accommodate an incremental increase in development cost, while the marginal impact will be larger in land uses that have a lower supportable land value (such as industrial in employment lands and residential sites in lower priced markets).

It should be noted that this analysis evaluated impacts on predicted development outcomes under a range of assumptions and did not assess canopy related environmental and public health services associated with the proposed changes. The analysis only looks at the impacts of regulatory changes on predicted development outcomes and does not represent a full cost/benefit analysis. The regulatory proposals are likely to have significant public benefit that would offset potential costs. While we recognize the existence of public benefits, this analysis does not attempt to quantify these.

### 3.Results

The analysis indicates that the most significant impact on predicted development would be for employment lands in the Harbor & Airport and Harbor Access study areas. Much of this property is currently exempted from tree preservation standards and the incremental impact would be substantive. In addition, industrial uses support relatively low residual land values and as a result they are less able to absorb cost increases. The impact on residential yields is less significant as these uses support higher land values and the marginal change in requirements is lower than for exempted zoning classifications (Table 9).



Table 9. Summary of predicted development yields by study area on 20-year horizon.

	Predicted Development Yield				Marginal Cost on Impacted Properties		
	Construction Investment	Residential Units	Employment Acreage	Employment Capacity	Loss of Exemption	Change in Coverage	Tree Density
<b>OVERALL SUMMARY</b>							
<b>BASELINE</b>							
COLUMBIA EAST	\$123,938,026	0	31.2	981	\$0	\$0	\$0
HARBOR - AIRPORT	\$312,742,428	0	110.6	3,629	\$0	\$0	\$0
HARBOR ACCESS LANDS	\$102,402,713	0	46.9	1,500	\$0	\$0	\$0
INNER RESIDENTIAL	\$23,408,389,350	62,931	21.0	1,094	\$0	\$0	\$0
MID-RESIDENTIAL	\$7,872,409,812	4,294	2.4	123	\$0	\$0	\$0
OUTER RESIDENTIAL	\$7,967,427,127	11,772	11.2	588	\$0	\$0	\$0
<b>VARIANCE FROM BASELINE</b>							
COLUMBIA EAST	(\$784,741)	0	(0.5)	(15)	\$0	\$153,598	\$0
HARBOR - AIRPORT	(\$19,035,928)	0	(11.7)	(616)	\$535,448	\$459,901	\$199,363
HARBOR ACCESS LANDS	(\$26,929,491)	0	(15.9)	(506)	\$379,823	\$133,648	\$852,175
INNER RESIDENTIAL	(\$5,444,872)	(24)	0.00	0	\$79,381	\$508,748	\$582,272
MID-RESIDENTIAL	(\$1,888,332)	(8)	0.0	0	\$30	\$477,459	\$66
OUTER RESIDENTIAL	(\$5,013,667)	(22)	(0.0)	(0)	\$12,943	\$2,166,422	\$43,526
<b>TOTAL</b>	<b>(\$59,097,031)</b>	<b>(54)</b>	<b>(28.1)</b>	<b>(1,137)</b>	<b>\$1,007,625</b>	<b>\$3,899,775</b>	<b>\$1,677,401</b>

In the Harbor Access Lands subarea, realized employment capacity is predicted to decline by 506 jobs over a twenty-year period, reflecting a 34 percent decrease. In the Harbor and Airport Districts, realized employment capacity is predicted to decline by 616 jobs, reflecting a 17 percent decrease. In contrast, the realized employment and housing capacity on in the commercial zones and residential subareas is predicted to decline by less than 1 percent.

Goal 9 implications - The impact of the proposed Tree Code changes on Portland's Goal 9 compliance is analyzed by comparing 1) the development impacts modeling of each code change by Johnson Economics and 2) the available surplus capacity (after meeting forecast 20-year needs) identified in the EOA. The results of the analysis are summarized below:

#### *Removal of tree preservation and tree density exemptions in EX and CX zones*

Development impacts modeling estimated no impact from this code change on employment capacity in Portland's Central City or any of the residential/mixed use market areas. The CX and EX zones are concentrated in the Central City and Gateway geographies, where the EOA found ample surplus capacity, meeting 260 percent and 328 percent of their forecast land needs, respectively. Some EX zones are also located in the Town Center, Neighborhood Commercial and Institutional EOA geographies, where the EOA found adequate 20-year capacity. This code change would be consistent with Goal 9.

#### *Removal of tree preservation and tree density requirements in IG1 zone*

Development impacts modeling estimated no impact from this code change on employment capacity in the Central City, Harbor and Airport Districts, or other areas citywide. The IG1 zone is located in the EOA's Central City Industrial, Harbor & Airport Districts and Dispersed Employment geographies, where the EOA found adequate 20-year capacity. This code change would be consistent with Goal 9.

### *Removal of tree preservation and tree density requirements in IH zone*

Development impacts modeling estimated a reduction of 11.8 acres to result from the removal of the IH tree preservation exemption and an additional 11.9 acres due to the removal of the IH tree density exemption, for a combined reduction of 23.7 acres of employment lands in this zone. The IH zone is located in the EOA's Harbor Access Lands and Harbor & Airport Districts geographies, where, as stated previously, the current 20-year surplus capacity is 10 acres and estimated land supply meets 102 percent of forecasted land needs to 2035. Additional development costs associated with the code changes have unusually high impacts on development yields in the IH zone because the low, freight-oriented density of these districts reduces developable land values.

Overall, development capacity is predicted to decline by 34 percent on sites with tree canopy in Harbor Access Lands and 17 percent in the Harbor & Airport Districts as a result of the proposed code changes, primarily due to removal of the IH exemptions, compared to reductions of less than 1 percent in Portland's commercial and residential subareas. The proposed removal of the tree preservation and tree density exemptions in the IH zone would be inconsistent with Goal 9, resulting in a reduction of Portland's existing surplus capacity of 10 acres to a deficit of 13 acres.

Johnson Economics also assessed employment impacts of reduced development in key industrial subareas from the proposed tree code changes. The impacts from the tree code changes there would result from three interrelated factors: 1) development in this freight-infrastructure hub location are difficult to replace elsewhere in the region; 2) the Harbor Access Lands and Harbor & Airport Districts have tight 20-year development capacity and short-term vacancy; and 3) development costs of the proposed code changes are estimated to have comparatively high impacts on development because of the low, freight-oriented density of these districts. If the exemptions for tree preservation and tree density were removed in the IH zone, the resulting impacts on 20-year employment growth in these districts is estimated at 837 jobs.

### *Expansion of tree preservation requirements to 20" trees (dbh)*

Development impacts modeling estimated a development capacity reduction due to the reduced tree preservation threshold in the Harbor Access Lands (-1.55 acres), Harbor & Airport Districts (-4.52 acres), and Columbia East (-0.48 acres) geographies of the EOA. If the IH tree preservation exemption is retained, the reduction in land capacity associated with this change is estimated to be 3.9-acres in the IG2 and EG2 zones of the combined Harbor Access Lands and Harbor & Airport Districts geographies, where the current surplus land capacity is 10 acres. Surplus 20-year capacity in the Columbia East geography is ample (66 acres) to accommodate the 0.48-acre reduction estimated as a result of the change. Applying this code change to all zones except IH would be consistent with Goal 9, retaining surplus capacity of 6 acres in the combined Harbor Access Lands and Harbor & Airport Districts geographies.

For residential development, the modeling estimated a reduction of 54 housing units from what would be expected under the current tree preservation threshold. These units span all development types from single-dwelling to multi-dwelling or mixed use.

While the model does not predict substantive changes in residential carrying capacity associated, the proposed changes are expected to increase residential construction costs by over \$20 million over the next twenty years.

This increase represents 0.11 percent of the total predicted residential new construction investment in the City over the next 20 years. As a result, the proposed changes are not expected to substantively impact affordability, on average.

#### **4. Job Growth and Income Inequality**

Job growth in industrial districts has an inclusive-prosperity role in the regional labor market as higher-paying alternatives to low-wage jobs accessible to workers without college degrees. These job opportunities on average can be expected to moderate the region's increasing income inequality, poverty (lack of income self-sufficiency), and income related health impacts. Harbor dependent sectors of the regional economy can also provide higher median incomes, as compared to other sectors, particularly for people of color. Industrial job growth is consistent with City policy which calls for expanding opportunities for and limiting negative impacts on plans and investments that support middle wage jobs.

As stated previously, Johnson Economics estimated employment impacts (Table 10) of the proposed code changes on development yields in Portland's harbor and airport industrial districts, with outcomes described above.

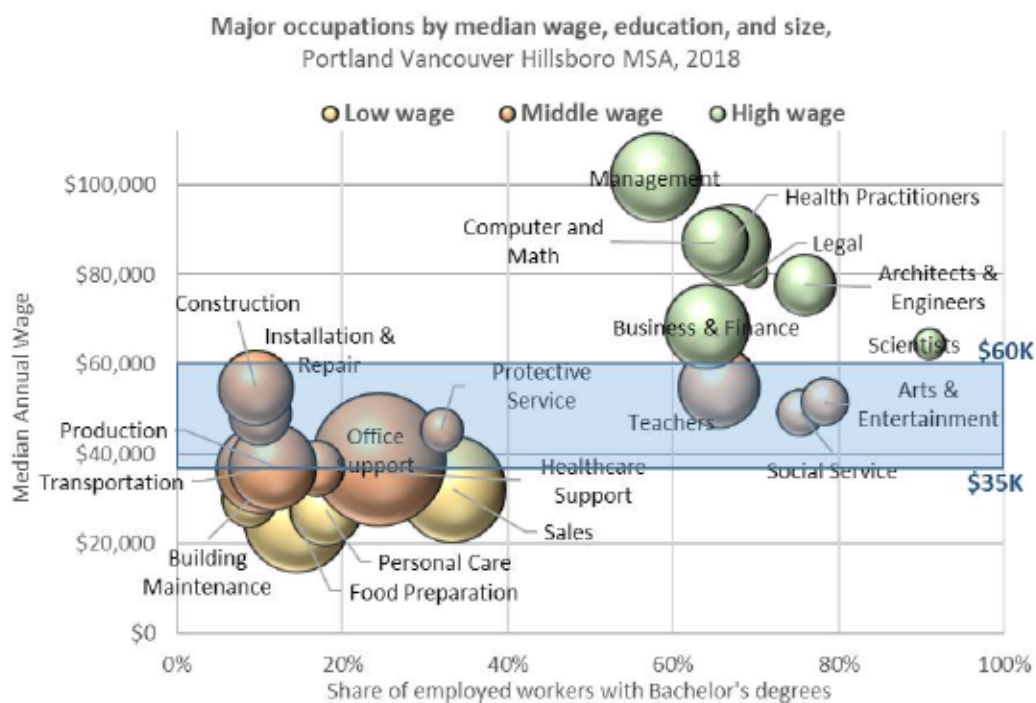
*Table 10. Estimated employment impacts on 20 year employment in harbor and airport industrial districts with removal of IH and IG1 exemptions and reduction of tree preservation size threshold in all zones.*

	Estimate over 20 years (# of jobs)	Estimate per average year (# of jobs)
Removal of exemption from tree preservation and tree density exemptions in IH zone	830	41.5
Expansion of tree preservation to 20" trees	300	15
<b>Total employment impacts in harbor and airport districts</b>	<b>1130</b>	<b>56.5</b>

#### ***Inclusive-prosperity benefits of middle-wage jobs and industrial districts***

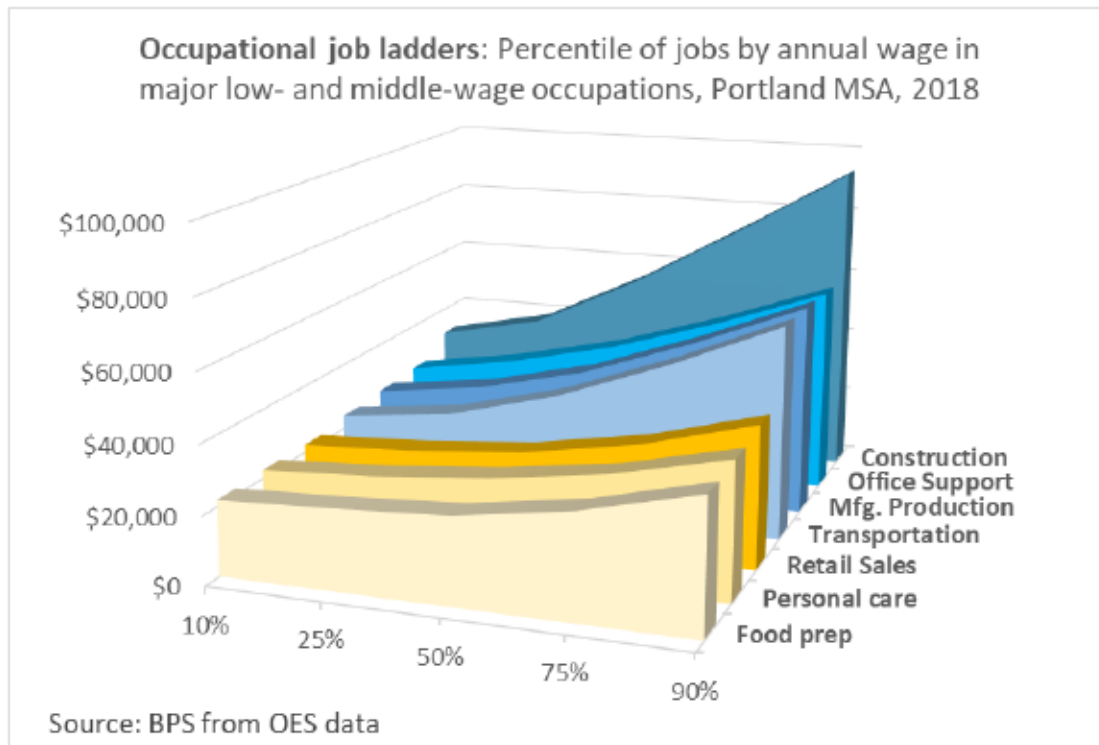
Middle-wage occupations (Abel and Dietz, 2012; Lehner 2019) in the Portland region (shown in the blue-shaded area in the Figure 7) had median annual wages between \$35,000 and \$60,000 in 2018. Industrial occupations (21% of regional jobs in 2018) and office support occupations (14% of regional jobs in 2018) are the largest sources of middle-wage jobs that don't require bachelor's degrees. The industrial occupations include production, transportation, installation and repair, and construction.

Earnings potential is higher for occupations that require advanced education than those that don't as shown in Figure 7, but only 26% of jobs nationally are in occupations that require bachelor's degrees or higher (BLS 2018).



*Figure 7. Major Occupations by median wage, education, and size in Portland Vancouver Hillsboro Metropolitan Statistical Area (MSA), 2018.*

For the 61 percent of regional employees (ACS 2011-2015) that don't have a bachelor's degree, middle-wage occupations can transform households by offering higher wages, more benefits, and job-ladder careers relative to low-wage occupations (Figure 8).



*Figure 8. Occupational job ladders in Portland MSA, 2018*

The unequal wage distribution of occupations in the labor market is also reflected in the varying business district types of Portland's comprehensive plan map (Figures 9 and Figure 10). Portland's Central City (an office district with 53 percent office-sector jobs in 2016) and campus institutions have a primarily high-wage distribution of jobs, corresponding to college-credential occupations. Neighborhood commercial corridors have a primarily low-wage distribution of consumer service and retail jobs. And industrial and mixed employment districts have primarily middle-wage jobs, at 58% compared to 13% low-wage jobs. Combined upper-middle and high-wage quartiles is comparable in Central City (66%), Institutional 68%, and Industrial and Employment districts (68%). These three business district types also all have comparable percentages of low quartile. The key distinction is that Industrial and Employment districts have the highest rate of occupations in the middle-upper wage quartile of all employment geographies, at 40%.

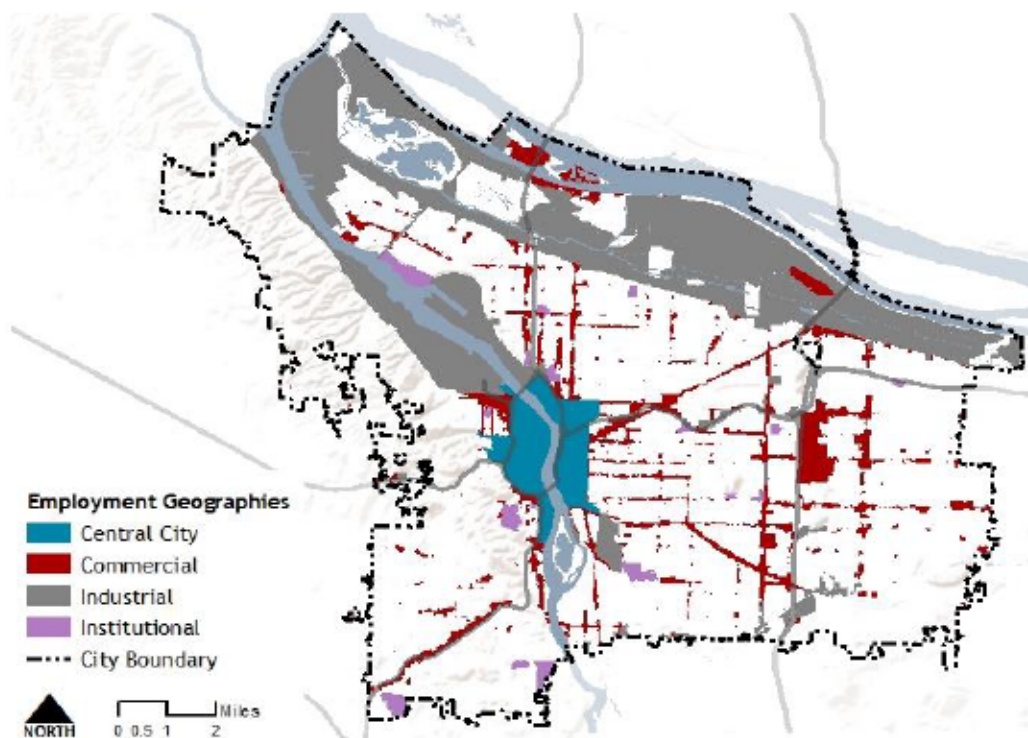


Figure 9. Employment geographies in Portland

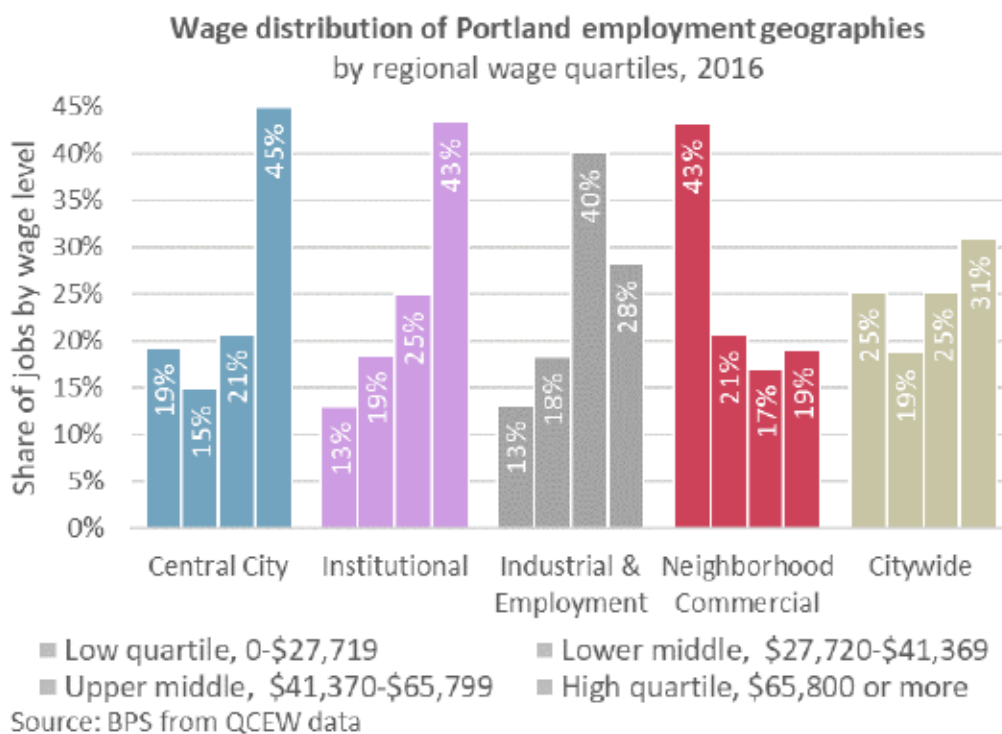
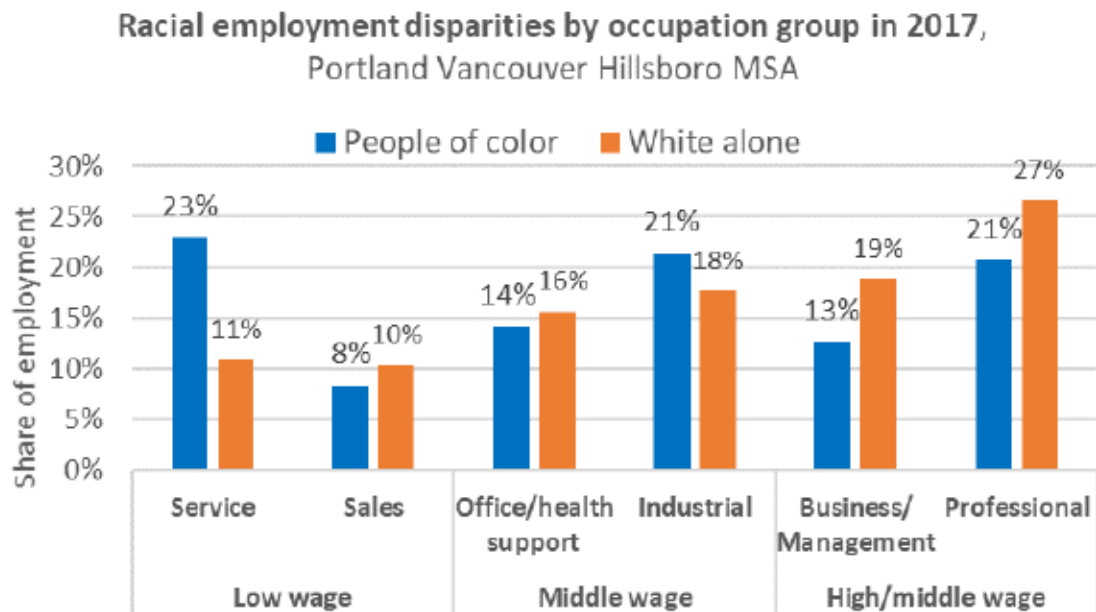


Figure 10. Wage distribution of Portland employment geographies by regional wage quartiles, 2016.

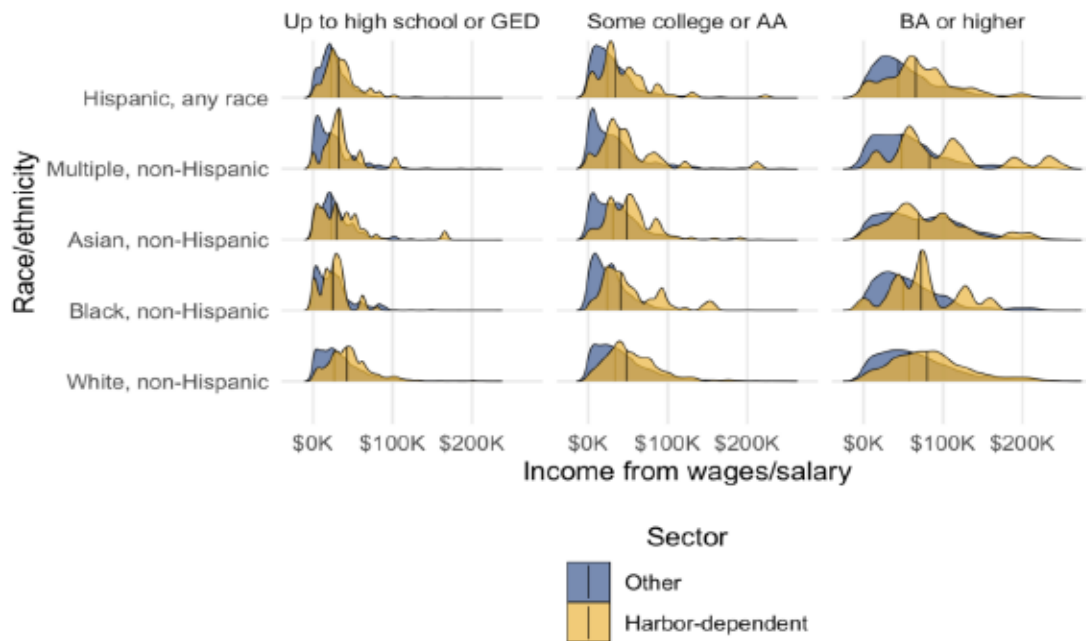
Workers of color are widely underrepresented in the region's high-wage occupations and overrepresented in the low-wage occupations (Figure 11). Given this occupational profile, the region's wage-polarized growth trends discussed below appear to disproportionately impact workers of color and contribute to racial income disparities. Among middle- and high-wage occupations, industrial jobs stand out as the only major occupation group in the Portland region that hires proportionally more workers of color than workers that are white alone.



Source: BPS from ACS data

*Figure 11. Racial employment disparities by occupation group in 2017, Portland Vancouver Hillsboro MSA1*

Figure 12 provides more detail, comparing income distribution by race and education for people employed in harbor-dependent sectors relative to the region's other sectors combined. Portland's harbor-area geography used by ECONorthwest (BPS, unpublished at time of staff proposal) to identify harbor-dependent sectors generally corresponds to the area that Johnson Economics found significant job impacts from tree code changes. The chart demonstrates the relationship between race, sector, and education by visualizing the relative distributions (the black bisecting lines representing medians) of each group's work-related income. Some groups, like multiracial non-Hispanic workers with a BA or Black non-Hispanic workers with an AA, demonstrate measurably higher incomes in harbor-dependent industries compared to other sectors. Jobs within harbor-dependent industries seem to offer a path upwards, usually providing higher floor and ceiling pay to workers at each major step of educational attainment.

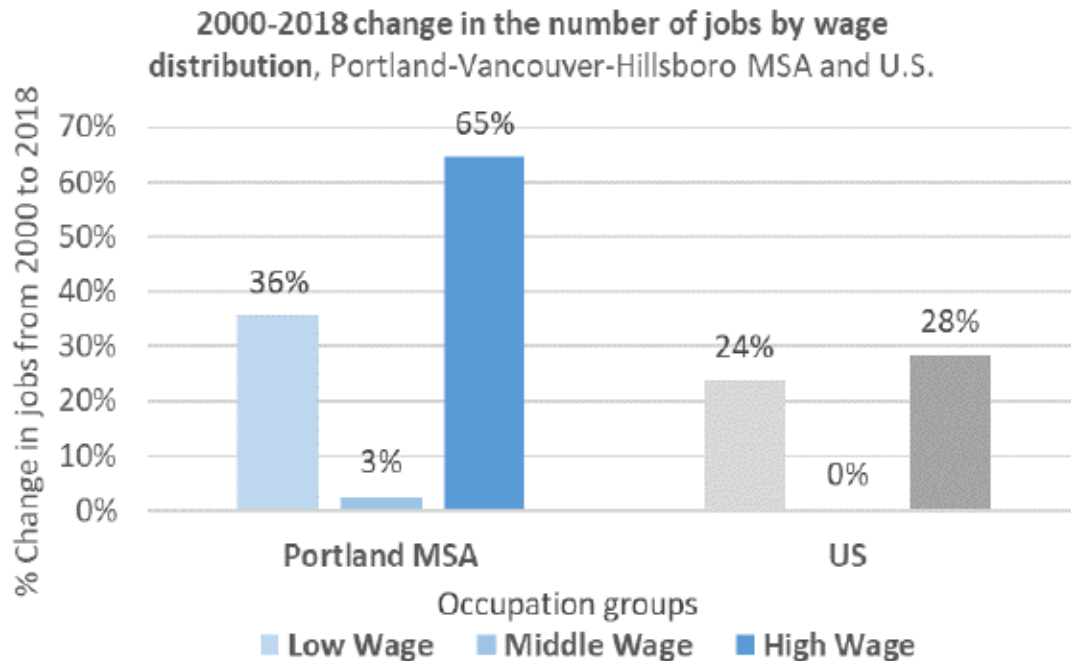


*Figure 12. Distribution of income by race/ethnicity and education in harbor-dependent sectors relative to all other sectors. Source: ECONorthwest from 2014-2018 ACS PUMS data*

### ***Increasing regional income inequality***

Lower levels of industrial job growth will accelerate the region's declining share of middle-wage jobs and related increase in income inequality. Nearly all of the region's job growth since 2000 (the last two business cycles) has been in high- and low-wage occupations (Figure 13). As a result, the middle-wage occupations declined from 58 percent in 2000 to 48 percent in 2018, nearly twice as much as the national change from 56 percent to 51 percent in that period. This is inconsistent with City policy which calls for equitable access to opportunities and reducing and mitigating the impacts of development on income disparity.





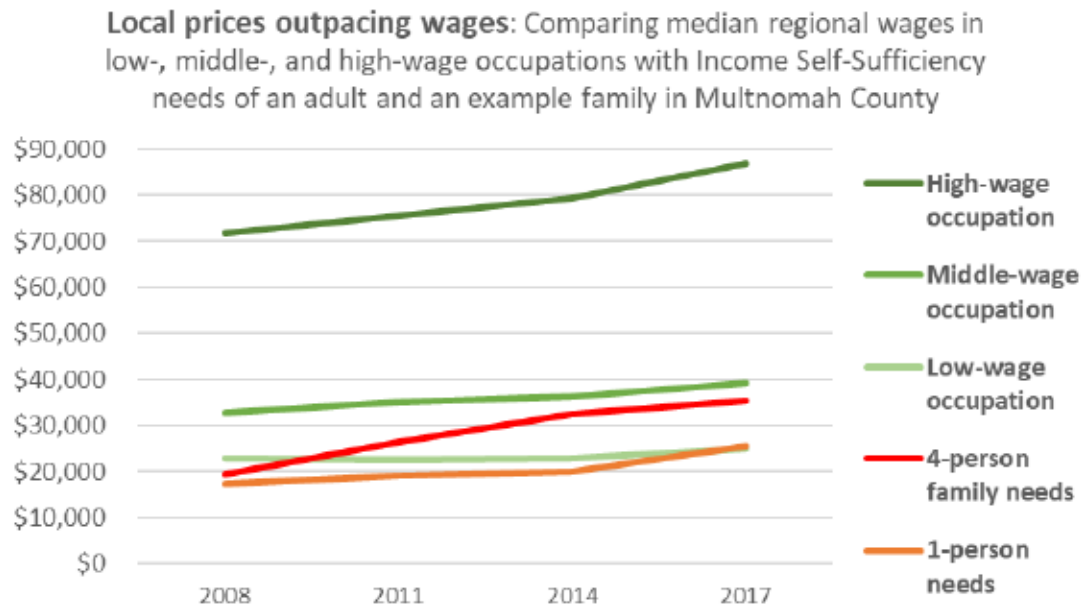
*Figure 13. 2000-2018 change in the number of jobs by wage distribution, Portland Vancouver Hillsboro MSA and US*

### ***Income self-sufficiency (increasing poverty)***

In 2017, 34 percent of Multnomah County households were poor, measured by the Income Self Sufficiency Standard, up from 23 percent in 2008 ([Multnomah County 2019](#)). Lower levels of industrial job growth are likely to incrementally contribute to this trend by reducing high-wage alternatives to low-wage jobs for workers without college degrees. The Income Self-Sufficiency Standard ([WorkSystems Inc 2017](#)), which is used by a variety of states (including Oregon and Washington), provides a more detailed local accounting than federal poverty statistics of people in need, measuring the minimum budget necessary to cover basic essentials by families of varying sizes at county-level prices (Figure 14). Essentials include rent, childcare, food, transportation, health care, household needs, and taxes. The region's wage-polarized job growth trends contribute to the county's declining income self-sufficiency rate in two ways: 1) alternatives to low-wage occupations are reduced for workers without bachelor's degrees, and 2) the strong growth in high-wage wage occupations puts upward pressure on local prices for basic needs, particularly housing and childcare. As shown in the chart above, middle-wage jobs have an equity role in lifting families above income self-sufficiency levels relative to low-wage occupations.

Income Self-sufficiency can be aided by expanding access to self-sufficient wage levels and career ladders for low-income people by maintaining an adequate and viable supply of employment land and public facilities to support and expand opportunities in

Portland for middle- and high-wage jobs that do not require a 4-year college degree, limiting negative impacts of plans and investments on middle and high wage job creation and retention. The Portland Plan (BPS 2012) aims to increase income self-sufficiency to 90 percent by 2035, the opposite direction of recent trends, as one of 12 measures of community success.

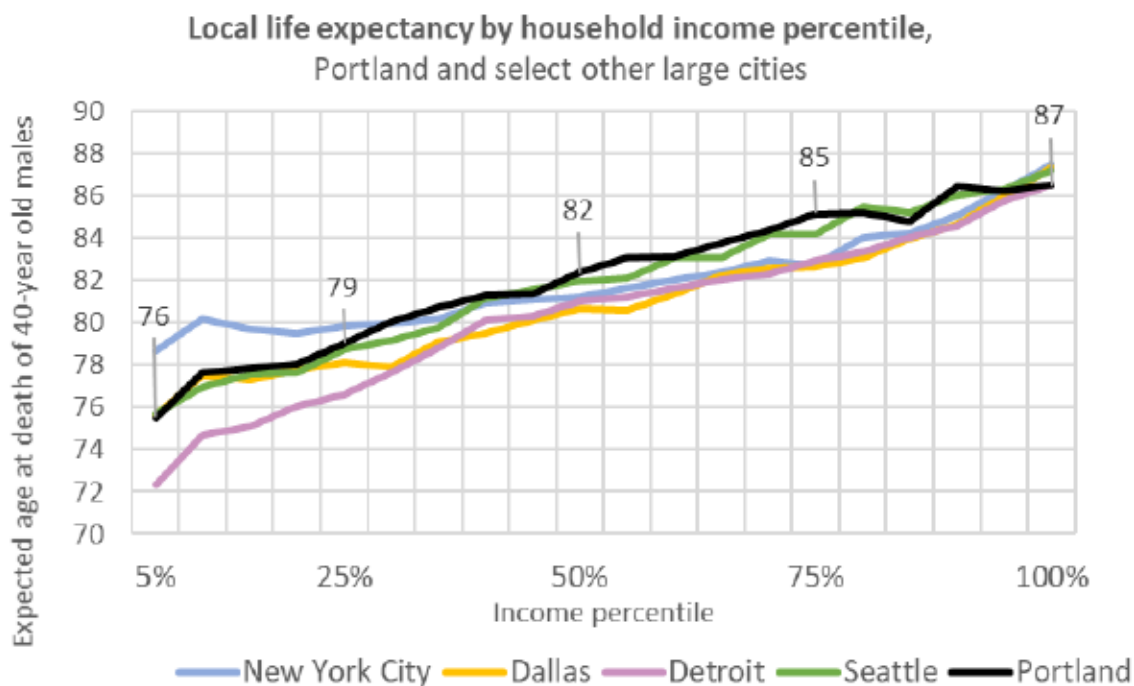


Source: BPS from OES and ISS data (Pearce). Nominal \$ (not inflation adjusted) Example 4-person family: 2 working adults, preschooler and school-age child.

Figure 14. Income self-sufficiency needs compared to median wage levels in Multnomah County.

### *Income-related disparities in public health*

Lower levels of industrial job growth are likely to contribute to income-related health disparities by reducing high-wage alternatives to low-wage jobs for workers without college degrees. Life expectancy and other public health outcomes are strongly related to income level. A national study comparing income and mortality among U.S. cities from 1999 to 2014 (Chetty et al. 2016) found that people in the highest 5-percent income category live about 10-15 years longer on average than people in the lowest 5-percent (Figure 15). In Portland, the highest-paid residents (top 5 percent) live about 4 years longer on average than median-income residents, who live about 7 years longer than the lowest-income 5 percent of residents.



Source: Chetty, et al., 2016, race-adjusted

Figure 15. Local life expectancy by household income percentile in Portland other cities.

## V. Climate-Related Equity Considerations

In July 2020, City Council responded to the global climate crisis by unanimously issuing a Climate Emergency Declaration. The resolution began with an acknowledgement that frontline communities, including Black, people of color, indigenous, and refugees are often least responsible for contributing to climate change and yet disproportionately experience the impacts and burdens.

The resolution states that climate change “threatens our city, our region, our state, our nation, humanity and the natural world, and that such an emergency calls for an immediate mobilization effort initiating greater action, resources, collaboration and new approaches to restore a safe climate.” The resolutions further notes that “protecting, restoring, and managing our urban natural resources – including rivers, streams, wetlands, floodplains, trees, and unique habitats – mitigates risks, sequesters carbon, and builds resilience to the impacts of climate change, provides benefits to human physical and mental health, protects private property and public infrastructure, and supports the intrinsic value of natural ecosystems and biodiversity.”

In issuing the declaration, City Council directed relevant City bureaus to update regulations that protect and enhance tree canopy to reduce heat island impacts on public health. Given the proximity of industrial areas to riparian zones and habitat, the heat island impacts caused by the prevalence of paved surfaces, and the lack of tree canopy relative to other

areas of the city, it is appropriate to view this project in alignment with that directive. It is similarly necessary that this project thoroughly assess the impact on the frontline communities who live and work either in or adjacent to these areas of the city.

### A. Air Quality

As has been discussed previously, people of color in Portland disproportionately live adjacent to the city's industrial zones. Figure 14 illustrates that 38 percent of minorities in Portland live in close proximity to the city's 10 biggest sources of air pollution. These facilities contribute a combined 35 percent of all air pollution produced within Portland (Kane et al. 2020). The map demonstrates many of these facilities are in North Portland within the IH zones considered in this project.

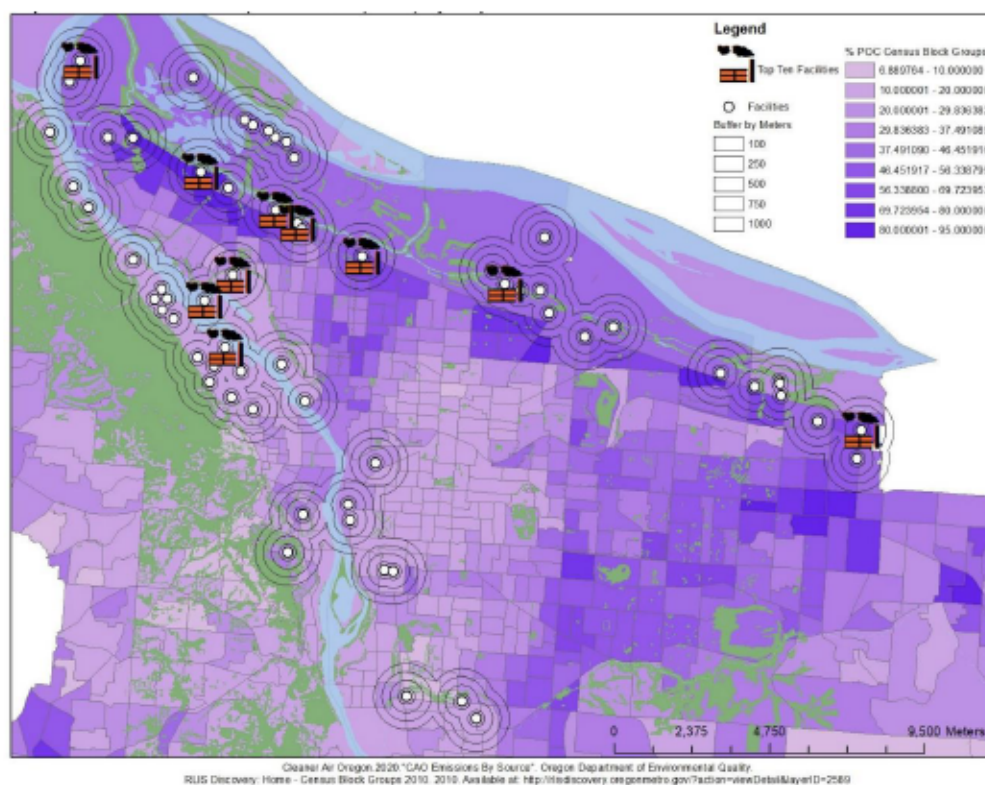


Figure 14. Top 10 facilities and people of color by population share

The impacts of air quality on health and life expectancy are well established. Long-term exposure to pollutants increases the likelihood of respiratory and cardiovascular diseases. Further, preliminary research in response to the COVID-19 pandemic has found “a small increase in long-term exposure to PM<sub>2.5</sub> leads to a large increase in the COVID-19 death rate.” It is important to note that non-point sources such as emissions from heavy duty vehicles, light duty cars and trucks, and wood burning stoves are a major contributor of PM<sub>2.5</sub> in the Portland region (DEQ). As such this impact should not be attributed primarily to the presence of industrial facilities. Nonetheless, industrial facilities are a significant contributor of air pollutants in addition to drawing heavy

freight traffic to North Portland via Columbia Blvd and Lombard Ave. along which a high percentage of people of color live and work.

These considerations are noteworthy in this report because of the documented role that urban trees play in removing pollutants from the air. In particular, trees remove PM<sub>2.5</sub> and other gaseous air pollutants through leaf uptake (Nowak et al, 2013). As such, tree removal and lack of required tree planting in the industrial zones in conjunction with anticipated future development can be reasonably expected to contribute to air quality concerns for communities working in and living adjacent to these areas.

## B. Urban Heat Islands

Trees are also a primary tool in reducing the heat island impacts prevalent in urban areas. A 2018 study by the Sustaining Urban Places Research (SUPR) Lab at Portland State University (Voelkel et al 2018) found that afternoon temperatures are significantly higher in areas of the city with low tree canopy, increased prevalence of concrete or asphalt, and along freeways and major arterials. Figure 4, previously cited, demonstrates temperatures in industrial areas can be almost 10 degrees Fahrenheit higher than in the well treed neighborhoods of the city.

Reducing urban heat island effects has emerged as a major public health priority in recent years and is a specific action point in Portland's Climate Emergency Declaration. The proposed code changes are expected to improve tree preservation in development situations while also increasing mitigation payments into the Tree Planting & Preservation Fund which can support increased planting efforts. Nonetheless, maintaining the exemption to preservation and tree density requirements in IH zones will likely result in continued tree removal and lack of new tree planting as those properties are developed over the next 20 years consistent with the Comprehensive Plan.

## VI. Potential Outcomes of Proposed Amendments on Tree Preservation and Planting

It is difficult to estimate the effects of this proposal in terms of numbers of trees preserved or fees in lieu of preservation collected. Conditions of specific sites will vary widely; the number of trees, their location, the ability to be flexible with building footprint, and the economic consequences of preserving or not preserving a tree or trees. However, it may be possible to use information based on a similar amendment passed in 2016 to extrapolate possible outcomes, with qualifications.

### A. Effect of 2016 Large Tree Stop-Gap Amendment

As discussed in more depth in sub-section I.A, the 2016 amendment required all non-exempt trees 36 inches dbh or greater to be preserved or an assessed fee in lieu of preservation. It also changed the fee in lieu of preservation for non-exempt trees 36 inches dbh or greater to an inch-per-inch fee (currently \$450/inch), instead of the pre-amendment flat fee of \$1800. As a result, removal of a 36 inch dbh tree now requires a fee-in-lieu of preservation of \$16,200.

Data suggests the 2016 amendment has been effective at encouraging preservation of large diameter trees (36 inches or greater dbh). From the effective date of the amendment, May 13, 2016, through March of 2019, the number of large diameter trees preserved increased by 71 percent while the number of trees large diameter trees removed decreased by 64 percent (Table 11). At the same time, the fees in lieu of preservation collected more than doubled, despite the number of permits remaining relatively consistent (Table 12). However, currently there is no data collected to understand decision making that led to more large diameter trees being preserved. Preservation of the larger diameter trees may be the result of a choosing to retain the tree instead of paying the greater fee in lieu of preservation, designing the project to retain the tree or, particularly on larger sites, preserving the tree because it was unaffected by development.

*Table 11. Number of 36 inch or larger dbh trees removed and preserved prior to current large tree amendment (in 2015) and after amendment (average per year in full years, 2018 and 2019).*

	Pre-Amendment (2015)	Post-Amendment (Average/Year)	%Change
# Non-exempt 36" + Trees Removed:	42	15	-64%
#36" + Trees Preserved	91	156	71%

*Table 12. Issued permits and Fees in lieu collected for 36 inch or larger dbh trees, prior to current large tree amendment (in 2015) and after amendment (average per year in full years, 2018 and 2019).*

	Pre-Amendment (2015)	Post-Amendment (Average/Year)	%Change
Fee In Lieu of Preservation Revenue	\$200,400	\$462,376	131%

## B. Possible Outcomes of Staff Proposal

### 1. Reduction of tree preservation threshold from 36 inches to 20 inches dbh in currently non-exempt zones.

Applying the same percentage decrease in number of trees removed (64 percent) that occurred for 36 inch dbh and greater trees to trees 20 to 36 inches dbh trees, after this proposed amendment, results in an estimated decrease of 65 trees removed on average per year, as shown in Table 13. The data in Table 13 is data from permits in full years 2018 and 2019.

*Table 13: Projected number of 20 to 36 inch dbh tree removals per year as a result of proposed amendment (reducing size threshold from 36 inches dbh to 20 inches dbh), compared to current number of 20 to 36 inch dbh trees removed (average/year, over full years 2018 and 2019).*

	Current (Average/Year)	Proposed Amendment (Average/Year, Projected)	%Change
<b># Non-exempt 20 to 36" Trees Removed:</b>	101	36	-64%

Additionally, even if 65 additional trees are preserved per year, the fees-in-lieu of preservation would still increase by 15%, due to the inch-per-inch fee in lieu of preservation calculation as shown in Table 14. The data in Table 14 is from permits in full years 2018 and 2019 and accounts for fees based on actual tree sizes removed in 2018 and 2019, with the 64% decrease applied to the amount of trees removed for each tree size 20 to 36 inches dbh.

*Table 14. Projected fees in lieu of preservation for 20 to 36 inch dbh tree removals per year as a result of proposed amendment (reducing size threshold from 36 inches dbh to 20 inches dbh), compared to current fees collected for 20 to 36 inch dbh trees removed (average/year, over full years 2018 and 2019).*

	Current (Average/Year)	Proposed Amendment (Average/Year, Projected)	%Change(Projected)
<b>Total Fees In Lieu of Preservation</b>	\$363,600	\$419,580	15%

**Qualifications:** There are several reasons why these projections may be higher or lower than actual results if the proposed amendments are adopted:

- **Higher prevalence of 20 to 36 inch dbh trees than trees 36 inch dbh or greater. Smaller trees are more prevalent than larger trees.** Data collected through permit research previously shown in Tables 7 and 8 indicate an average of 1.7 20 to 36-inch dbh trees per acre in single and multi-dwelling zones and an average of .75 36-inch dbh or greater trees per acre in the same zones. In industrially-oriented zones, as shown in Table 5, the average trees per acre are estimated to be 4.4 trees per acre in the 20 to 36 inch dbh category and .9 trees per acre for trees 36 inches dbh or greater. The greater prevalence of the 20 to 36-inch dbh trees could mean that there is less flexibility to accommodate both a building and disturbance area and preservation of 20 to 36 inch dbh trees, *possibly resulting in 20 to 36-inch dbh trees being removed at a higher rate than those that are 36-inch dbh or greater.*
- **Smaller root protection zones.** On the other hand, smaller trees have smaller root protection zones, areas that cannot be impacted by building area or other disturbance, than larger trees. The standard root protection zone is one-foot radius for every one inch diameter tree size, with an encroachment allowance of 25 percent of the root protection zone area. A 36-inch dbh tree has a root protection zone that is 36 feet in radius, or 72 feet in diameter minus the allowed encroachment; a 20-inch dbh tree has a root protection zone that is 20 feet in radius, or 40 feet in diameter minus the allowed encroachment. Smaller root protection zones will provide more flexibility for accommodating tree preservation, *possibly resulting in trees 20 to 36-inch dbh being removed at a lower rate than those that are 36-inch dbh or greater.*
- **Incentive to provide alternate root protection zones.** As an alternative to the standard root protection zone described above, applicants may choose to propose an alternate root protection zone prepared by a certified arborist. An alternate root protection zone can take into consideration specific conditions like the species of the tree, site characteristics and specific construction activities. These root protection zones can often be smaller than the standard root protection zones. If adopted, this amendment would increase the fee-in-lieu of preservation and may incentivize investment in an arborist's consultation and proposed alternate root protection zone. This could *possibly result in trees 20 to 36-inch dbh being removed at a lower rate than they are under the current regulations.*

## 2. Removing exemptions in CX, EX, IG1 and IH zones

By combining the data obtained by the SWCA tree canopy analysis as shown in Table 5, and applying the rates of preservation gathered through permit research as shown in Tables 7 and 8, potential outcomes on tree preservation by removing the tree preservation exemption in IG1 zone may be estimated. Similarly, we can estimate the missed outcomes by not removing the tree preservation exemption in the IH zone. Outcomes in the CX and EX zones are not estimated due to the amount of data available



for those zones and the fact that they are more apt to develop at a building coverage where they are exempt from tree preservation regardless. *As opposed to the possible outcomes for additional tree preservation currently non-exempt zones described above which are expressed as an average per year, these potential outcomes are expressed as total possible outcomes over an indefinite period of time.* This is because there is no historical permit data to estimate outcomes on a per year basis, and because it does not account for how many or which properties will develop or redevelop on an annual basis.

As shown in Table 11, trees subject an inch-per-inch fee in lieu of preservation are preserved at a rate that is ten times that of trees removed (15 trees removed versus 156 trees preserved per year). Removing the exemption in the IG1 zone could result in preservation of 236 additional trees 20 to 36" dbh (Table 15). By not removing the tree preservation exemption in IH, 1,947 trees 20 to 36" in diameter would not be required to be preserved of a fee paid in lieu of preservation.

*Table 15 Number of trees 20 inches dbh or greater projected to be preserved and removed in unlimited timeframe in IG1 and IH if tree preservation exemption is removed.*

Zone	Total # of Trees Estimated	# of Trees Preserved (Projected)	# of Trees Removed (Projected)
IG1	261	236	25
IH	2154	1947	207

**Qualifications:** There are several reasons why these projections may be higher or lower than actual results if the proposed amendments are adopted:

- **Estimated Rates of Preservation.** These projections use past data on the rate of preservation versus removal of trees 36-inches dbh or greater. As explained above, *the rate of preservation for smaller trees may be less than for larger trees.*
- **Other exemptions to tree preservation and tree density requirements.** This proposal does not alter other exemptions, notably an exemption for tree preservation for sites with existing or proposed building coverage of 85 percent or more. All three zones where the exemptions are proposed for removal, CX, EX, and IG1 allow for 100 percent building coverage, though this condition is more prevalent in CX and EX than in IG1 zones. Similarly, for tree density, sites get credit for the land area used for building coverage above what is required to calculate the base tree density requirements. For sites with high levels of building coverage, no tree preservation (or payment in lieu of preservation) or planting would be required by Title 11. This will *lower the overall rate of preservation and planting in all three zones combined, though note that preservation estimates were not provided for CX and EX zones.*

- **Site Variables.** In industrial areas outside of the central city, trees are often clustered or located at the fringes of development sites, which could make them easier to preserve. In addition, though 100 percent building coverage is allowed in all four zones, the characteristics of typical development outside of the central city include exterior development areas such as parking areas, loading areas, or other areas that leave space open and/or already require landscaping through Title 33, Planning & Zoning, providing open space to plant or preserve trees to meet tree density requirements. These conditions *could increase the rate of preservation and planting*, especially in areas outside of the central city.

In addition, since CX, EX, and IG1 zones are currently exempt from tree preservation and tree density, there is no permit data to verify current rates of preservation or tree removal in these zones. The possible outcomes use data gathered from single-dwelling and multi-dwelling zones. There different development characteristics between these groups of zones that may not allow for an accurate projection for CX, EX, IG1 and IH zones. Single and multi-dwelling zoned sites are typically smaller and present less opportunity for creative site design. However, those zones also require a minimum amount of non-developed area; where sites in CX, EX, IG1, and IH zones are allowed to develop with 100 percent building coverage, and would be exempt from tree preservation or tree density requirements altogether.

- **Overall,** given the existing exemptions for sites with high levels of building coverage, the possible outcomes on tree preservation and tree density for all four zones combined *would be expected to be lower* than indicated in the possible outcomes.

## VII. Conclusion and Staff Proposal

These proposed amendments were brought forth to City Council by the UFC and the PSC out of concern for loss of tree canopy in industrial and commercial zones during development. Additionally, the UFC recommended reducing the size threshold for tree preservation from 36 inches to 20 inches dbh, with associated increase in inch-per-inch mitigation fees in order to preserve more trees throughout the city (there are more 20 inch dbh and greater trees than 36 inch dbh and greater trees) . The proposed amendments address public and environmental health disparities due to the unequal distribution of tree canopy in Portland. Trees are important components of urban infrastructure and provide numerous public health and environmental services. Unfortunately, low income communities and communities of color often reside in or adjacent to low canopy areas of the city- particularly industrial areas, where tree preservation and tree planting are not required during development.

Concurrently, state mandated land use planning goals require a certain amount of developable land to support economic growth. Industrial areas- particularly, the Harbor Access and Airport & Harbor geographies, are a source for middle wage job opportunities for workers without bachelor's degrees. Data from BPS shows that jobs related to the Harbor

Access sector provide greater opportunity for people of color and address polarized job growth resulting from regional wage income gaps (lack of middle wage jobs).

Removing exemptions to tree preservation and tree planting requirements in IG1, EX and CX zones provides an opportunity to the above, supporting climate, canopy and economic goals for Portland. Economic analysis also demonstrates that reducing the size threshold for tree preservation during development on private property also provides an opportunity for supporting more canopy throughout the city, without significantly increasing the cost of housing. Furthermore, when tree preservation cannot be accommodated, fees in lieu of mitigation paid into the Tree Preservation and Planting Fund allow for tree planting and preservation to occur where needed most, as identified in Urban Forestry's Growing a More Equitable Urban Forest Citywide Tree Planting Strategy.

Further analysis of how requiring tree preservation and tree planting while supporting economic development in the IH zones is recommended as an immediate next step.

**Considering:**

- The purpose of Title 11 and the goals of this project;
- Input from community members;
- The outcomes of the Economic Analysis that was informed by the Tree Canopy Analysis;
- Opportunities to advance tree canopy and economic equity outcomes; and
- The direction of City Council expressed in Resolution 37473;

**Project staff propose the following:**

- **Remove** the exemption from tree preservation and tree density in IG1 (General Industrial 1), EX (Central Employment), and CX (Central Commercial) zones on private or City-owned/managed property.
- **Retain** the exemption from tree preservation and tree density in IH (Heavy Industrial) zone on private and City-owned or managed property.
- **Reduce** the threshold for required preservation of trees on private property from 36 inches to 20 inches in diameter, wherever tree preservation is required.
- **Reduce** the threshold for inch-per-inch fee in lieu of preservation for trees on private property from 36 inches to 20 inches in diameter.

**The staff proposal does not:**

- Change any of the other existing exemptions from tree preservation or tree density.
- Change anything else about the rules for tree preservation or tree density in development situations.

Staff also proposes to re-examine the exemptions from tree preservation and tree density in the IH zone through the 5-year update to the Economic Opportunities Analysis (EOA)

required by the State of Oregon to demonstrate compliance with Statewide Planning Goal 9, undertaken by the Bureau of Planning and Sustainability as part of their regular work program. The last EOA was adopted in 2016. Public engagement for the 5-year update is anticipated to begin in early 2021. In that forum, mitigating strategies may be established to offset the development constraints presented by adding tree preservation and tree density regulations in the IH zone.

While staff understands the analysis does not allow for the exemption to be removed, as has been documented in this report, the lack of existing tree canopy in these areas coupled with the volume of impermeable surfaces directly result in higher air and land surface temperatures, decreased air quality, stormwater management challenges, and habitat degradation within sensitive riparian zones, amongst a multitude of other environmental and public health impacts now exacerbated by the climate crisis. These are concerns shared by many stakeholders. Staff recommends the City commit to identify solutions using all available tools to preserve and grow canopy coverage in IH zones to improve public and environmental health outcomes, in a future project. Beyond exploring the removal of the IH zone exemptions in the next required Economic Opportunities Analysis conducted by BPS, additional actions could include but not be limited to, determining alternative fee-in-lieu levels to maintain compliance with Goal 9, reviewing environmental regulations in industrial zones of other Oregon cities, and exploring amendments to Title 33 or other City codes which relate to the retention and planting of trees in industrial zones.



## **Proposed Changes to Title 11.50 Trees in Development Situations**

**Appendix A: Code and Commentary Document**

**Appendix B: References**

**Appendix C: Summary of Community Interviews**

**Appendix D: Summary of Community Survey**

**Appendix E: Summary of Online Community Forum**

**Appendix F: SWCA Tree Canopy Analysis**

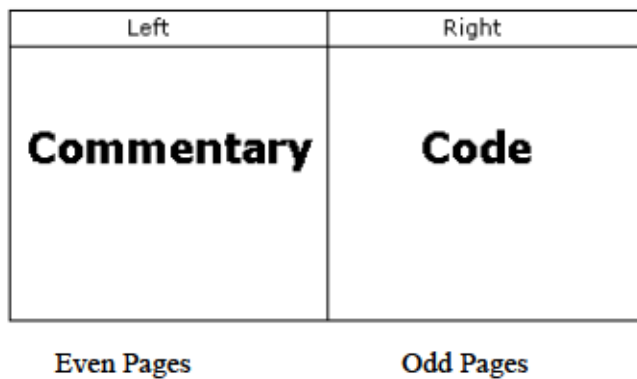
**Appendix G: Johnson Economics Analysis**



**Understanding this Document.**

This document provides the reviewer with both the proposed code changes and explanatory language supporting the change. The explanatory language, or commentary, faces the corresponding code language revisions on the opposite page.

All commentary language is located on the even pages, and the corresponding code language is located on the odd pages. (See Diagram below)



This format allows the reviewer to see both code change and rationale in the same location, thereby facilitating quick review



## Appendix A: Code and Commentary

## Commentary

**Chapter 11.50 Trees In Development Situations**

The introductory sections and the sections for Tree Preservation (11.50.040) and Tree Density (11.50.050) are shown in their entirety for reference.

**11.50.010, 11.50.020, 11.50.030**

No changes are proposed in these sections; they are shown for reference.

## Appendix A: Code and Commentary

## CHAPTER 11.50 - TREES IN DEVELOPMENT SITUATIONS

**Sections:**

- 11.50.010 Purpose.
- 11.50.020 When a Tree Plan is Required.
- 11.50.030 Development Impact Area Option for Large Sites and Streets.
- 11.50.040 Tree Preservation Standards.
- 11.50.050 On-Site Tree Density Standards.
- 11.50.060 Street Tree Planting Standards.
- 11.50.070 Tree Plan Submittal Requirements.
- 11.50.080 Changes to Approved Tree Plans and Emergency Tree Removal.
- 11.50.090 Administrative Review.
- 11.50.095 Appeals.

**11.50.010 Purpose.**

The regulations of this Chapter support and complement other City development requirements, with a focus on achieving baseline tree preservation and total tree capacity on a site, considering the anticipated use and level of development. This Chapter regulates the removal, protection and planting of trees through the development process to encourage development, where practicable, to incorporate existing trees, particularly high quality or larger trees and groves, into the site design, to retain sufficient space to plant new trees, and to ensure suitable tree replacement when trees are removed. It is the intent of these provisions to lessen the impact of tree removal and to ensure mitigation when tree preservation standards are not met.

**11.50.020 When a Tree Plan is Required.**

(Amended by Ordinance No. 188816, effective March 16, 2018.) A tree plan is required in conjunction with all development permits, unless there are no Private Trees 12 inches or more in diameter, no City Trees 6 inches or more in diameter, and/or no Street Trees 3 inches or more in diameter, and the site or activity is exempt from Section 11.50.050 On-Site Tree Density Standards; and Section 11.50.060 Street Tree Planting Standards. If multiple development permits are required for a development proposal, including demolitions and subsequent construction, the same Tree Plan shall be included with each permit. For tree removal when no development permit is required, following completion of the development permit, or when tree preservation does not apply per Subsection 11.50.040 A.1., see Chapter 11.40.

**11.50.030 Development Impact Area Option For Large Sites and Streets.**

(Amended by Ordinance No. 188278, effective April 14, 2017.) Where development is proposed on a site larger than one acre or where work is occurring in the street and is not associated with an adjacent development site, the applicant may choose to establish a development impact area. For sites using the development impact area option, tree preservation requirements shall be based on the trees within the development impact area and tree density will be based on meeting Option A as applied only to the area within the development impact area. Trees may be planted to meet tree density requirement elsewhere on the site.

## Appendix A: Code and Commentary

## Commentary

**11.50.040. Tree Preservation Standards****A. Where these regulations apply.**

The word “any” is added to clarify that any ground disturbance triggers tree preservation requirements; not ground disturbance greater than 100 square feet.

**B. Exemptions**

Exemption B.1 shows the removal of the exemption from tree preservation standards for IG1, EX, and CX zones. The exemption from tree preservation is retained in the IH zone to maintain adequate supply for industrial jobs in the IH zone as required by Statewide Planning Goal 9, Economic Development. This exemption applies to sites as defined in Title 33, Planning & Zoning, not rights-of-way.

## Appendix A: Code and Commentary

**11.50.040 Tree Preservation Standards.**

(Amended by Ordinance Nos. 187675, 188278, 188816, 188959, 189078 and 189795, effective December 12, 2019.)

**A. Where these regulations apply.**

1. This Section applies to trees within the City of Portland and trees on sites within the County Urban Pocket Areas in the following situations. On sites where these regulations do not apply, tree removal is subject to the requirements of Chapter 11.40, Tree Permit Requirements.
  - a. On sites. Development activities with any ground disturbance or a construction staging area greater than 100 square feet on unpaved portions of the site within the root protection zone, as defined in Subsection 11.60.030 C.1.a., of one or more Private Trees 12 or more inches in diameter and/or one or more City Trees 6 or more inches in diameter.
  - b. In streets. Development activities with ground disturbance or construction staging not limited to existing paved surfaces where there are one or more Street Trees 3 or more inches in diameter.
2. Any Heritage Trees and trees required to be preserved through a land use condition of approval or tree preservation plan cannot be removed using the provisions in this Chapter, but may be counted toward the tree preservation requirements of this Section.

**B. Exemptions. The following are exempt from the tree preservation standards of this Section:**

1. On portions of sites located within an IH, IG1, ~~EX~~, or ~~CX~~ zone.
2. On sites that are less than 5,000 square feet in area.
3. On sites that have existing or proposed building coverage of 85 percent or more.
4. Trees that are dead, dying, dangerous, or a nuisance species, as documented in a Tree Plan per Subsection 11.50.070 B. These are subtracted from the total number of trees to be addressed by the standards.
5. Trees exempted from this standard by a land use decision.
6. Tree preservation requirements approved in a land division or planned development review under Title 33, Planning and Zoning and the requirements of that review are still in effect.

## Appendix A: Code and Commentary

## Commentary

**11.50.040. Tree Preservation Standards****C. Tree Preservation Requirement**

No changes are proposed to the general retention and mitigation standard that 1/3 of the non-exempt trees 12 inches and larger in diameter located completely or partially on the development site must be preserved or a fee paid in lieu of preservation.

## Appendix A: Code and Commentary

7. Repair and replacement of existing fences and decks that are not changing in footprint or length when no trees are to be removed as a part of the project.
- C. **Tree Preservation Requirement.** Any trees preserved shall be protected in accordance with the specifications in Section 11.60.030. The regulations for Private Trees in Subsection 11.50.040 C.1. sunset after December 31, 2024. After December 31, 2024 the regulations in effect will be those in effect on January 1, 2015.
1. **Private Trees.**
    - a. **General tree preservation.**
      - (1) **Retention.** An applicant shall preserve and protect at least 1/3 of the non-exempt trees 12 inches and larger in diameter located completely or partially on the development site, unless mitigation occurs per Subsection 11.50.040 C.1.a.(2) below. Retaining trees at least 6 and less than 12 inches in diameter that are documented in a report prepared by an arborist or landscape professional to be Garry Oak (*Quercus garryana*), Pacific Madrone (*Arbutus menziesii*), Pacific Yew (*Taxus brevifolia*), Ponderosa Pine (*Pinus ponderosa*), or Western Flowering Dogwood (*Cornus nuttallii*) species are not included in the total count of trees on the site but may be used toward meeting the preservation standard.
      - (2) **Mitigation.** For each tree not preserved and protected below the 1/3 requirement, payment to the Tree Planting and Preservation Fund is required as shown in Table 50-1. The fee is calculated using the per-inch Restoration Fee for Tree Removal in the adopted fee schedule for Title 11. In cases where more than one tree is proposed for removal in excess of that allowed by Subsection 11.50.040 C.1.a.(1), the mitigation payment required to meet the 1/3 retention standard is based on the largest tree or trees proposed for removal.

## Appendix A: Code and Commentary

## Commentary

**11.50.040. Tree Preservation Standards (Cont'd)****C. Tree Preservation Requirement (Cont'd)**

**Table 50-1** is proposed to eliminate the mitigation cost category for 20-36" trees, and to change the cost category for 36" trees or greater to begin at 20" trees or greater. This change means that trees 20" or greater must pay a mitigation fee in lieu of preservation at a rate equal to the cost per inch of tree removed, or "inch-per-inch" fee in lieu.

**11.50.040.C.1.b** is proposed to change the threshold for required preservation or mitigation fee in lieu of preservation from 36" or greater to 20" or greater. This means that all non-exempt trees 20" or greater must be preserved or a fee in lieu of preservation paid; regardless if the 1/3 preservation standard of 11.50.040.1(a)(1) is already met with the preservation or fee in lieu of preservation. However, trees greater than 20" may be used to meet the 1/3 preservation standard.

**11.50.040.C.1.b(2)** changes the name of the Planting and Establishment Fee in Lieu for development to be consistent with the name of the fee as shown on the adopted Urban Forestry Fee Schedule, which was changed since the writing of this code.

**11.50.040.C.1.c** changes the number and title of this sub-paragraph to be clear that the notice requirement continues to apply to trees that are not preserved that are 36" or greater.

## Appendix A: Code and Commentary

**Table 50-1  
Required Mitigation**

Size of Tree Removed (inches in diameter)	Required Mitigation
At least 12 and less than 20	The cost of (2) two-inch diameter replacement trees
<del>At least 20 and less than 36</del>	<del>The cost of (4) two-inch diameter replacement trees</del>
At least <del>20</del> 36 or more	The cost per inch of tree removed

- b. Preservation of trees 2036 inches or greater.
- (1) Retention. An applicant shall preserve and protect all non-exempt trees 2036 inches in diameter or greater located completely or partially on the development site, unless mitigation and notice occurs per Subsections 11.50.040 C.1.b.(2) and 11.50.040 C.1.b.(3), below. Retention or mitigation of these trees may also be used to meet the standards for general tree preservation in Subsection 11.50.040 C.1.a. above.
  - (2) Mitigation. For each tree 2036 or more inches in diameter not preserved and protected, payment to the Tree Planting and Preservation Fund is required as shown in Table 50-1. The fee is calculated using the per-inch ~~Restoration Fee for Tree Removal~~ Planting and Establishment Fee in Lieu for development in the adopted fee schedule for Title 11.
- c.~~(3)~~ Notice for trees 36 inches or greater not preserved and protected. If a tree 36 inches or greater in diameter is not preserved and protected as allowed by Subsection 11.50.040 C.1.b.(2) above, the property owner or the property owner's representative must post a notice on the site and send a notice to the recognized Neighborhood Association and District Coalition in which the site is located. The notices are for notification purposes only. The notices do not provide for public comment on the proposal or for appeal of the proposal. The property owner or the property owner's representative must provide a signed certification to the Bureau of Development Services that a notice was posted on the site and a notice was sent to the Neighborhood Association and District Coalition. The development permit may not be issued until the business day following the day the notification period is completed.



## Appendix A: Code and Commentary

## Commentary

**11.50.040. Tree Preservation Standards (Cont'd)**

## C. Tree Preservation Requirement (Cont'd)

**11.50.040.C.1.c** **11.50.040.C.1.d** and **11.50.040.C.1.e** are renumbered and a reference changed due to renumbering.

## Appendix A: Code and Commentary

- (1)(a)** The posted notice must:
- (a)(i)** Be posted on the site for at least 45 calendar days prior to development permit issuance;
  - (b)(ii)** Be posted within 10 feet of the street lot line nearest the tree or trees to be removed;
  - (c)(iii)** Include the date of posting and the date of the end of the notification period;
  - (d)(iv)** Include a site plan at least 8.5 x 11 inches in size showing the location and description of the trees(s) to be removed including diameter inch size(s); and
  - (e)(v)** Include contact information for the property owner or the property owner's representative.
- (2)(b)** The notices to the Neighborhood Association and District Coalition must:
- (a)(i)** Be e-mailed or mailed to the Neighborhood Association and District Coalition using the contact information maintained by the Office of Community & Civic Life. If mailed, the notice must be sent via certified or registered mail. The date of the e-mail or the mailing must be at least 45 calendar days prior to development permit issuance;
  - (b)(ii)** Include a description of the trees(s) to be removed including diameter inch size(s); and
  - (c)(iii)** Include contact information for the property owner or the property owner's representative.
- d.(4)** Exemption of tree preservation mitigation payments for affordable housing developments. Projects are exempt from the mitigation requirements in Subsection 11.50.040 C.1.b.(2) if the development will be an affordable housing development approved for system development charge exemptions under Section 30.01.095. The amount of the mitigation exemption shall be pro-rated to a percentage equal to the percentage of dwelling units on the development site that are approved for the systems development charge exemption in Section 30.01.095. The Director of the Portland Housing Bureau may adopt administrative rules for the administration of Subsection 11.50.040 C.1.~~d.b.(4)~~.

## Appendix A: Code and Commentary

## Commentary

**11.50.040. Tree Preservation Standards (Cont'd)**

## C. Tree Preservation Requirement (Cont'd)

**11.50.040.C.1.c** **11.50.040.C.1.d** and **11.50.040.C.1.e** are renumbered and a reference changed due to renumbering.

## Appendix A: Code and Commentary

~~e.e.~~ Exception for Capital Improvement Projects. Trees on private property that are part of a capital improvement project and within the development impact area are regulated as City and Street Trees.

2. City and Street Trees.

a. Retention. For development on City owned or managed sites, new public streets, or improvements to existing streets, applicants are required to consult with the City Forester at the preliminary project design phase if City or Street Tree removal is likely to occur to complete the project. The purpose of this consultation is to identify potential impacts and opportunities to retain existing trees, as well as any measures required to protect trees on site, on adjacent sites, or in the street.

b. Mitigation. Any required mitigation specified below shall occur on the site, in the street planter strip, or in the same watershed either by planting or a payment into the Tree Planting and Preservation Fund. The City Forester may reduce or waive the following mitigation requirements.

(1) Approved Street Tree removal in conjunction with improvements to partially or fully unimproved streets. Each tree at least 12 inches in diameter that is allowed to be removed shall be replaced with at least one tree. Trees planted to meet Street Tree Planting Standards will be credited toward meeting this requirement.

(2) Any other Street or City Tree allowed to be removed that is 6 or more inches in diameter shall be replaced with at least one tree in addition to trees required to meet required tree density or Street Tree planting standards.

**11.50.050 On-Site Tree Density Standards.**

(Amended by Ordinance Nos. 187675, 188278 and 188959, effective May 24, 2018.)

A. Where these Regulations Apply. This Section applies to sites within the City of Portland and the County Urban Pocket Areas. Unless exempted in Subsection 11.50.050 B., the following are subject to the On-Site Tree Density Standards:

1. New Development;

2. Exterior alterations to existing development with a project valuation that is more than the threshold stated in Subsection 33.258.070 D.2.a.

## Appendix A: Code and Commentary

## Commentary

**11.50.050 On-Site Tree Density Standards****B. Exemptions**

Exemption B.1.c shows the removal of the exemption for on-site tree density standards for IG1, EX, and CX zones. The exemption from on-site tree density standards is retained in the IH zone to maintain adequate supply for industrial jobs in the IH zone as required by Statewide Planning Goal 9, Economic Development. This exemption applies to sites as defined in Title 33, Planning & Zoning, not rights-of-way.

## Appendix A: Code and Commentary

**B. Exemptions.**

1. The following development activities are exempt from the on-site tree density standards:
  - a. A specific condition of land use review approval exempts the site from these density standards;
  - b. The site is within the Portland International Airport Plan District or Cascade Station/Portland International Center Plan District and is subject to the Airport Landscape Standards; see Title 33, Planning and Zoning.
  - c. On portions of sites located within an IH, IG1, ~~EX~~, or ~~CX~~ zone.
  - d. Work conducted under Demolition, Site Development, Septic, Plumbing or Zoning Permits.
  
2. Sites with the following primary uses are exempt from the on-site tree density standards:
  - a. Railroad Yards;
  - b. Waste Related;
  - c. Agriculture;
  - d. Aviation and Surface Passenger Terminals;
  - e. Detention Facilities;
  - f. Mining;
  - g. Radio Frequency Transmission Facilities; or
  - h. Rail Lines and Utility Corridors;

- C. New development shall meet City specifications and standards in Chapter 11.60 and the on-site tree density requirements in Subsection D., below. Exterior alterations shall meet City specifications and standards in Chapter 11.60 and the on-site tree density requirements in Subsection D., below, but are only required to spend 10 percent of project value on the requirements in Subsection D. and the nonconforming upgrades required by Chapter 33.258, Nonconforming Situations.

## Appendix A: Code and Commentary

## Commentary

**11.50.050.D On-Site Tree Density Requirements**

There are no changes proposed to tree density standards. They are shown for reference.

## Appendix A: Code and Commentary

**D. On-Site Tree Density Requirements.**

1. **Required Tree Area.** The required tree area is based on the size of the site and the type and size of proposed and existing development as shown in Table 50-2. Applicants may choose Option A or Option B for calculating required tree area except only Option A may be used to apply standards to a "Development Impact Area".

**Table 50-2  
Determining Required Tree Area**

<b>Development Type</b>	<b>Option A</b>	<b>Option B</b>
One and Two Family Residential	40 percent of site or development impact area	Site area minus building coverage of existing and proposed development
Multi Dwelling Residential	20 percent of site or development impact area	
Commercial/Office/Retail/Mixed Use	15 percent of site or development impact area	
Industrial	10 percent of site or development impact area	
Institutional	25 percent of site or development impact area	
Other	25 percent of site or development impact area	



## Appendix A: Code and Commentary

## Commentary

**11.50.050.D On-Site Tree Density Requirements (Cont'd)**

There are no changes proposed to tree density standards. They are shown for reference.

## Appendix A: Code and Commentary

2. **Required Tree Density.** The required tree area shall be planted with some combination of large, medium or small canopy trees at the following rates:

**Table 50-3  
Number of Required Trees and Minimum Planting Area**

Canopy size category (at maturity)	Number of trees required per size of tree area	Min. required planting area per tree (min. dimension)
Large	1 per 1,000 s.f.	150 s.f. (10' x 10')
Medium	1 per 500 s.f.	75 s.f. (5' x 5')
Small	1 per 300 s.f.	50 s.f. (3' x 3')

Refer to Chapter 11.60, Technical Specifications, to calculate tree canopy size categories. When the canopy size category of the tree species is not or cannot be determined, the tree will be considered a small canopy tree.

3. **Tree Density Credits**
- a. Trees planted on site to meet any required stormwater or other landscaping requirement may be counted toward the On-site tree density requirements.
  - b. Trees that are retained and protected, including trees preserved per Section 11.50.040, may be credited as follows:
    - (1) Trees between 1.5 and less than 6 inches in diameter count as one small canopy size tree.
    - (2) Trees 6 or more inches in diameter count as one medium canopy size tree for each full increment of 6 diameter inches.
  - c. **Payment in lieu of planting.** The applicant may pay a fee to the Tree Planting and Preservation Fund per Section 11.15.010 equivalent to the cost of planting and establishing one 1.5-inch caliper tree. The fee per tree shall be credited at a rate of one medium canopy size tree.
  - d. On sites less than or equal to 3,000 square feet, healthy non-nuisance species trees planted or retained in the street planting strip may be credited as described in this Subsection.

## Appendix A: Code and Commentary

## Commentary

**11.50.060-11.50.095**

No changes to the remaining sections in chapter 11.50 are proposed. The titles of the sections are provided for reference.

## Appendix A: Code and Commentary

- 11.50.060 Street Tree Planting Standards.**  
[No change]
- 11.50.070 Tree Plan Submittal Requirements.**  
[No change]
- 11.50.080 Changes to Approved Tree Plans and Emergency Tree Removal.**  
[No change]
- 11.50.090 Administrative Review.**  
[No change]
- 11.50.095 Appeals.**  
[No change]

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PP&R 2017b. Street Tree Inventory Report

<https://www.portlandoregon.gov/parks/article/638773>

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## Appendix C: Summary of Community Interviews

### Portland Title 11, Trees – Code Amendments **Stakeholder Interviews**

#### Highlights

#### Updating Portland's Tree Code

The City of Portland is shaping proposals to strengthen tree preservation during development. Three City bureaus – Development Services, Planning & Sustainability, and Parks & Recreation – are seeking community input on upcoming proposals. The City will be conducting surveys and holding educational meetings to share analysis and research on this topic, and inviting views of community members.

It is widely recognized urban trees make vital contributions to the environment and human health, while lessening the adverse effects of climate change. In 2011, Portland adopted its first unified Tree Code to regulate tree preservation, removal, planting and pruning. The current Tree Code took effect in 2015.

In 2019, public concern about the removal of large trees led to recommendations by the Planning and Sustainability Commission and the Urban Forestry Commission to further strengthen regulations by removing the exemptions for tree preservation and planning for private trees or trees on City-owned or managed sites in some industrial, commercial, and employment zones. The Urban Forestry Commission also recommended decreasing required preservation and “inch-per-inch” fee-in-lieu tree diameter threshold from 36 inches to 20 inches for private trees.

City Council responded by directing the bureaus to consult with stakeholders and develop options for addressing these recommendations. The City is also developing a scope of work for more comprehensive updates to further strengthen Portland's Tree Code. Stakeholders will be invited to weigh-in on what topics should be considered.

#### Stakeholder Interviews

As an early step in stakeholder outreach, the City's consultants – Barney & Worth, Inc. – interviewed a cross-section of 27 interested stakeholders: tree and wildlife advocates, development community, potentially affected property owners, neighborhood associations, equity groups, members of City Commissions and advisory groups, and representatives of City bureaus involved in Tree Code issues. Interviews were conducted in-person and by telephone with persons who are involved or have an interest in decisions surrounding tree preservation. Some participants took part in the previous policy discussions on Tree Code amendments. Interviewees were asked to share their perspectives related to Portland's trees and the proposed amendments, along with their vision and suggestions for the future.

This report reflects the advice, feelings and attitudes of the individuals interviewed. It is not intended to provide a scientifically valid profile of community opinion as a whole.

## Appendix C: Summary of Community Interviews

### Highlights

The following highlights summarize the leading points offered by stakeholders who were interviewed for the update of the Portland Title 11, Trees – Code Amendments.

- a. **Trees are valued by Portlanders for their contributions to livability, beauty and “sense of place”.** Their role in air and water quality, cooling effects, climate change mitigation and other health and environmental benefits is well understood. Trees are viewed as deserving and needing protection.
- b. **It is broadly recognized that trees are not evenly or equitably distributed throughout the City.** Some neighborhoods enjoy dense canopies of mature trees and shaded streets, while other, primarily low-income communities are “tree deficient”. Research has identified “heat islands” associated with lack of trees, resulting in higher summer temperatures and adverse health effects on residents of these communities.
- c. **There is widespread agreement the current Tree Code is not working well.** While Portland is seen as a “well-treed city” compared with other parts of the country, almost everyone agrees the Code is overly complex, difficult to understand and enforce, inadequately funded and staffed, inequitable, and plagued by inconsistency and conflicting requirements.
- d. **Portland’s Tree Code conflicts with other City codes and policies.** Title 11 and Chapter 33 seem uncoordinated and unnecessarily duplicative, while other City rules and requirements are contradicted by the Tree Code. As a result, there are structural conflicts among City Bureaus on tree protections, with permit applicants forced to navigate these stormy waters or choose which rules to follow.
- e. **The Tree Code fails to clarify “what we want to protect.”** Lack of clarity about tree protection goals feeds contrasting views on whether all properties should be treated the same, or whether better results would be achieved by site-specific assessments. Some observers feel Portland’s trees are “generally fine” and see the Code as overly restrictive, while others think the current tree canopy is “woefully inadequate”
- f. **Stakeholders are left guessing about how mitigation funds are used.** While many are aware of the fee-in-lieu mitigation option and can calculate the fee per tree removed, few have any idea how the monies are invested. Many express hope the funds are used to plant trees in low-income communities where they are lacking.
- g. **Participants have sharply contrasting views on the proposed removal of some industrial and commercial lands from tree preservation and planting requirements.** Some see removing the exemption as an important step toward treating all properties fairly and for creating/protecting

## Appendix C: Summary of Community Interviews

canopy in adjacent low-income neighborhoods. Others believe the rules should prioritize development and use of industrial/commercial sites to promote jobs and economic opportunity.

- h. Perspectives differ significantly on the proposed reduction of the threshold for the inch-per-inch mitigation fee from 36" to 20" diameter.** Opinions range from a conviction that preserving smaller diameter trees will hasten progress toward meeting canopy goals, to a belief that the size threshold is arbitrary, inequitable and would create perverse effects.
- i. Most stakeholders acknowledge increased urban density, affordable housing and tree preservation are competing goals and that more work/creative thinking is needed to address this problem.**
- j. There is strong support for a comprehensive update of the Portland Tree Code, and participants suggest a rich treasure of topics to be addressed.** Some recommend the comprehensive review take place *before* any specific amendments are considered; otherwise, we "have it backwards".

## Appendix C: Summary of Community Interviews

Proposed topics are shown below.

### Suggested Topics for Upcoming Tree Code Update

#### **Streamline Process**

- Reduce complexity; simplify
- Align conflicting rules (Title 11 and Chapter 33; tree related requirements of other Bureaus)

#### **Improve Results**

- Clarify tree protection goals, addressing criteria in addition to tree size
- Analyze best practices in other cities
- Allow for site flexibility
- Offer incentives: "Use more carrots than sticks! Don't make it hard to do the right thing."
- Make cost part of decision-making, especially for small scale urban-infill projects
- Develop appeals process for specific situations based on equitable criteria
- Ensure adequate resources for implementation
- Provide assistance to low-income communities for tree planting/nurture

#### **Plan for the Future**

- Develop landscape level "green infrastructure plan" focused on trees that sets goals; where trees should be planted; the desired future canopy; diverse tree species and age classes; and climate change resilience.
- Make trees a primary strategy for addressing climate change in Portland.

A list of the persons interviewed and discussion questions are attached.

## Appendix C: Summary of Community Interviews

## Portland Title 11, Trees – Code Amendments

Jeff Bachrach	Bachrach Law, Planning & Sustainability Commission, Development Review Advisory Committee (DRAC)
Tom Bouillion & Matt Paroulek	Port of Portland
Corky Collier	Columbia Corridor Association
Susan Ellis & Tyler Mann	Bureau of Development Services
Rick Faber	Portland Parks & Recreation – Urban Forestry
Leah Fisher	Southeast Uplift
Andrew Gallahan	Portland Parks & Recreation – Urban Forestry
Ezra Hammer	Home Builders Association
Morgan Holen	Consulting Arborist
Jon Issacs	Portland Business Alliance
Maryhelen Kincaid	Former Chair – DRAC
Ted Labbe	Urban Greenspaces Institute
Oriana Magnera	Verde, Planning & Sustainability Commission
Catherine Mushel	Trees for Life
Linda Nettekoven	Hosford-Abernathy Neighborhood Association
Wendy Rahm	Downtown Neighborhood Association
Bob Sallinger & Micah Meskel	Portland Audubon Society
Michelle Schulz	BOMA
Suzannah Stanley	NAIOP
Ginny Stern & Peter Sallinger	Portland Youth Climate Council
Megan Van de Mark	Urban Forestry Commission
Ellen Wax	Working Waterfront Coalition
Justin Wood	Fish Construction NW, DRAC

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Portland Title 11, Trees – Code Amendments  
Stakeholder Interviews

Name: \_\_\_\_\_ Phone: \_\_\_\_\_

Organization: \_\_\_\_\_ Email: \_\_\_\_\_

DISCUSSION GUIDE

**Introduction**

The City of Portland is considering amendments to strengthen tree preservation under the City Code. City officials are interested in hearing the views of community leaders on possible changes to tree regulations.

- 1. How have you been involved with trees in the City of Portland or with Portland’s Tree Code? Did you participate in earlier policy discussions about possible changes to tree protections?

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- 2. What phrases come to mind that best characterize the City of Portland’s trees and the communities that reside here? What are the most important contributions trees make to our city and the communities that reside here?

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- 3. How do you compare current conditions for Portland’s trees with what you would like to see? Are there any barriers to achieving that vision?

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- 4. What’s your general outlook on the current tree protections in Portland’s City Code? Are they working well? What isn’t working? (Explain.)

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Appendix C: Summary of Community Interviews

Proposed Amendments

The areas being considered for changing Portland’s Tree Code include:

- Removing exemptions from tree preservation and planting requirements on private lands and city-owned parcels zoned for economic development, including specific commercial, industrial and employment zones.
- For private trees, reducing the tree size threshold for “inch-per inch” mitigation in lieu of preservation from 36 inches in diameter to 20 inches for trees subject to tree preservation requirements.

5. A. Are you familiar with the current tree preservation requirements and/or the proposed changes? Do you understand the purpose of the changes? Do you have any questions about the current rules or proposed changes?

Current rules: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

Proposed changes: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

B. Are you familiar with the mitigation fund and how those monies are allocated?  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

6. What is your outlook on the possible Code changes? What results do you expect?

Removing exemptions for tree protection and tree planting in some industrial and commercial zones:  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

Reducing the tree size threshold for inch-per-inch mitigation from 36” to 20” diameter:  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

## Appendix C: Summary of Community Interviews

7. What are the benefits and drawbacks of requiring tree preservation in industrial and commercial areas? Are there more effective ways to balance economic and environmental goals in changing the Tree Code?

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8. Do you have any thoughts on how housing could be affected, particularly by reducing the preservation threshold to 20", or how to balance tree protections with community housing needs?

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9. How could communities of color, marginalized or low income communities be affected by changes to the Tree Code?

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10. The City of Portland is also developing a scope of work for more comprehensive updates to further strengthen Portland's Tree Code. The scope will be presented to City Council later this year.

What additional topics would you like to see that comprehensive review consider?

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11. What things should the City Council consider in making decisions on additional tree protections? Are there any values that should guide their decisions?

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Appendix C: Summary of Community Interviews

Stakeholder Engagement

12. A. Are there any other people or organizations you would recommend we contact at this early stage to get their views on tree preservation in Portland’s Code?

Three horizontal lines for text entry.

B. What information will be of greatest interest to them? What would be of interest to you / your organization about tree protections and the proposed Portland Code amendments?

Three horizontal lines for text entry.

13. What is the best way for the City of Portland to get information to you as this issue moves ahead?

- Four checkbox options: Attend a meeting, Get information on the website: portlandoregon.gov/bds, Receive email updates, Other: \_\_\_\_\_

Wrap-up

14. Can you offer a single most important piece of advice for the City of Portland as it considers amendments to tree protections in the City Code?

Three horizontal lines for text entry.

15. Any further comments or suggestions?

Three horizontal lines for text entry.

## Appendix D: Summary of Community Survey

**Portland Title 11, Trees – Proposed Code Amendments****Online Survey – April/May 2020**HIGHLIGHTS Rev. 6/2/20

**Participation:** 2,064 completed surveys  
 1,277 written comments;  
 5:46 typical time to complete

**Survey Results*****Q#1 – Highest priorities for Code amendments (% very important/important)***

*There is near-consensus among survey respondents on priorities for Tree Code amendments.*

- 95% – Preserving and planting more trees in industrial areas in close proximity to the Willamette River, Columbia Slough, the Columbia River, or other environmentally sensitive natural areas.
- 92% – Preserving trees in certain industrial and commercial sites, when possible.
- 92% – Preserving and planting trees in industrial areas in close proximity to low-income communities and communities of color.
- 86% – Collecting fees paid into the tree planting and preservation fund when trees must be removed.
- 82% – Ensuring all industrial, commercial, and residential areas are subject to the same tree preservation requirements.

***Lower priorities***

- 29% – Minimizing the cost of developing industrial sites.
- 29% – Maximizing the amount of land available for industrial uses to accommodate middle-income job growth.

***Q#2 – Highest priorities for mitigation fee (% very important/important)***

*Likewise, there is strong agreement on objectives for the mitigation fee.*

- 91% – Improving environmental and health outcomes
- 87% – Preserving more trees when construction occurs on private property
- 78% – Increasing mitigation fees enabling more trees to be planted and preserved elsewhere
- 77% – Minimizing the cost of housing, including affordable housing

## Appendix D: Summary of Community Survey

**Lower priorities**

32% – Minimizing the cost of development

**Q#3 – How to improve tree preservation for private development**

*The leading strategies for improving tree preservation on private property include:*

83% – Better incentives

70% – More flexibility

64% – More community education: how to preserve trees, improve public health

55% – Higher mitigation fees

**Q#4 – Topics for future comprehensive update of Portland’s Tree Code**

*Around half of respondents suggest topics for a Tree Code update.*

**Common Themes**

*Recurrent themes are listed below.*

	<b>Total Mentions</b>
Preserve/preservation/replace/replacement/protect	253
Large tree/heritage tree/mature tree/old tree/big tree/native/native species	202
Code/rules/enforcement/fine/mitigation fee	175
Affordable/affordable housing/housing/low income	168
Tree canopy/canopy	126

## Appendix D: Summary of Community Survey

Climate change/carbon/light-heat-noise/pollution	98
Industry/industrial area/development	87
Incentives/incentivize/subsidize/waiver/tax breaks	67
Invasive species/invasive/ivy	40
Flexible/flexibility/option	40
Public education/education/educate/classes	38

**Suggestion Box**

A sampling of participants' suggestions, in their own words:

*"Plant fruit trees in areas where residents are economically poor so they can harvest fruit."*

*"Trees help people reduce their energy costs and medical costs."*

*"I would love if trees around Portland had their species labeled on them so that children, adults and families could learn about trees."*

*"Save heritage tree seed to replant."*

*"Removal with replacement of healthy trees should be considered."*

*"I really want to plant some evergreens, but all that's allowed is deciduous – useless as windbreaks."*

*"Affordable tree arborist help in lower income areas."*

*"Specific incentives to replace invasive tree species with better trees."*

*"Larger protection of native trees and more incentives on replanting native trees."*

*"It is critical that industrial landowners be required to protect the environment. Growing our urban forest is an essential part of our response to climate change."*

*"More emphasis on the tree canopy as habitat." "Preserving trees which are homes to animals." "Attention to wildlife corridors increasing green space."*

*"Increase fines for people who illegally remove trees."*

*"Reduce fees for removal of trees when necessary to remove a diseased tree."*

*"Consider offering trees and teams to plant them on private property for homes who want to increase tree canopy."*

*"We are in a drought and climate change, fewer and fewer replacement trees will survive."*

*"More trees more trees more trees."*

## Appendix D: Summary of Community Survey

**Q#5,6,7,8 – Participant Profile**

*Survey respondents are from all parts of the city, with proportionately greater representation from participants who are female, white and homeowners.*

*More than 40% of respondents identify with advocacy groups for environment/climate/trees/wildlife/community.*

**Geographic**

- Citywide representation: 30+ zip codes
- Many respondents (43%) live in close-in neighborhoods: SE, N/NE, NE and S/SW

**Demographic**

59%	female
89%	white (Portland average is 77%)
79%	homeowners (53%)
18%	rent (47%)
2%	own industrial or commercial property
2%	rent industrial or commercial property

**Affiliations**

90%	interested community member
53%	own/manage property
16%	environmental/climate advocacy group
14%	community-based organization
11%	tree/wildlife advocacy group
6%	government agency
4%	tree care/arborist
4%	business/industry group
3%	development/construction firm
11%	another affiliation

## Appendix E: Summary of Online Community Forum

Online Community Forum – July 14-August 3, 2020

HIGHLIGHTS

**Participation:** 591 completed surveys  
1,479 written comments on surveys  
22 comments/questions submitted by email  
2,176 participants (2,573 total visits)

**Survey Results:**

**Q#1 – Do you support the proposal to remove the exemption from tree preservation in CX and EX and IG1 zones?**

83% – Yes

16% – No

**Q#2 – Do you support the proposal to remove the exemption from tree density in the CX and EX and IG1 zones?**

83% – Yes

17% – No

**Q#3 – Do you support the proposal to retain the exemption from tree preservation in the IH zone?**

14% – Yes

85% – No

**Q#4 – Do you support the proposal to retain the exemption from tree density in the IH zone?**

14% – Yes

86% – No

**Q#5 – Do you support the proposal to reduce the tree diameter threshold from 36" to 20" for private trees wherever tree preservation is required?**

81% – Yes

18% – No

## Appendix E: Summary of Online Community Forum

### Representative Comments:

Trees are a precious resource; tree canopy should expand citywide; we need more trees

Trees help in climate crisis: reduce temperature, improve air quality

Industrial lands are often located in environmentally sensitive areas

Too many trees are removed without replacements

Hold industrial landowners accountable for protecting trees

Heavy industry is the biggest air polluter

All zones should do their part in protecting trees

Preserving smaller trees will lead to larger ones

In the City, 20" is a large-ish tree – or – this is a small tree

Exemptions should be considered from tree size threshold

Concerned about removing diseased/damaged trees

This is a shameless money grab

Homeowners should be able to remove trees

Appendix F: SWCA Tree Canopy Analysis





# City of Portland Tree Canopy Analysis Final Report

## Estimates of Tree Canopy Characteristics Through GIS Object Based Image Analysis

JUNE 2020

PREPARED FOR

**City of Portland:**  
**Bureau of Planning and Sustainability**  
**Bureau of Environmental Services**

PREPARED BY

**SWCA Environmental Consultants**

**CITY OF PORTLAND TREE CANOPY  
ANALYSIS FINAL REPORT**

**ESTIMATES OF TREE CANOPY  
CHARACTERISTICS THROUGH GIS  
OBJECT BASED IMAGE ANALYSIS**

Prepared for

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SWCA Project No. 56879.03

June 2020

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City of Portland Tree Canopy Analysis Final Report  
Estimates of Tree Canopy Characteristics Through GIS Object Based Image Analysis

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## INTRODUCTION

This report was produced for the City of Portland Tree Canopy Analysis Project. The goal of the project is to develop an estimate of tree canopy characteristics for lands classified as Industrial and Commercial (IG1, IG2, IH, and EG2 specifically) by analyzing geographic information systems (GIS) data using object-based image analysis (OBIA) techniques and regression analysis to develop equations for estimating allometric measurements, specifically dividing individual tree crowns (ITCs) into four diameter at breast height (DBH) categories (less than 20 inches, 20 to 27.9 inches, 28 to 35.9 inches, and 36 inches or greater).

## Steps in the GIS Analysis

To model ITCs and general structure, two publicly available datasets were used, both obtained from the Regional Land Information Survey (RLIS) and developed by Metro: 1) a 3-foot resolution canopy height surface model (CHM) using 2014 LiDAR and normalized difference vegetation index (NDVI) data derived from four-band imagery and 2) a 3-foot resolution, classification model, delineating the CHM into coniferous and deciduous phyla. A segmentation routine was applied to the CHM (outlined below in *Methodology*) to define the general shape and area of ITCs and derive their height as well as assign a coniferous or deciduous classification based on its intersection with the coniferous-deciduous data layer.

To derive DBH from estimated crown widths, City of Portland Park Tree Inventory data were used in a regression analysis to develop equations of best fit by general structure, one set for coniferous trees and another for deciduous. These equations were applied to ITCs and these predicted DBH values were plotted versus the measured DBH values in an independent dataset—the City of Portland street tree inventory.

Based on the number of modeled ITCs within the study area, site visits were conducted on six public and two Port of Portland properties, wherein all tree within a 150-foot-diameter plot were catalogued and geolocated. For each tree of greater than 12 inches DBH the height, crown width, DBH, species, and general condition (living, dead, or stressed) were assessed and recorded. These tree measurements were used to further assess the performance of the modelled results, attempting to capture locations with growing conditions different from the sort encountered in the park and street tree inventories, i.e., dense copses or stands and/or trees in natural or semi-natural conditions in contrast to the groomed and regulated planting conditions of the trees within the tree inventories.

The reader is cautioned that differences between modelled outputs and observed measurements are inevitable. There are a variety of sources of error and discrepancy inherent to remotely sensed data, these limitations include, but are not limited to seasonal and/or yearly variability for acquisition times of the various data products, resolution limitations in the CHM, possible classification errors in the coniferous-deciduous data layer, temporal variability of park and street tree inventory data, and the limitations of image segmentation, which creates hard breaks between objects—in this case trees—which may not accurately model the landscape, particularly in areas with dense stands of trees with heavily overlapped tree crowns. A fuller analysis and quantification of the uncertainty and errors in the model outputs is detailed in the *Model Validation and Performance* and *Findings* sections of the report below.

## METHODOLOGY

The approach used to estimate DBH uses an OBIA that in turn uses two primary processes. The first component is segmentation, wherein GIS processes are used to group like pixels together into a single shape or object. In this analysis the peak within groups of raster cells in the high-resolution, LiDAR-derived, CHM are identified and a variable width analysis window around this modelled treetop groups cells into a modelled tree crown as using a function of the relationship between tree height and crown width in observed allometric data (derived in this case from a regression analysis of City of Portland Park Tree inventory crown height and crown width measurements). The second component of the OBIA is classification of these segments into two categories, by phyla. The Coniferous-Deciduous canopy model developed by Metro from LiDAR and NDVI data is intersected with the segmentation output, and the final output contains attributes for crown width, crown area, crown height, and classification by general structure as either deciduous or coniferous.

The second phase of the analysis involves using the modelled outputs created in the OBIA and using it to estimate the DBH value for each individual tree crown. To generate the equations needed to derive these estimates, the preponderance of forestry research has determined that the strongest allometric relationship for DBH is with a tree's crown width. U.S. Forest Service researchers developed the Urban Tree Database and Allometric Equations general technical report (McPherson et al. 2016), which provides equations for estimating a variety of measurements so long as the species is known. An attempt to classify trees by species proved to be untenable, given the scope and lack of available high-resolution hyperspectral or multispectral imagery for this project, therefore it was necessary to develop other means of estimating DBH from available data. City of Portland Park Tree Inventory data were binned into coniferous and deciduous data subsets and regression analyses were applied to these subsets to generate equations of best fit (a linear and power function).

The last phase of the analysis is an assessment of the performance of the model's predicted number of ITCs and DBH values. Each model result is compared with independent datasets not used in the development of the model, Portland Street Tree Inventory data, and tree measurement data collected during fieldwork. These point-based data layers are intersected with the tree segments to evaluate the accuracy of the count of observed versus modelled trees and measured DBH values are plotted versus predicted DBH values in a regression analysis to assess the amount of variance explained by the model.

## Research and Technical Approach

A review of the forestry and remote sensing professional journal articles and academic literature, regarding the use of GIS data to model ITCs and tree canopy characteristics, provides a variety of approaches. For this analysis a process for identifying treetops and tree crowns was used, based on a marker-controlled segmentation algorithm to define tree crowns (Beucher and Meyer 1993), wherein a 3-foot resolution, LiDAR-derived CHM with a variable window filter (Popescu and Wynne 2004) that progressively scans through the CHM raster, grouping contiguous cells that form an inverted sink into a single vector polygon object.

The object-based model approach in this analysis uses a LiDAR-derived CHM developed by Metro from 2014 LiDAR point cloud data (Appendix A) and NDVI data and was analyzed with the ForestTools 0.2.0 package for R statistical computing software Version 3.6.3 (via a script and bridge plugin inside ArcGIS Pro 2.5). The ForestTools package offers functions for detecting treetops and outlining tree crowns based on local maxima and a variable window filter to search a neighborhood of cells around a cell with the highest hit. The tool analyzes the raster and if a cell is found to be the highest value in the moving

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window it is tagged as the treetop and the size of the window varies as a function of height in the raster cells, operating under the assumption that taller trees have wider crowns.

## Data Parameterization and Processing

Preprocessing of data involved projecting all data into HARN State Plane Oregon North FIPS 3601 (Intl Feet) where needed and defining the analysis extent. IG1, IG2, IH, and EG2 zoning designations were extracted from the data provided by the City of Portland and merged into a single feature. This merged zoning layer was buffered to 500 feet (enlarged to this size to fully encompass park and street tree inventory data for model calibration and validation) and broken into seven subsections (along natural breaks in the CHM). Dividing the analysis area into manageable blocks of data was necessary because of memory limitations inherent in the R Statistical Software, ForestTools package. This enlarged analysis extent permits the CHM to entirely cover the Industrial (IG1, IG2, and IH) and Commercial (EG2) tax lots without the possibility of clipping tree segments that only partially intersect a given tax lot, i.e., eliminating edge effects or loss of data that can occur at the edge of raster datasets being evaluated with a focal window.

With uncertainty about the overall composition and distribution of tree species within the Industrial and EG2 tax lots, a parameter to define the *variable window filter* search radius in ForestTools was derived from an analysis of the totality of the Portland Park Trees Inventory (the most complete dataset available with full allometric measurements). Crown heights and crown widths were plotted on a scatterplot and a linear equation of best fit was generated from a trendline in Microsoft Excel. The resulting linear equation  $CR = 4.5 + 0.1754 * CH$  ( $R^2 = 0.2704$ ) is used to define the *variable window filter* parameter in the ForestTools script (where  $CR$  equals Crown Radius and  $CH$  equals Crown Height). This assumes a minimum 9-foot diameter crown width, corresponding to a  $3 \times 3$  grid of cells, the smallest area that can be defined as a tree with a definable peak. Other parameters defined for the ForestTools process were a minimum height of 15 feet for treetops (the minimum vertical values in the CHM are 10 feet—this minimum value was likely chosen by Metro to filter out scrub-shrub vegetation picked up in the LiDAR point cloud data).

ForestTools generates point and polygon output layers with fields for height (derived from the local maxima), “WinRadius” (the size of the search window used to evaluate the area around a cell identified as a treetop) and the polygon layer has an additional field, “CrownArea” (in square feet). In some areas this output requires some post-processing due to peculiarities unique to the CHM used in this analysis because its height value is stored in integer format; the issue is that adjacent pixels with identical values identified as treetops are erroneously identified as ITCs around each point. With a combination of buffering the treetop points to 3.1 feet (enough to touch) and dissolving on height, followed by a spatial join with the polygon segments, these segments are merged, eliminating errors of commission (over segmentation). This output is further refined by applying a union with the coniferous-deciduous layer obtained from Metro’s RLIS database. This raster dataset was converted to vector polygonal data and joined with the ForestTools segments with the ArcGIS *union* tool to categorize each segment as either coniferous or deciduous, an important discriminant for estimating DBH as a function of crown width because of general structural differences between conifers and deciduous trees.

Estimated crown diameter values are added to the tree crown segments, calculated as a circle of best fit, from the area of the segment (where  $CD$  equals crown diameter in feet and  $CA$  equals crown area in square feet) (Note: The value of  $\pi$  is rounded to 3.14159 for use in the field calculator in ArcGIS Pro 2.5):

$$(CD = 2 * \sqrt{\frac{CA}{\pi}})$$

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Research conducted by the U.S. Forest Service (McPherson et al. 2016) determined that the crown diameter has the highest correlation to DBH out of a variety of allometric measurements. Without species determinations to apply specialized allometric equations to individual tree crown segments, the City of Portland Park Trees inventory was used as a surrogate dataset to estimate DBH values using a regression analysis. A scatterplot and regression analysis of the entire dataset (25,534 trees) with crown diameter (feet) as the independent variable and DBH (inches) as the dependent variable yielded trendlines of best fit. A linear trendline equation and a power trendline were applied in effort to achieve the highest  $R^2$  correlation possible. Both regressions apply a line fitted to the scatterplot to minimize the amount of variance at any point on the between crown width (x-axis) and DBH (y-axis). The difference between the models is the linear trendline, which uses a linear equation to produce a simple straight line of best fit, and the power trendline uses an exponential function that produces a slightly curved line of best fit. *(Note: Park tree inventory data with null or 0 values for either DBH or crown width, and/or categorized as "dead" were omitted as data points in this analysis):*

- Linear equation:  $DBH = 1.3752 + 0.5463 * CD$  with an  $R^2 = 0.5614$
- Power equation  $DBH = 0.2527 * CD^{1.2075}$  with an  $R^2 = 0.7233$

When the data is divided into subsets, by general structure with needleleaf and broadleaf categories, higher degrees of correlation were achieved according to regression analyses, which can be visualized in Figures 1 and 2:

- **Needleleaf trees** (10,742 trees) using a linear equation of best fit  $DBH = 0.7595 * CD$  produced an  $R^2 = 0.9242$ . A power equation of best fit  $DBH = 0.3286 * CD^{1.2225}$  produced an  $R^2 = 0.7649$ .
- **Broadleaf trees** (14,792 trees) using a linear equation of best fit  $DBH = 0.4816 * CD$  produced an  $R^2 = 0.9272$ . A power equation of best fit  $DBH = 0.1802 * CD^{1.2397}$  produced an  $R^2 = 0.8411$ .



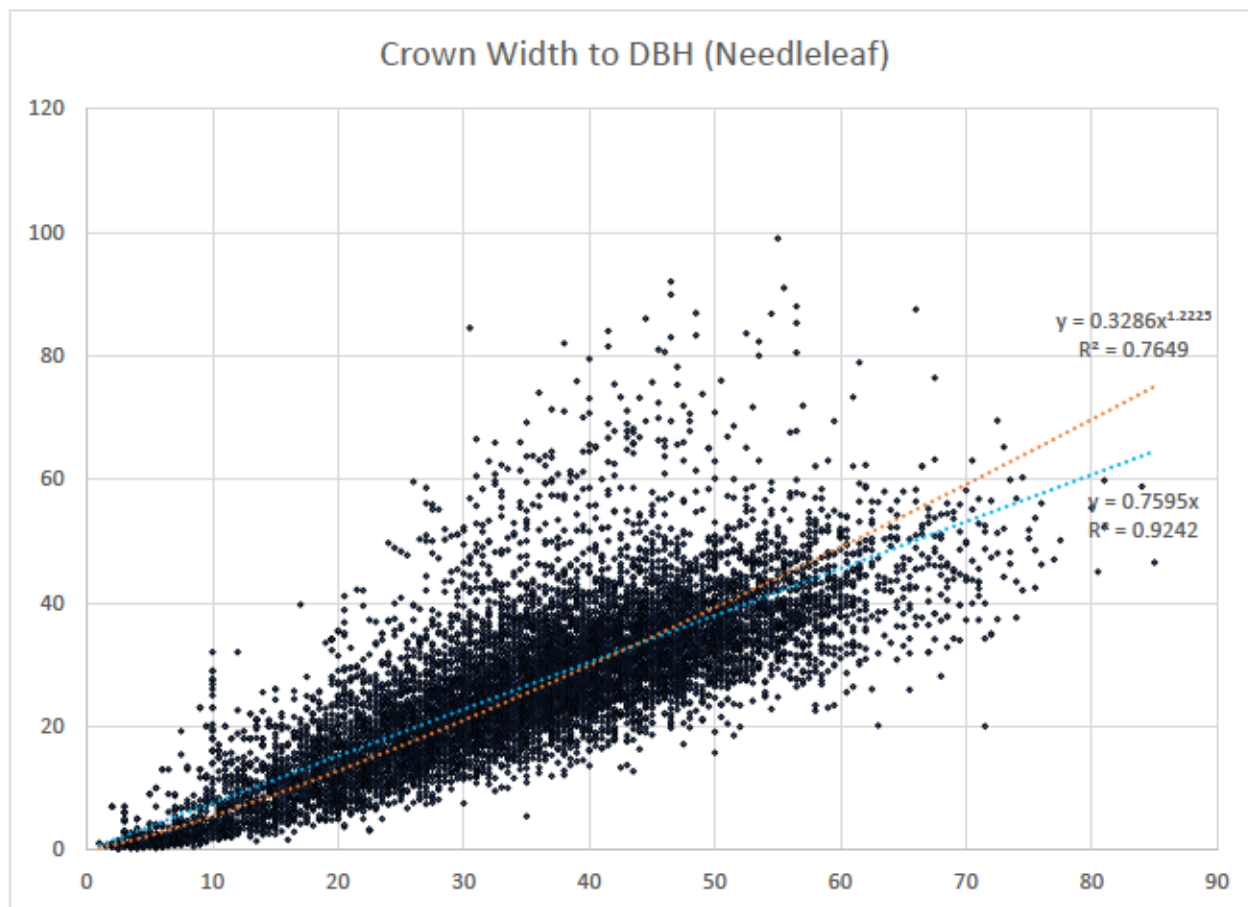
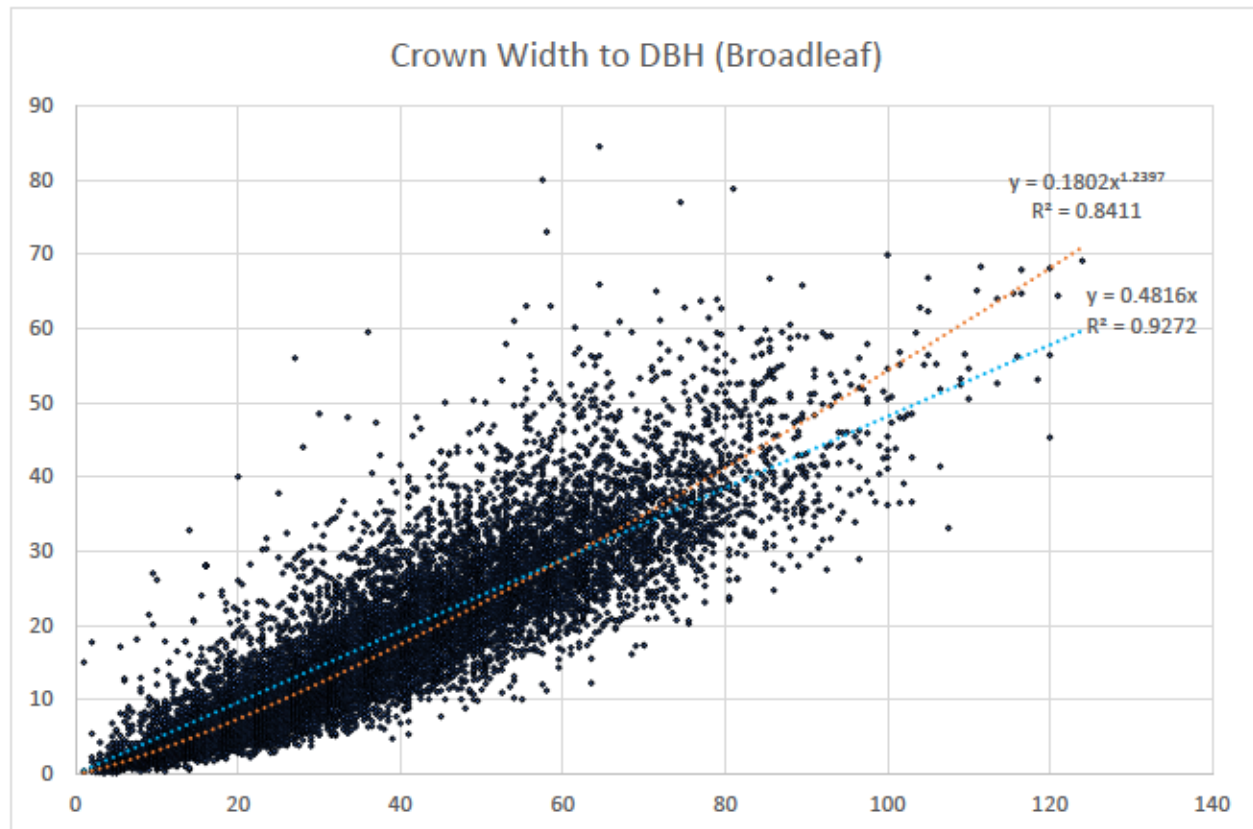


Figure 1. Needleleaf crown width to DBH regression equations.

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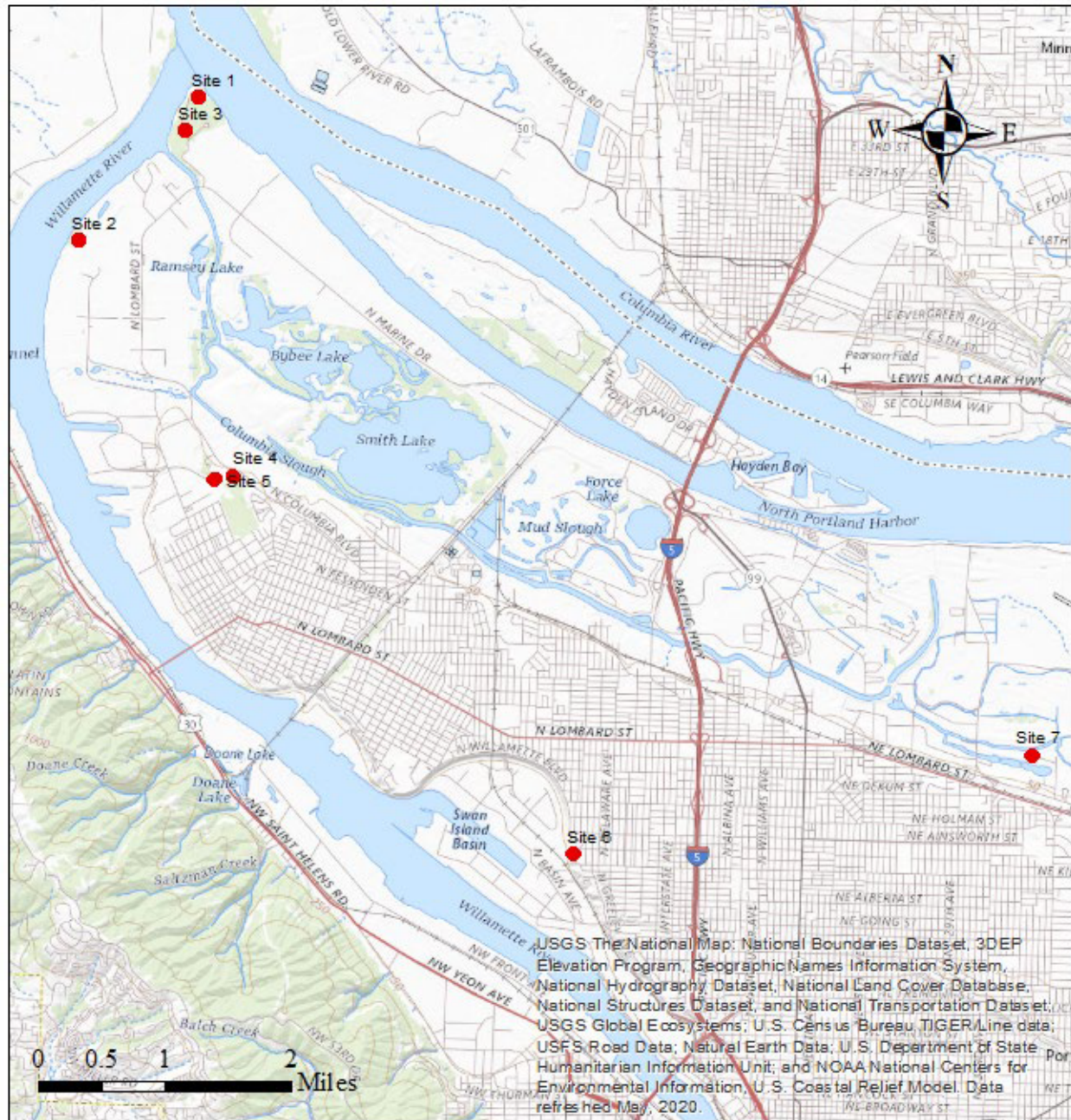
**Figure 2. Broadleaf crown width to DBH regression equations.**

As a result of these analyses, the tree segment DBH estimates are based on the needleleaf and broadleaf discriminant and includes a field for both equations of best fit, *DBH\_linear\_est* and *DBH\_power\_est*, as well as fields for corresponding residuals, *DBH\_linear\_res* and *DBH\_power\_res*, in cases where tree inventory point data intersect with individual tree segments. Data are subsequently categorized by DBH into the four size categories outlined in the delivery requirements (**Category 1** = less than 20 inches, **2** = 20–27.9 inches, **3** = 28–35.9 inches, and **4** = greater than or equal to 36 inches). Tree segments are subdivided into separate feature classes based on the intersection with IG1, IG2, IH, IR, and EG2 tax lots.

## Sampling Methodology

In order to achieve a minimum 95% confidence level and 10% confidence interval of sampled trees, it was determined that a minimum of 96 trees should be catalogued and measured (based on 57,544 ITCs that intersect the Industrial and EG2 tax lots). These sampled trees were assessed for height, DBH, condition, number of stems, and species. In total, 138 trees were measured in five publicly accessible sample plots and two sample plots on Port of Portland owned properties, constrained to locations that were accessible and/or immediately adjacent to the Industrial and EG2 tax lots within the study area (Figure 3). Sample plots were 150 feet in diameter and included a mix of dense stands of trees (>90% canopy coverage) and medium density stands (50%–90% canopy coverage).

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**Figure 3. Map of field sites.**

All trees within the sample plots with a greater than 12-inch DBH were geolocated and catalogued. A Geode submeter-accurate global positioning system (GPS) receiver, paired with an Android tablet running ESRI Collector for ArcGIS, was used to generate tree points (3-m minimum positional accuracy) and allometric measurements were recorded: height (with a clinometer and a 100-foot ground tape), crown width estimates (measured along the north-south and east-west axes), and DBH (with a Forestry Suppliers steel DBH tape). Additionally, condition and species were recorded (field photographs were taken of the bud, bark, and stem and of the whole tree where allowed).

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Site conditions were generally dense stands of trees with a large number of thorny vines and nuisance vegetation, as well as other obstacles complicating height measurements. Trees were in leaf-off condition, but buds were emergent on most trees sampled and posed no significant obstacle to species identification. Samples were acquired between March 2 and 13, 2020.

## Model Validation and Performance

The performance of the model was evaluated for accuracy and precision using several criteria. The first part of the accuracy assessment measured the ability of the segmentation algorithm to correctly identify the number of trees. The City of Portland Park Tree and Street Tree Inventories along with site sample data were used to evaluate errors of commission (over-segmenting ITCs) and omission (multiple tree inventory points intersecting a single ITC). The ability of the model to accurately predict the number of trees varied by location and stand characteristics. Comparing the park tree and street tree inventory tree points as well as the tree data collected during fieldwork with the marker-controlled segmentation algorithm resulted in an 82% accuracy rate for the count of ITCs. In total, 6,558 park and street tree inventory points were intersected by 5,380 ITCs, indicating that the segmentation tends to slightly aggregate and underestimate the total number of trees present in the study area. This underestimation illustrates the limitations of the CHM and how it only captures the highest hit minus the last hit of a LiDAR pulse during leaf-on conditions and cannot differentiate trees that are overtopped by dominant trees and tightly packed co-dominant trees. To the extent trees are widely spaced in the study area and distinct from one another, the model does a very good job of identifying and delineating them. In areas where trees stands are dense with complex multistory structures the model is less accurate. This observation is confirmed at least in part through samples collected during fieldwork, due in large part to the leaf-on acquisition date (flown in September 2014) of the LiDAR used to create the CHM. This was especially noticeable in stands of black cottonwood (*Populus trichocarpa*), which were 101 out of 138 collected samples. The stands in the Kelly Point Park and industrial areas near the Willamette River and Columbia River Slough demonstrated noticeable errors of omission in the tree segmentation routine. In the eight sample plots surveyed, the performance of the marker-controlled segmentation was only 65.3% accurate in identifying ITCs.

The segmentation routine's ability to estimate crown width was also analyzed. The residuals of measured crown widths to modelled crown widths yielded a mean of 2.0 feet, a median of 3.0 feet (positive values an indicate underestimation and negative values an overestimation), and standard deviation of 15.9 feet. In general, this means that the model tended to underestimate crown widths slightly on average, but 68.2% of all estimates are within approximately 16 feet of the mean. This variance is attributable in part to the hard breaks that the marker-controlled segmentation imposes on the objects derived from the CHM; any trees with overlapping crowns that cannot be distinguished and are assigned to one object or another yield underestimates and any trees overtopped by others or lumped together into a single object yield overestimates. The distribution of these residuals is visualized in Figure 4.

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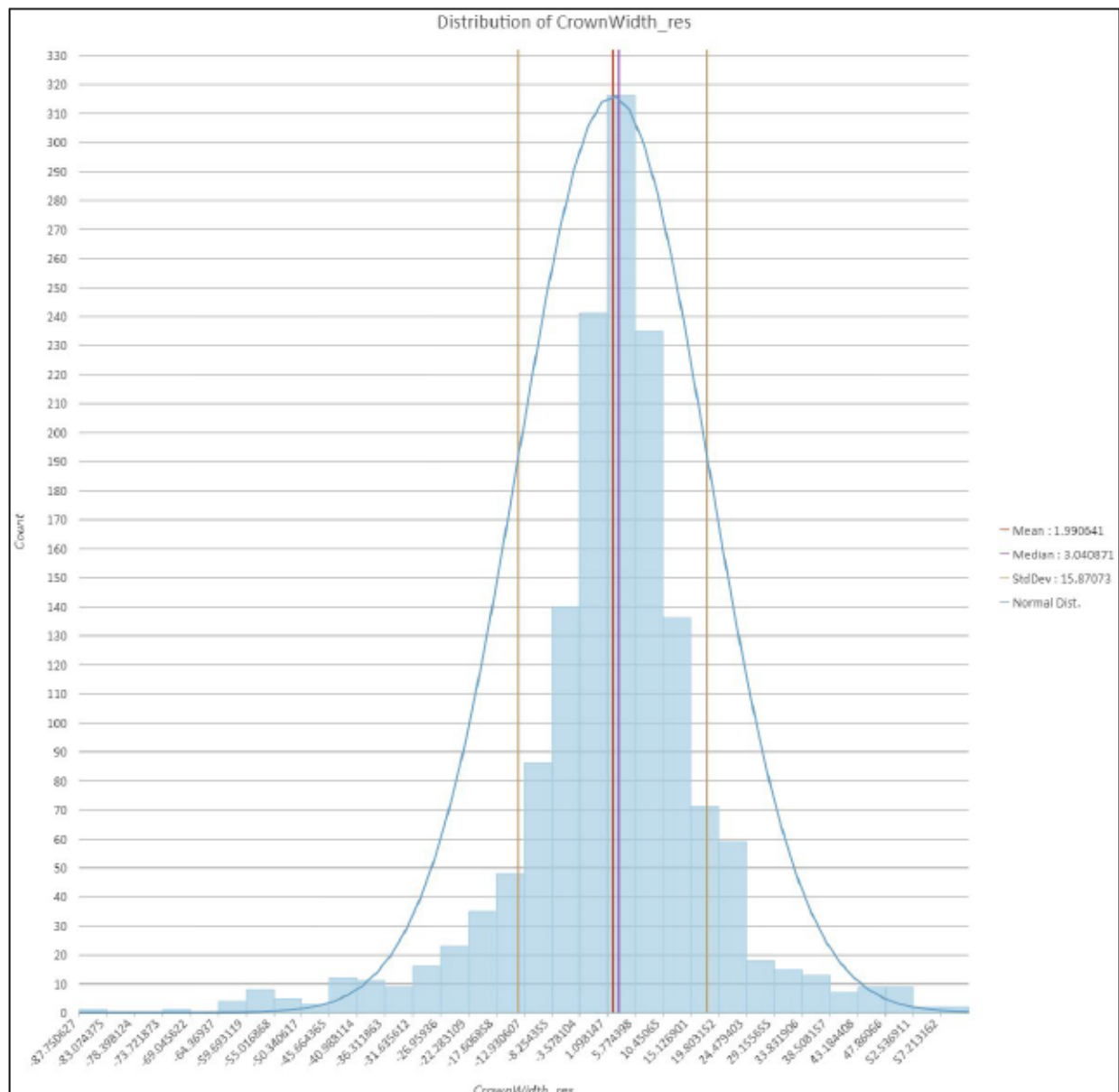
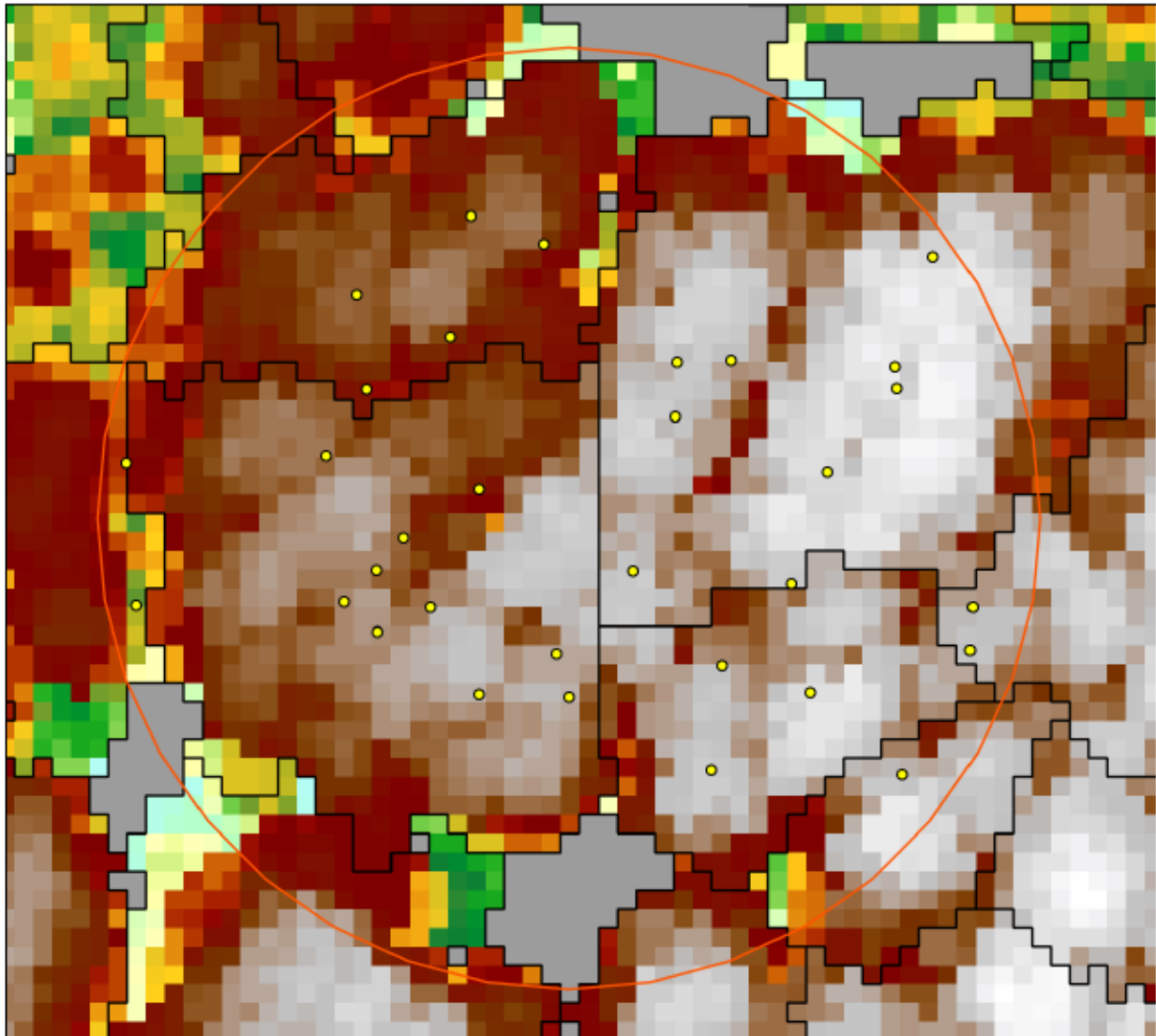


Figure 4. Estimated crown width residuals vs. measured crown widths.

Results of fieldwork and comparison of the data revealed that the segmentation protocol did a poorer job of delineating ITCs for stands dominated by black cottonwood due to their unique structure, i.e., densely packed stands with mingled crowns and generally very tall crown heights compared to relatively narrow, asymmetrical crown widths (Figure 5). It is possible that reprocessing these areas with homogenous stands with similar canopy characteristics might achieve a more accurate result by using field data as the basis for parameterizing the marker-controlled segmentation routine using species-specific height to crown-width measurements, versus the more generalized function derived from the totality of the City of Portland Park Tree Inventory. However, it is also possible that the unique composition of these tree stands might require other approaches to accurately segment them into ITCs, e.g., using a leaf-off LiDAR-derived CHM, or non-GIS-based approaches.



**Figure 5. Example of segmentation of the CHM in a field site with a dense, multistory stand of trees dominated by black cottonwood.**

The tabular results in the summary tables below include results where individual problematic tax lots dominated by black cottonwood are omitted from the Industrial and EG2 tax lots.

The third component of the accuracy assessment evaluates the performance of the regression functions for their capability to accurately estimate DBH from crown width by comparing predicted values with known values of DBH in the City of Portland Street Tree and Park Tree Inventories and the data collected from sample sites. These predicted versus measured values are plotted and analyzed with a regression of least-squares. The residuals of the linear equation estimate compared to street and park tree DBH values has a mean of 0.2 inch, a median of -0.4 inch, and a standard deviation of 7.9 inches (Figure 6). The residuals of the power equation estimate compared to the street and park tree DBH values has a mean 1.9 inches, a median of 1.6 inches, and a standard deviation of 8.2 inches. (Figure 7). The amount of variance between the linear and power regression models was  $R^2 = 0.4036$  and  $R^2 = 0.4022$  respectively, meaning that approximately 40% of the variation can be explained by either function (Figures 8 and 9).

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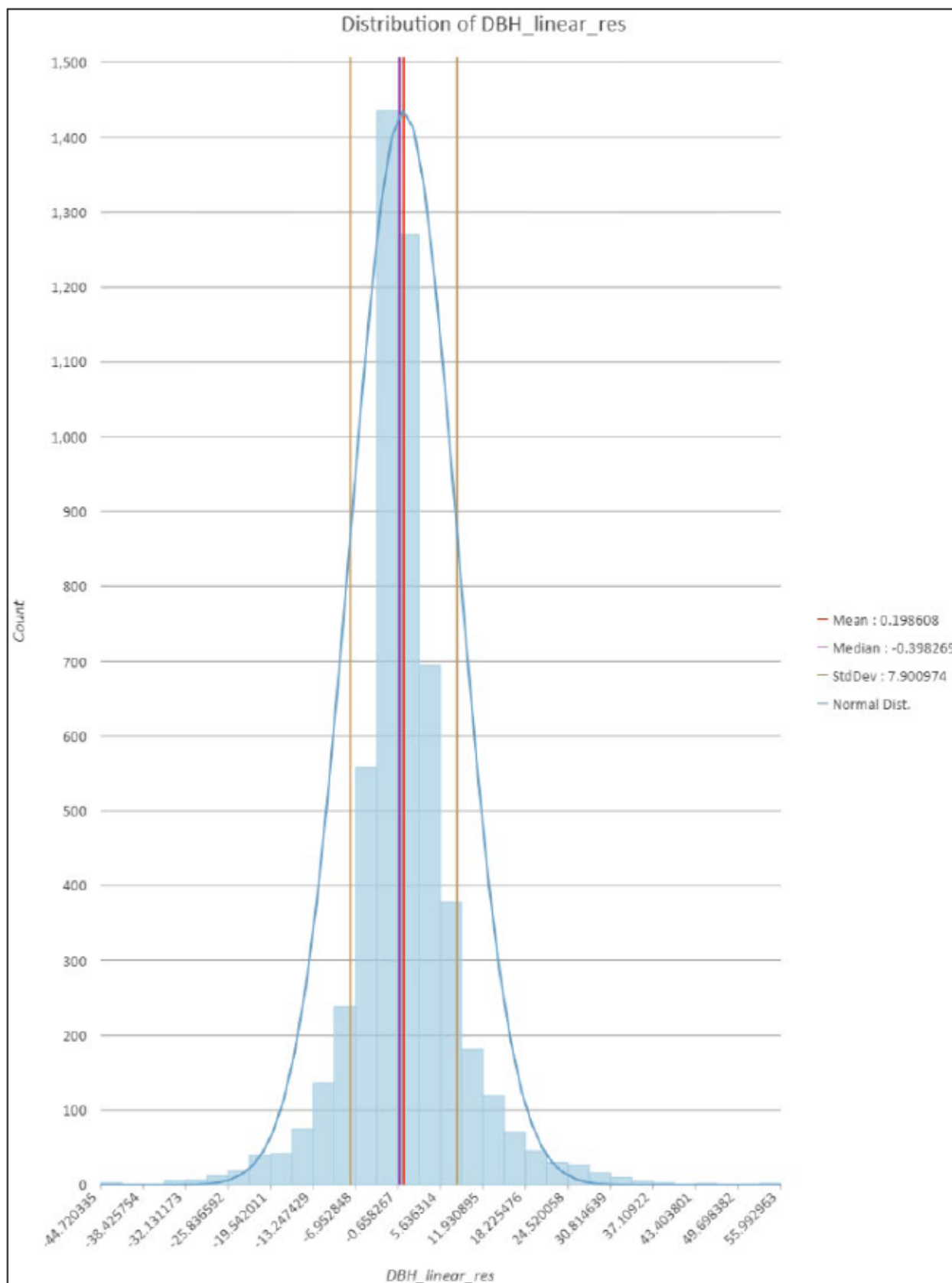


Figure 6. Linear function residuals for estimating DBH.

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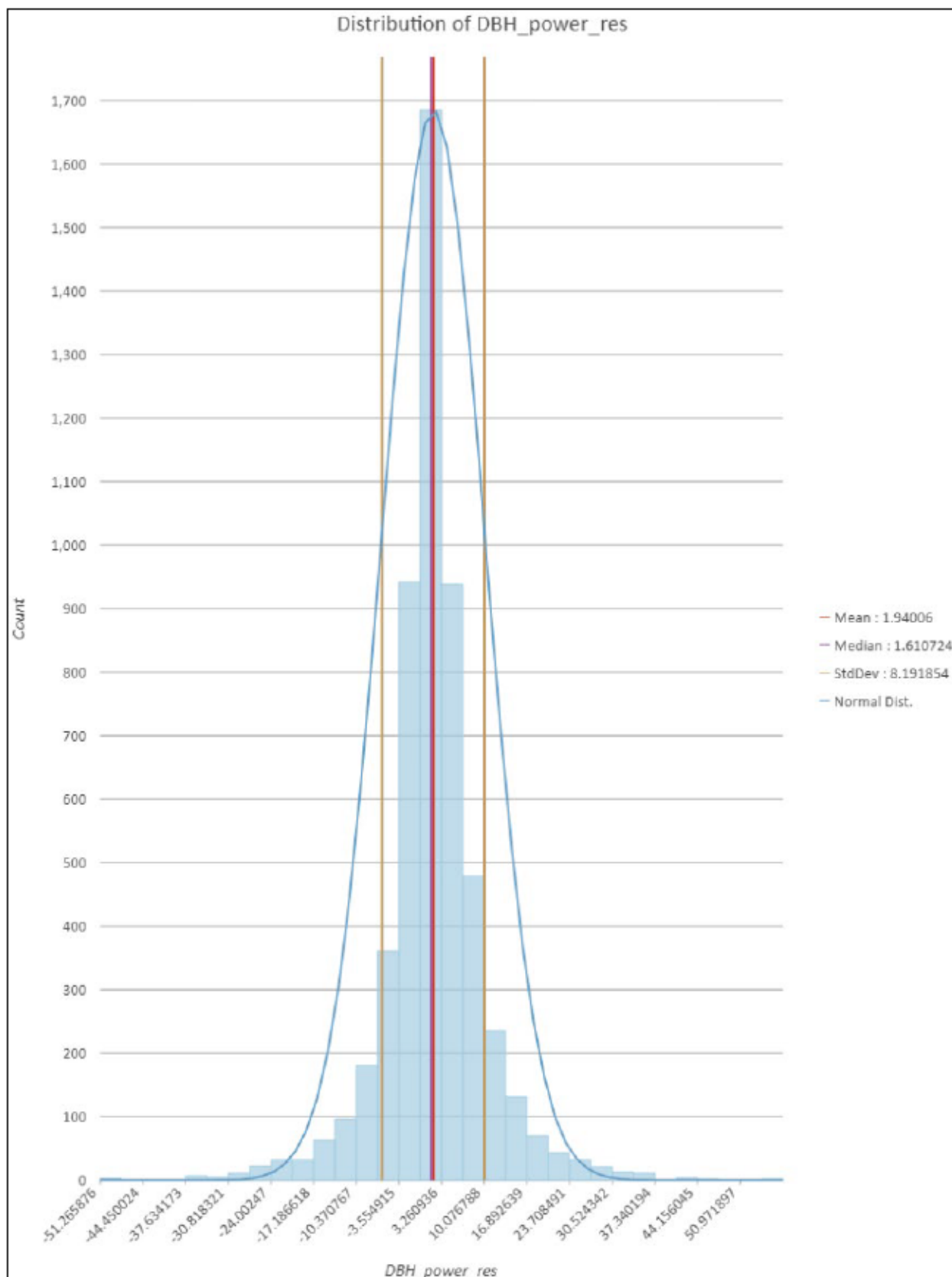
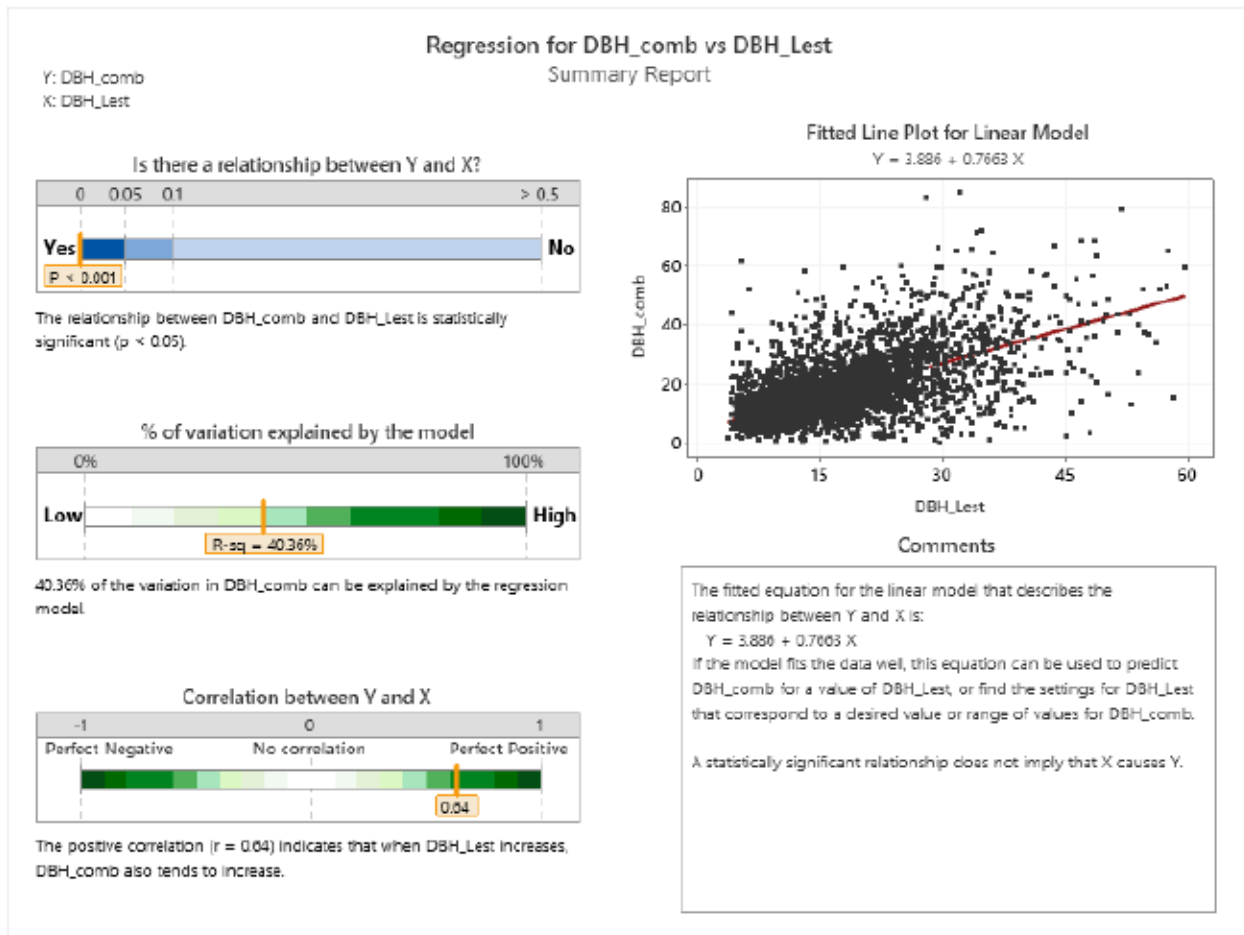


Figure 7. Power function residuals for estimating DBH.

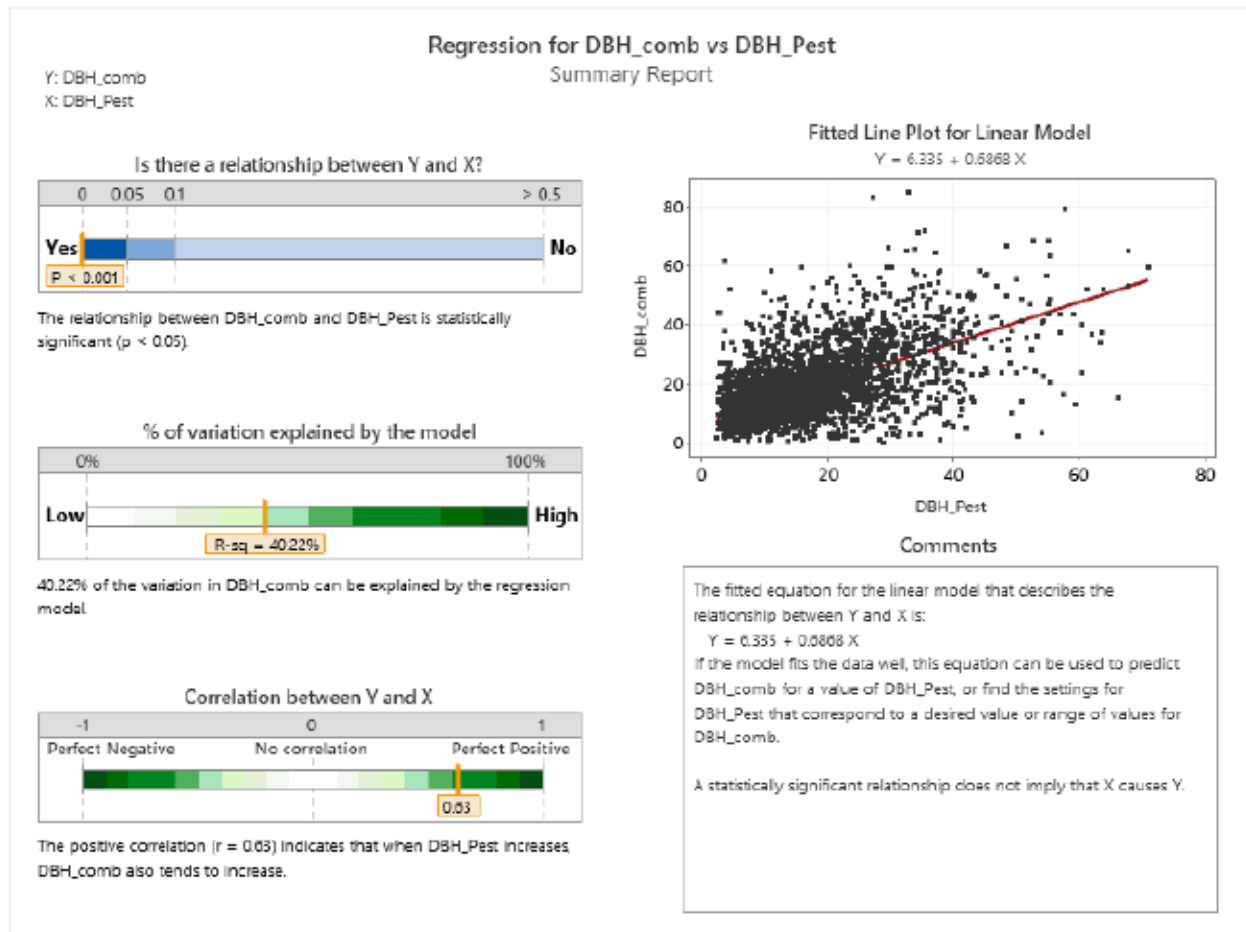


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**Figure 8. Regression analysis of predicted versus measured DBH values in the linear equation model.**

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**Figure 9. Regression analysis of predicted versus measured DBH values in the power function model.**

## FINDINGS

The summarized statistics in Tables 1 to 4 provide DBH estimates, canopy acres, and average trees per canopy acre using two different equations of best fit, a linear equation and a power function, with nearly identical  $R^2$  values (0.4036 and 0.4022 respectively). Separate tables are also provided that omit several tax lots where the model performed noticeably poorer in dense stands known to be dominated by black cottonwood.

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## Summary Tables

### Tree Segments Intersecting Tax Lots in the Analysis Area

**Table 1. DBH Categories by Power Function\***

Zone	<20 inches	20 to 27.9 inches	28 to 35.9 inches	≥36 inches	Total Trees**	Total Canopy Acres	Tax Lot Acres	Average Trees Per Tax Lot Acre
EG2	9,491 (90.2%)	663 (6.3%)	244 (2.3%)	122 (1.2%)	10,520	135.3	1,062.4	9.9
IG1	2,029 (90.1%)	115 (5.2%)	42 (1.9%)	46 (2.1%)	2,232	28.0	360.5	6.2
IG2	25,209 (89.5%)	1,929 (6.8%)	654 (2.3%)	373 (1.3%)	28,165	380.8	6,101.9	4.6
IH	14,781 (88.1%)	1,249 (7.4%)	433 (2.6%)	316 (1.9%)	16,779	255.1	4,658	3.6
All Tax Lots	51,510 (89.3%)	3,956 (6.9%)	1,373 (2.4%)	857 (1.5%)	57,696	799.2	12,182.8	4.7

\* Needleleaf:  $DBH = 0.3286 * CD^{1.2225}$ , Broadleaf:  $DBH = 0.1802 * CD^{1.2397}$

\*\* Tree counts are tabulated by intersection with respective tax lots. There are cases where individual tree segments intersect more than one tax lot, and thus are counted more than once.

**Model Accuracy Statistics:** measured DBH – predicted DBH, where total Industrial and EG2 model outputs intersect park and street tree inventory data

**Residuals:** mean = 1.9 inches, median = 1.6 inches, standard deviation = 8.2 inches, standard error = 0.1113 inches

**Model Correlation:**  $R^2 = 0.4022$

**Table 2. DBH Categories by Linear Function\***

Zone	<20 inches	20 to 27.9 inches	28 to 35.9 inches	≥36 inches	Total Trees	Total Canopy Acres	Tax Lot Acres	Average Trees Per Tax Lot Acre
EG2	9,184 (87.3%)	938 (8.9%)	295 (2.8%)	103 (1.0%)	10,520	135.3	1,062.4	9.9
IG1	1,971 (88.3%)	169 (7.6%)	49 (2.2%)	43 (1.9%)	2,232	28.0	360.5	6.2
IG2	24,382 (86.6%)	2,688 (9.5%)	792 (2.8%)	303 (1.1%)	28,165	380.8	6,101.9	4.6
IH	14,273 (85.1%)	1,706 (10.2%)	538 (3.2%)	262 (1.6%)	16,779	255.1	4,658	3.6
All Tax Lots	49,810 (86.3%)	5,501 (9.5%)	1,674 (2.9%)	711 (1.2%)	57,696	799.2	12,182.8	4.7

\* Needleleaf:  $DBH = 0.7595 * CD$ , Broadleaf:  $DBH = 0.4816 * CD$

**Model Accuracy Statistics:** measured DBH – Predicted DBH, where total industrial and EG2 model outputs intersect park and street tree inventory data

**Residuals:** mean = 0.2 inches, median = -0.4 inches, standard deviation = 7.9 inches, standard error = 0.1073 inches

**Model Correlation:**  $R^2 = 0.4036$

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### Tree Segments Intersecting Tax Lots (minus problematic tax lots)<sup>1</sup>

**Table 3: DBH Categories by Power Function\***

Zone	<20"	20" to 27.9"	28" to 35.9"	≥36"	Total Trees	Total Canopy Acres	Tax Lot Acres	Average Trees Per Tax Lot Acre
EG2	9,491 (90.2%)	663 (6.3%)	244 (2.3%)	122 (1.2%)	10,520	135.3	1,062.4	9.9
IG1	2,029 (90.1%)	115 (5.2%)	42 (1.9%)	46 (2.1%)	2,232	28.0	360.5	6.2
IG2 (omitted problem lots)	25,078 (89.7%)	1,890 (6.8%)	628 (2.2%)	359 (1.3%)	27,955	374.1	6,084.7	4.6
IH (omitted problem lots)	13,814 (89%)	1,060 (6.8%)	365 (2.4%)	274 (1.8%)	15,513	224.8	4,450.3	3.5
All Tax Lots	50,412 (89.6%)	3,728 (6.6%)	1,279 (2.3%)	801 (1.4%)	56,220	762.2	11,957.9	4.7

\* Needleleaf:  $DBH = 0.3286 + CD^{1.2225}$ , Broadleaf:  $DBH = 0.1802 + CD^{1.2397}$

**Model Accuracy Statistics:** measured DBH – Predicted DBH, where total industrial and EG2 model outputs intersect park and street tree inventory data

**Residuals:** mean = 1.9 inches, median = 1.6 inches, standard deviation = 8.2 inches, standard error = 0.1113 inches

**Model Correlation:**  $R^2 = 0.4022$

**Table 4: DBH Categories by Linear Function\***

Zone	<20"	20" to 27.9"	28" to 35.9"	≥36"	Total Trees	Total Canopy Acres	Tax Lot Acres	Average Trees Per Tax Lot Acre
EG2	9,184 (87.3%)	938 (8.9%)	295 (2.8%)	103 (1.0%)	10,520	135.3	1,062.4	9.9
IG1	1,971 (88.3%)	169 (7.6%)	49 (2.2%)	43 (1.9%)	2,232	28.0	360.5	6.2
IG2 (omitted problem lots)	24,262 (89.8%)	2,640 (9.4%)	762 (2.7%)	291 (1%)	27,955	374.1	6,084.7	4.6
IH (omitted problem lots)	13,359 (86.1%)	1,469 (9.5%)	457 (2.9%)	228 (1.5%)	15,513	224.8	4,450.3	3.5
All Tax Lots	48,776 (86.7%)	5,216 (9.3%)	1,563 (2.8%)	665 (1.2%)	56,220	762.2	11,957.9	4.7

\* Needleleaf:  $DBH = 0.7595 + CD$ , Broadleaf:  $DBH = 0.4816 + CD$

**Model Accuracy Statistics:** measured DBH – Predicted DBH, where total industrial and EG2 model outputs intersect park and street tree inventory data

**Residuals:** mean = 0.2 inches, median = -0.4 inches, standard deviation = 7.9 inches, standard error = 0.1073 inches

**Model Correlation:**  $R^2 = 0.4038$

<sup>1</sup> Two lots zoned as IG2: Property IDs R171715 and R237851 (17.2 acres); seven lots zoned as IH: Property IDs R239681, R256362, R325506, R323385, R256223, R323445, and R256242 (207.7 acres)

## EXPLANATION OF RESULTS

Regression equations to estimate DBH as a function of crown width were derived from the totality of the park trees inventory, binned by general structure (needleleaf-conifers and broadleaf). A linear and power trendline was fitted to these datasets in Microsoft Excel (see *Park\_trees\_BROAD.xlsx* and *Park\_trees\_CON.xlsx*) and the results of these equations and the root-mean-square errors (RMSE) for each demonstrated a moderate to strong correlation between crown width (CD) and DBH.

- **Needleleaf:** Linear trendline equation:  $DBH = 0.7595 * CD$ ,  $R^2 = 0.6181$  and power trendline equation:  $DBH = 0.3286 * CD^{1.2225}$ ,  $R^2 = 0.7649$ .
- **Broadleaf:** Linear trendline equation:  $DBH = 0.4816 * CD$ ,  $R^2 = 0.789$  and power trendline equation: Broadleaf:  $DBH = 0.1802 * CD^{1.2397}$ ,  $R^2 = 0.8411$ .

Crown diameter estimates for ITCs were derived with a circle of best fit to the tree segment outputs generated by the R, ForestTools tree segmentation tool. Modeled crown widths were compared to coincident park tree inventory point allometry and the residuals of the actual versus estimated crown width yielded a mean of 2.0 feet, a median of 3.0 feet, and a standard deviation of 15.9 feet. These positive values demonstrate a tendency in the model to underestimate crown width.

## Analysis of Errors, Model Limitations, and Further Refinement

A number of limitations, sources of potential error, and areas of possible refinement (as a part of future study) were identified during this study, including the following.

The CHM's 9-square feet resolution is derived from normalized LiDAR point-cloud data during leaf-on conditions, by subtracting the last hit (ground) from the first hit (tree crown or upper canopy). Therefore, the model is incapable of detecting trees that are over-topped by dominant or co-dominant trees. Using a higher resolution CHMs with leaf-on and leaf-off conditions could yield more accurate representations of the canopy characteristics present in the study area.

The LiDAR dataset used to develop the CHM is now nearly 6 years old and is asynchronous with many of the inventory dates in the park and street tree datasets, leading to potential underestimation of height, crown width, and DBH due to growth. Additionally, losses due to death or removal since the base data were acquired are beyond the scope of this analysis.

As a result of the way the segmentation routine works, hard breaks are created between tree crowns. In areas where crowns overlap or are co-mingled, the model invariably underestimates the crown widths of these ITCs, and then propagates this as an underestimation error for the DBH values of these ITCs. Certain tree species are also resistant to being accurately modeled; dense stands of black cottonwood encountered during site sampling were universally narrowly spaced, very tall, had heavily co-mingled crowns, and contained many trees under the dominant tree that are not visible in LiDAR acquired under leaf-on conditions. The model in these instances usually failed to capture ITCs, tending to noticeably commit errors of omission (undercounting the number of individual trees) and errors of commission (lumping multiple tree crowns together into a single segment) and because of this lumping, overestimates DBH values for the trees delineated in the marker-controlled segmentation.

There are temporal discrepancies in the data used in the analysis. Measurements taken during February 2020 fieldwork and the values recorded in the City of Portland Park and Street Trees Inventories between 2017 and 2019 vary from 3 to 6 years from the 2014 CHM that forms the basis of this analysis. This

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inevitably leads to an underestimation of allometry for certain trees due to growth, as well as changes to canopy coverage characteristics due to death, removal, or modification of trees. The extent of this variation is unknown.

Identifying individual trees by species would allow for more precise estimates of DBH values, by allowing the use of species-specific functions for modelling crown-width to DBH relationships, developed by the Urban Tree Database and Allometric Equations, developed by the U.S. Forest Service. Such a classification exercise would likely require proprietary, high-resolution hyperspectral imagery and specialized classification tools, and likely a piecemeal approach (iteratively processing small geographic study areas) backed up by extensive sampling and ground truthing. Thus, this approach would likely require significant processing time and the costs associated with this alternate approach and the proprietary tools and imagery required are unknown and beyond the scope of this analysis.

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**APPENDIX A**

**Data Sources**

2014 Metro Canopy Height Model

<http://rlisdiscovery.oregonmetro.gov/?action=viewDetail&layerID=3552>

2014 Metro Coniferous Deciduous dataset

<http://rlisdiscovery.oregonmetro.gov/?action=viewDetail&layerID=3572>

City of Portland Park Trees Inventory *(Provided by the City of Portland)*

City of Portland Street Trees Inventory *(Provided by the City of Portland)*

City of Portland zoning dataset *(Provided by the City of Portland)*

City of Portland tax lot data *(Provided by the City of Portland)*

Appendix G: Johnson Economics Analysis



ANALYSIS OF ANTICIPATED IMPACTS  
PROPOSED CHANGES IN TREE ORDINANCE

PREPARED FOR  
CITY OF PORTLAND  
BUREAU OF PLANNING AND SUSTAINABILITY

JUNE 2020

**JOHNSON ECONOMICS, LLC**

621 SW Alder St, Suite 506  
Portland, Oregon 97205



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## I. INTRODUCTION

The City of Portland's Bureau of Planning and Sustainability is evaluating changes to the Tree Code as part of the City's Title 11 process. The evaluation includes impacts on the City's future economic growth capacity in industrial and other employment lands, as well as on housing costs in the city. The following are proposed changes under consideration:

- Remove the exemption from the Tree Preservation Standards and Tree Density Standards for private trees in development situations for four zoning designations – IH, IG1, CX, and EX; and
- Reduce the Tree Preservation size threshold that triggers an inch-for-inch mitigation fee for private trees in development in all zones from 36 to 20 inches in diameter at breast height (DBH).

This report evaluates the anticipated marginal impact of the proposed changes on employment and residential development patterns. The focus of the analysis is the expected impact on future development yield of properties impacted by the proposed changes and utilizes a predictive development/redevelopment model to translate policy actions into associated shifts in anticipated development outcomes.

## II. EXECUTIVE SUMMARY

The proposed changes in the Tree Code would be expected to increase the cost of development when applicable. This impact would be the most pronounced on parcels that are currently exempt from tree preservation standards: sites zoned IH, IG1, CX, and EX. All zoning classification would be impacted by the shift in size threshold, which expands coverage of the tree preservation requirements to trees 20 inches DBH and greater, for all zones.

The impacts assumed in the model included a marginal increase in development cost associated with the proposed changes in the ordinance. Each of these types of changes are expected to result in lower supportable land values in the area and a predicted reduction in development activity and carrying capacity of the properties.

The optimal solution to respond to the proposed ordinance would vary on a site by site basis, based on key variables such as the development requirements and location of the trees on the property. The scope of this analysis does not allow for a detailed site by site assessment, and incremental costs assumed that trees would have to be removed.

The general impact of the increased development costs is reflected in a reduction in the indicated residual value of undeveloped land. This would be expected to marginally reduce the likelihood of development or redevelopment of properties, as the yield to new development is lower. The incremental cost of tree removal was calculated using an assumed distribution of trees by size and a mapping of impacted tree canopy. This was based on work completed by SWCA and the Portland Bureau of Planning and Sustainability.



The analysis focused on the marginal impact of the ordinance, and as a result only included parcels identified as having existing tree canopy on site. The model also excluded sites that currently are within an environmental overlay, as the new ordinance would not substantively change development requirements. The model used predicted development yields on these impacted parcels based. Key variables were the estimated cost to mitigate the tree impacts on site development, as well as the underlying value of the property in a development scenario. As a general rule, land uses that support relatively high underlying land values can more easily accommodate the incremental increase in development cost, while the marginal impact will be larger in land uses that have a lower supportable land value (such as industrial in employment lands, and residential sites in lower priced markets).

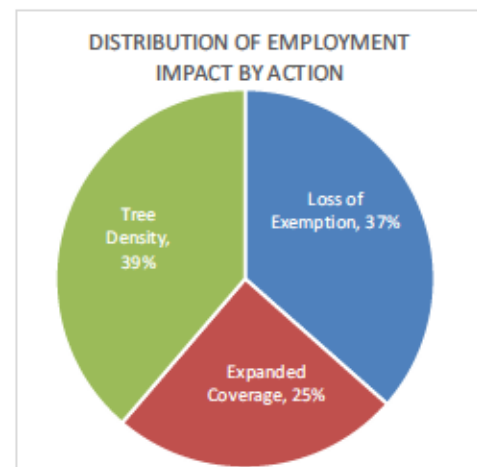
This analysis evaluates impacts on predicted development outcomes under a range of assumptions and does not assess environmental or other benefits associated with the proposed changes. The analysis only looks at the impacts of regulatory changes on predicted development outcomes and does not represent a full cost/benefit analysis. The regulatory proposals are likely to have significant public benefit that would offset potential costs. While we recognize the existence of public benefits, this analysis does not attempt to quantify these.

FIGURE 2.1: SUMMARY OF PREDICTED DEVELOPMENT YIELDS BY STUDY AREA, 20-YEAR HORIZON

	Predicted Development Yield				Marginal Cost on Impacted Properties		
	Construction Investment	Residential Units	Employment Acreage	Employment Capacity	Loss of Exemption	Change in Coverage	Tree Density
<b>OVERALL SUMMARY</b>							
<b>BASELINE</b>							
COLUMBIA EAST	\$123,938,026	0	31.2	981	\$0	\$0	\$0
HARBOR - AIRPORT	\$312,742,428	0	110.6	3,629	\$0	\$0	\$0
HARBOR ACCESS LANDS	\$102,402,713	0	46.9	1,500	\$0	\$0	\$0
INNER RESIDENTIAL	\$23,408,389,350	62,931	21.0	1,094	\$0	\$0	\$0
MID-RESIDENTIAL	\$7,872,409,812	4,294	2.4	123	\$0	\$0	\$0
OUTER RESIDENTIAL	\$7,967,427,127	11,772	11.2	588	\$0	\$0	\$0
<b>VARIANCE FROM BASELINE</b>							
COLUMBIA EAST	(\$784,741)	0	(0.5)	(15)	\$0	\$153,598	\$0
HARBOR - AIRPORT	(\$19,035,928)	0	(11.7)	(616)	\$535,448	\$459,901	\$199,363
HARBOR ACCESS LANDS	(\$26,929,491)	0	(15.9)	(506)	\$379,823	\$133,648	\$852,175
INNER RESIDENTIAL	(\$5,444,872)	(24)	0.00	0	\$79,381	\$508,748	\$582,272
MID-RESIDENTIAL	(\$1,888,332)	(8)	0.0	0	\$30	\$477,459	\$66
OUTER RESIDENTIAL	(\$5,013,667)	(22)	(0.0)	(0)	\$12,943	\$2,166,422	\$43,526
<b>TOTAL</b>	<b>(\$59,097,031)</b>	<b>(54)</b>	<b>(28.1)</b>	<b>(1,137)</b>	<b>\$1,007,625</b>	<b>\$3,899,775</b>	<b>\$1,677,401</b>

Our analysis indicates that the most significant impact on predicted development yields would be for employment lands in the Harbor-Airport study area. Much of this property is currently exempted from tree preservation standards, and the incremental impact would be substantive. In addition, industrial uses support relatively low residual land values, and as a result they are less able to absorb cost increases. The impact on residential yields is less significant as these uses support higher land values, and the marginal change in requirements is lower than for exempted zoning classifications.

For employment areas, the loss of exemption and the tree density standards are the most significant factors influencing the





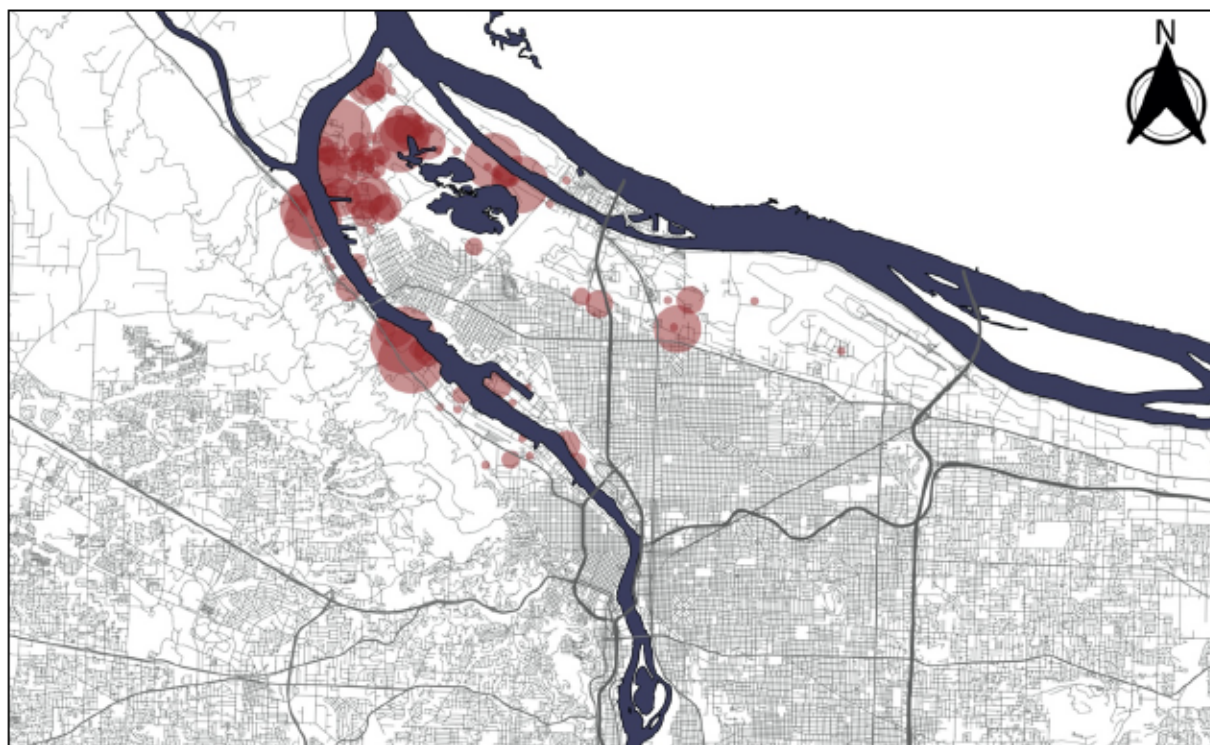
marginal shift in anticipated outcomes. In residential areas, the tree density requirements are most significant in terms of impact. The following table summarizes the predicted change in outcome attributed to individual proposed modifications. This is based on the percentage of cost impact. Impacts in the model reflect an aggregation of cost changes.

FIGURE 2.2: PREDICTED CHANGE IN OUTCOMES ATTRIBUTED TO ORDINANCE CHANGE (20-YEAR HORIZON)

	EMPLOYMENT ACREAGE			RESIDENTIAL UNITS		
	Loss of Exemption	Change in Coverage	Tree Density	Loss of Exemption	Change in Coverage	Tree Density
COLUMBIA EAST	0.00	(0.48)	0.00	0.00	0.00	0.00
HARBOR - AIRPORT	(5.26)	(4.52)	(1.96)	0.00	0.00	0.00
HARBOR ACCESS LANDS	(4.41)	(1.55)	(9.90)	0.00	0.00	0.00
INNER RESIDENTIAL	0.00	0.00	0.00	(1.63)	(10.43)	(11.94)
MID-RESIDENTIAL	0.00	0.00	0.00	(0.00)	(8.00)	(0.00)
OUTER RESIDENTIAL	(0.00)	(0.01)	(0.00)	(0.13)	(21.44)	(0.43)
TOTAL	(9.68)	(6.56)	(11.86)	(1.76)	(39.87)	(12.37)

The distribution of impact for employment lands is concentrated along the Portland Harbor and in North Portland. The following map outlines areas of predicted impact on employment lands.

FIGURE 2.3: IMPACTED EMPLOYMENT LANDS<sup>1</sup>



<sup>1</sup> The circles shown represent parcels impacted by tree canopy and are scaled to reflect the amount of area impacted. The map is intended to represent the generalized distribution of impacted parcels and should not be used to identify individual parcels.

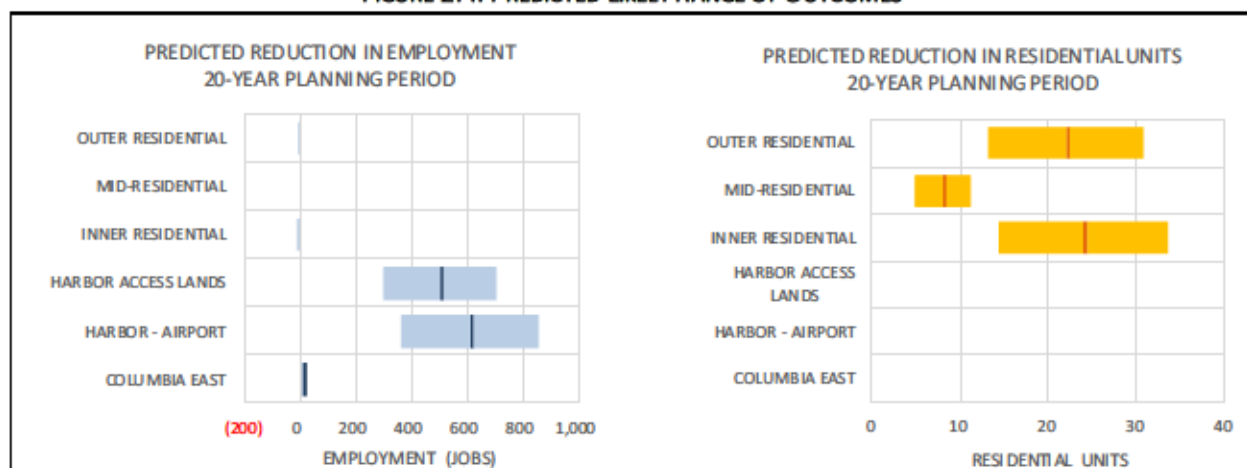




The modeling structure's focus is on realized development yield, and the marginal increase in development costs associated with the proposed changes is expected to reduce the predicted yield because of reduced financial viability. The incremental increase in costs translates into a lower supportable land value, reducing the likelihood of development and/or redevelopment. If land values are not reduced at a level necessary to offset the increased costs, development activity would be expected to shift to alternative locations.

The model output is based on the interaction of a multitude of variables and assumptions, not all of which will likely have a normal distribution. While variables such as tree canopy composition are expected to be normally distributed, the model also relies upon assumptions such as property owner disposition which are not normally distributed. As a result, the model outputs do not lend themselves to the calculation of a traditional standard error and confidence bands. We have included a range of anticipated outcomes in the analysis to reflect an inherent degree of uncertainty in the output. The following chart summarizes the generalize range expected outcomes in terms of reduced employment and residential unit yield.

**FIGURE 2.4: PREDICTED LIKELY RANGE OF OUTCOMES**



The model indicates an expected significant impact on employment capacity for zoning classifications that are currently exempted. The anticipated impact on realized residential density is relatively low in terms of units. For all land use types a marginal increase in development cost is expected to potentially have an inflationary impact on pricing for end users. As development costs increase, that increase will need to be shifted either to the market through higher pricing deducted from land value. Reductions in land value would be expected to reduce the likelihood of development and/or redevelopment.

The model was also run to specifically test the impacts on anticipated levels of development associated with removing the exemptions in the IH and IG1 zones. The analysis indicates that the loss of exemption alone would reduce employment capacity over a twenty-year horizon by 592 jobs, or roughly two thirds of predicted employment capacity lost.



FIGURE 2.4: PREDICTED IMPACT OF LOSS OF CURRENT EXEMPTION ON IH AND IG1 PROPERTIES  
TWENTY YEAR HORIZON

	Predicted Development Yield		
	Construction Investment	Employment Acreage	Employment Capacity
<b>OVERALL SUMMARY</b>			
<b>BASELINE</b>			
HARBOR - AIRPORT	\$103,558,035	30.0	945
HARBOR ACCESS LANDS	(\$12,826,828)	45.6	1,433
CENTRAL CITY	\$50,303,262	1.8	632
NON-CENTRAL	\$7,467,318	0.2	7
<b>VARIANCE FROM BASELINE</b>			
HARBOR - AIRPORT	(\$12,826,828)	(7.8)	(349)
HARBOR ACCESS LANDS	(\$26,003,121)	(15.5)	(488)
CENTRAL CITY	(\$6,143)	(0.0)	(0)
NON-CENTRAL	(\$161)	(0.0)	(0)
<b>TOTAL</b>	<b>(\$38,829,949)</b>	<b>(23.3)</b>	<b>(838)</b>

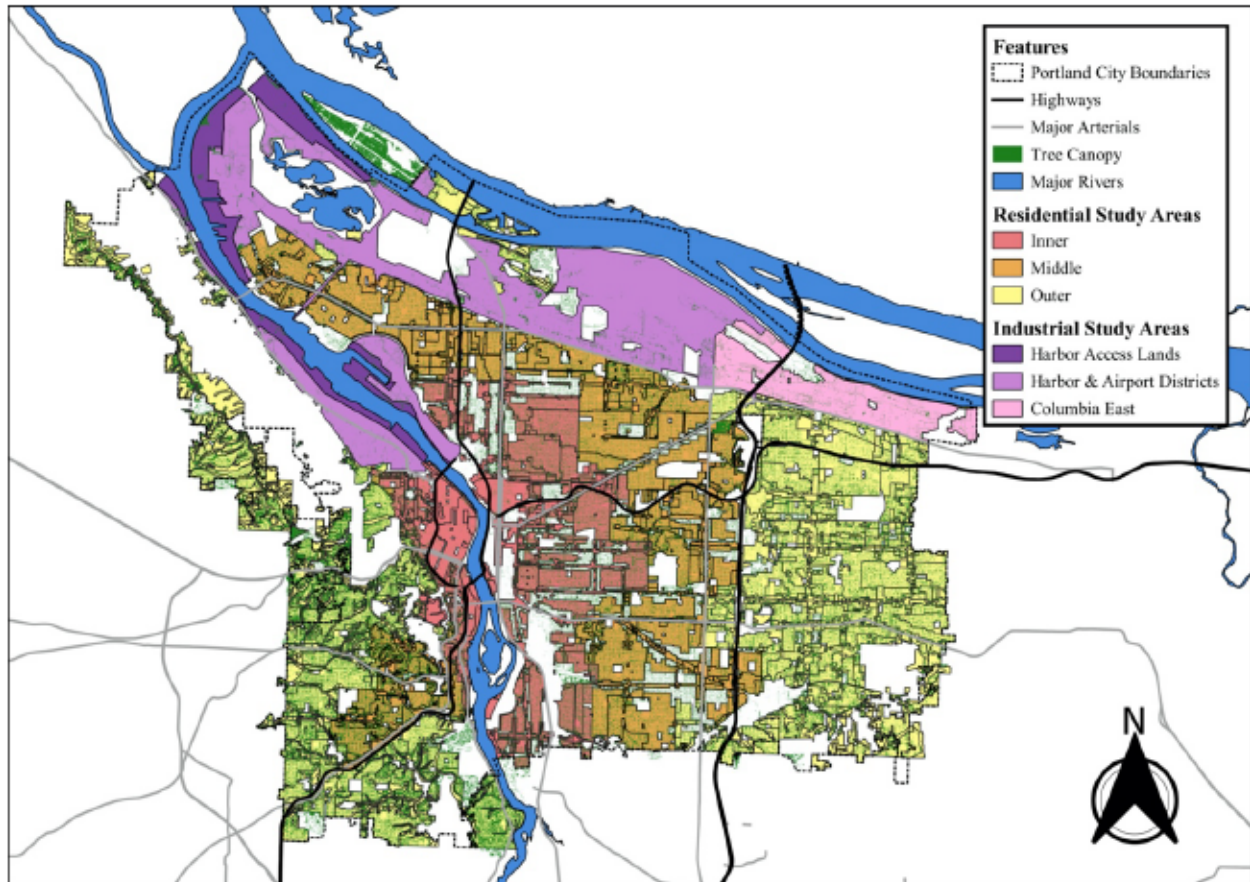
The impact is largely associated with properties zones IH, as IG1 properties are more concentrated in markets with a greater achievable pricing. The residual land value in these areas is adequate to better allow for developers to address the incremental costs associated with the proposed changes.



### III. STUDY AREA DEFINITION

The study area for this project was defined based on properties impacted by tree canopy in five geographic areas. Two primarily employment study areas were defined, the Harbor & Airport Districts and Columbia East. Three primarily residential study areas were also defined based on general price profiles, the inner, middle, and outer residential areas. The current tree canopy was overlaid on the sites.

FIGURE 3.1: SITES EVALUATED BY STUDY AREA



SOURCE: City of Portland and JOHNSON ECONOMICS

Parcel level data was derived from the County Assessor's office while zoning and tree canopy was provided by BPS.

For each tax lot, the total area and percentage of the area of a tax lot and building area identified as tree canopy was calculated. The total vacant and/or redevelopable land area intersecting the tree canopy was calculated based on the City of Portland's BLI layer for employment lands, and the entire site for residential areas.

The impacted properties evaluated included 95,123 sites, representing 21,556.7 acres. The identified tree canopy covered 27.0% of this property, or 5,812.6 acres. The following table summarizes impacted parcels in the delineated submarkets.



## SUMMARY OF STUDY AREAS

	# of Parcels	Impacted Acres	Canopy Acres	% Canopy
COLUMBIA EAST	488	302.3	77.0	25.5%
HARBOR - AIRPORT	1,793	849.2	205.3	24.2%
HARBOR ACCESS LANDS	136	278.2	64.4	23.2%
INNER RESIDENTIAL	27,482	4,351.2	971.5	22.3%
MID-RESIDENTIAL	40,756	6,325.7	1,581.6	25.0%
OUTER RESIDENTIAL	24,468	9,450.2	2,912.8	30.8%
<b>TOTAL</b>	<b>95,123</b>	<b>21,556.7</b>	<b>5,812.6</b>	<b>27.0%</b>

SOURCE: City of Portland Bureau of Planning and Sustainability, Johnson Economics

## IV. PROPOSED CODE CHANGES

Three proposed code changes were evaluated:

- *Remove the exemption from the Tree Preservation Standards for private trees in development situations for zoning designations – IH, IG1, CX, and EX; and*
- *Reduce the Tree Preservation size threshold that triggers an inch-for-inch mitigation fee for private trees in development in all zones from 36 inches diameter-at-breast height (dbh) to 20 inches dbh for all zones.*
- *Remove the exemption from tree density standards from zoning designations IH, IG1, CX and EX*

Each of these changes are expected to marginally increase the cost to develop affected properties. In addition to impacting costs, the changes are likely to induce marginal changes in development programs to reduce mitigation costs when appropriate.



## V. MODEL FRAMEWORK

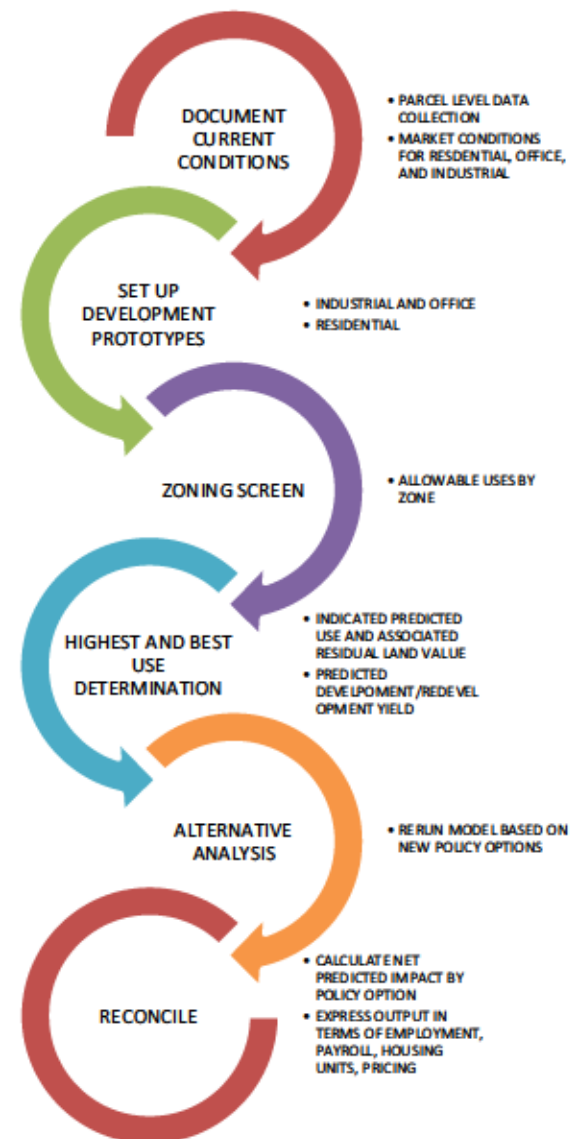
To assess the anticipated magnitude and character of impacts on development outcomes associated with the proposed code changes, we utilized a predictive development modeling framework to forecast development outcomes with and without the proposed changes.

The model is designed to predict the magnitude and form of likely development or redevelopment activity over an assumed time frame. The primary metric used to predict likely development patterns is the relationship between the supportable residual land value for prospective uses and the current value of the property (including land as well as improvements, if any). The underlying assumption is that when the value of a property for new development is high relative to the current value of the property, it will be more likely to see development or redevelopment over a defined time-period.

The model is designed to generate an estimated ratio between the current value of a parcel and the underlying value of the parcel under potential development scenarios. This ratio is used as the primary indicator of the likelihood of development or redevelopment. Within the model, we use Real Market Value (RMV) from the assessors' office as a proxy for the value of the site. While we understand that this is an imperfect measure, it is readily available at the parcel level and any inherent bias is expected to be largely consistent. The residual land value is determined using a series of simplified pro formas that represent potential development forms. The resulting ratio between current and residual value has proven to be a strong predictor of the likelihood of development or redevelopment at the parcel level.

The model solves for a development solution that represents the highest and best use at the parcel level under the assumptions used, as well as outputting an associated residual property value. The highest and best use of each parcel is defined as the allowable land use program that yields the greatest return to the existing property, and the residual property value reflects the maximum acquisition value supported by that program under the assumptions used. For this analysis, the model evaluated a total of 30 prototypical programs which cover the range of residential and employment development forms allowed under the current and proposed code in the study area. An entitlement screen narrows the allowed use types to reflect existing and proposed zoning.

The probability of development/redevelopment activity is predicted by the model at the parcel level based on the ratio generated by dividing the current value (RMV) by the indicated residual land value. A shift in assumptions that increases the value of the property under a new development scenario, such as higher





achievable pricing or less restrictive entitlements, will increase the denominator in this ratio as well as the likelihood of development or redevelopment. Sites with relatively high current values resulting from significant physical improvements will have a relatively high numerator and will be significantly less likely to redevelop.

The model evaluates the likelihood of development at the parcel level, although the results are expressed in aggregated geographies. What the model solves for is probabilities to redevelop as well as anticipated development forms, and the results reflect the expected value of development/redevelopment activity. The model will not indicate that a specific parcel will or will not redevelop, it will change the probability of that occurrence as well as the likely form of development.

In summary, the model uses the relationship between current value of the property and the indicated value of the property under the highest and best use development prototype as the primary predictive measure of the likelihood of development and/or redevelopment.

## PROTOTYPES

To test the impact of the proposed changes, Johnson Economics modeled the economic feasibility of a range of prototypical development programs on the impacted sites. This included 11 employment uses (office and industrial), 10 rental-residential, and 9 ownership residential prototypes.

The following series of tables summarizes these program assumptions.

**PROTOTYPE OFFICE AND INDUSTRIAL DEVELOPMENT PROGRAMS**

	Office high rise	Office mid/ structured	Office mid/ ext. structured	Office mid/ surface	Office high rise - CC	Office mid/ structured - CC	Office mid/ ext. structure	Office low rise	Manufacturing	Warehouse/ Distribution	Multi-Tenant Flex
<b>Stories</b>	10	5	4	4	10	5	4	1	1	1	1
<b>FAR</b>	7.50	3.75	2.00	0.50	7.50	3.75	2.00	0.30	0.45	0.40	0.33
<b>Parking Ratio/000 SF</b>	1.50	1.50	1.50	1.50	0.50	0.50	0.50	1.50	2.0	1.0	1.0
<b>Structured Parking %</b>	100%	100%	85%	0%	100%	100%	85%	0%	0%	0%	0%



### PROTOTYPE RENTAL RESIDENTIAL PROGRAMS

	Rental high rise	Rental high rise – Low Parking	Rental Mid Rise	Rental Mid Rise – Low Parking	Rental 5 over 2	Rental Type V w/podium	Rental Type V w/podium – Low Parking	Rental 3-story wood zero parked	Rental 3-story wood w/surf	Rental Middle Type V
Density/Acre	400	400	225	225	210	170	170	130	35	20
Ave Unit Size	725	725	750	750	750	750	750	750	750	1,000
FAR	7.83	7.83	4.54	4.54	4.24	3.44	3.44	2.63	0.60	0.45
Parking Ratio/Unit	1.00	0.50	1.00	0.50	1.25	1.00	0.25	-	1.50	1.25

### PROTOTYPE OWNERSHIP RESIDENTIAL PROGRAMS

	Condo Highrise	Condo Mid Rise	Condo 5 over 2	Condo Type V w/podium	Condo 3-story wood w/surf	Middle Housing Type V	For-Sale Duplexes	Skinny Homes	Single Family
Density/Acre	400	225	210	170	35	25	18	17	9
Ave Unit Size	775	775	775	775	800	1,250	1,250	1,350	1,750
FAR	8.57	4.81	4.48	3.64	0.64	0.56	0.50	0.61	0.35
Parking Ratio/Unit	1.25	1.25	1.25	1.50	1.75	1.50	1.50	1.50	2.00

## DEFINITION OF TERMS

This report uses several terms in the tables and text. The following is a brief definition of terms used.

#### Impacted Acres

The impacted acres in this approach reflect parcels that contain identified tree canopy areas. For employment zones, the vacant and redevelopable acreage within the impacted parcels reflects the City's current BLI estimates. In residential zones, the BLI was not used to limit impacted areas as much of the bulk of residential capacity within the City of Portland is in redevelopment and infill.

#### Employment Capacity

Employment capacity in the context of this analysis represents the expected number of employees that would be accommodated in the predicted development. This represents the expected marginal increase in realized employment and does not represent the theoretical capacity at full build-out.



Real Market Value (RMV)	RMV is derived from assessor records and represents the assessor opinion as to the current market value of land and improvements on a property.
Prototype	The prototypes represent prototypical development forms that were evaluated. There are innumerable development options for individual sites, but the prototypes represent a series of common development forms that are prevalent in the local market.
Buildable Land Inventory (BLI)	The BLI is a formal inventory maintained by the City as part of their Goal 9 and 10 compliance. The BLI establishes available sites and assumed carrying capacity for employment (Goal 9) and housing (Goal 10). The City's BLI was used to limit the impacted acres for employment uses in this analysis.
Floor Area Ratio (FAR)	FAR refers to a ratio between gross square footage of building area divided by land area. As an example, a 30,000 square foot industrial building on a 100,000 square foot site would have a FAR of 0.30.

## VI. CODE CHANGES AND ASSUMED IMPACTS

The proposed code changes are expected to alter the economics of developing impacted properties. The following summarizes the assumed impact of the proposed code changes.

PROPOSED CODE CHANGE	ANTICIPATED IMPACTS	
	EMPLOYMENT	RESIDENTIAL
Remove exemptions for IH, IG1, CX, and EX zoned parcels	<ul style="list-style-type: none"> <li>▪ Increase in development costs for parcels in these zones</li> <li>▪ Tree canopy estimates reduced by 10% in residential/commercial areas and 15% in industrial area to account for allowed removal of dead, dying, or dangerous trees.</li> </ul>	<ul style="list-style-type: none"> <li>▪ No marginal impact</li> </ul>
Reduce size threshold to 20 inches	<ul style="list-style-type: none"> <li>▪ Increase in development costs for all impacted parcels</li> </ul>	<ul style="list-style-type: none"> <li>▪ Increase in development costs for all impacted parcels</li> </ul>
New Tree Density Standards	<ul style="list-style-type: none"> <li>▪ Increase in development costs for parcels losing their current exemption.</li> </ul>	<ul style="list-style-type: none"> <li>▪ No marginal impact</li> </ul>

The impact of each of these proposed changes will vary significantly on a parcel by parcel basis, and the modeling did not include a detailed site by site assessment. This would be time and cost prohibitive considering the sample site includes over 95,000 sites. In general, the anticipated impacts would be expected to include a combination of increased cost for mitigation as well as some marginal changes in development patterns to avoid incremental costs. Both are expected to reduce the level of realized development in the sample site, through reduced economic returns and/or lower realized densities. Any





increase in cost, decrease in yield, or increase in required rate of investment return is expected to negatively impact likely development outcomes on parcels in the study area.

The following is a summary of the cost calculations used:

Tree Preservation Standards in Currently Exempted Zones

- *Trees 36" or larger, preserve or pay mitigation fee of \$450 per inch dbh.*
- *Preserve 1/3 of the 20" to 35.9" trees or pay mitigation fee of \$3,600 per tree.*
- *Preserve 1/3 of the 12" to 19.9" trees or pay mitigation fee of \$1,800 per tree.*

Expanded Tree Preservation to 20" Trees

- *Preserve 20" and greater or pay mitigation fee-in-lieu of \$450 per inch.*
- *Subtract the current requirement to preserve 1/3 of the 12" to 19.9" trees or pay mitigation fee of \$1,800 per tree.*

New Tree Density Standards in Currently Exempted Zones

- *Increase in costs associated with an assumed fee in lieu for currently exempted properties.*

## VII. SUBAREA ANALYSES

The impact area was broken into six geographic subareas:

- *Columbia East*
- *Portland Harbor – Airport*
- *Harbor Access Lands*
- *Inner Residential*
- *Middle Residential*
- *Outer Residential*

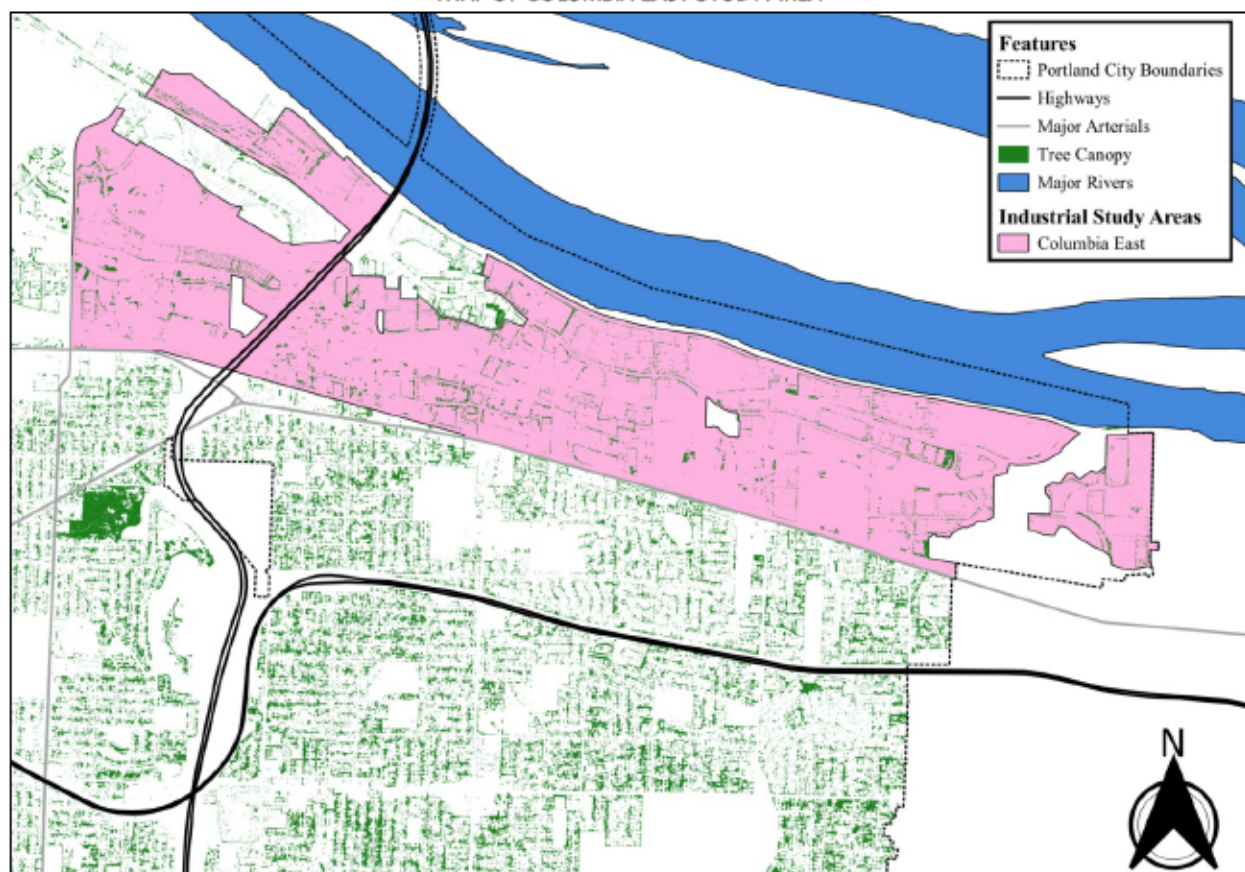
For each of these areas, our predictive development model was run under the current development code, as well as with adjustments based on the proposed changes to the tree ordinance.



## COLUMBIA EAST

The Columbia East study area is located north of Sandy Boulevard and east of the Portland International Airport. The area has been largely developed for employment uses.

MAP OF COLUMBIA EAST STUDY AREA

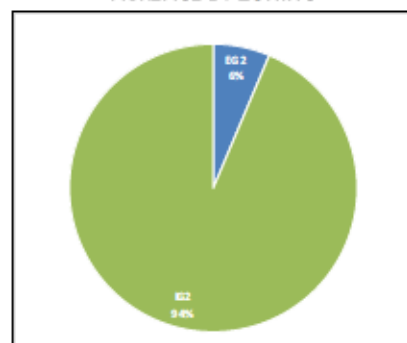


A total of 488 sites were identified as impacted, representing 302 acres in the BLI. These sites have 77 acres of identified tree canopy, representing 25.5% of the site area. Impacted sites in this study area were largely zoned IG2, with some EG2 as well. As a result, the current zoning did not exempt these sites from tree preservation standards. The impact in IG2 and EG2 was therefore limited to the expansion of the tree preservation requirements to include smaller trees.

### MODEL OUTPUT

Our analysis indicates that the proposed changes would have a negligible impact on development and redevelopment in the study area, with a reduction in realized employment capacity over the next twenty years of only 16 jobs. This is largely attributable to the current zoning in the area, which includes no sites that are currently in exempted zoning classifications.

ACREAGE BY ZONING





Under baseline scenario, the impacted portions of the subarea would be expected to accommodate an additional 981 additional jobs on impacted sites. This would be predicted to decline to 965 under our assumptions. The impact would be greater over an assumed 100-year horizon, but still quite modest.

**SUMMARY OF MODEL RESULTS, COLUMBIA EAST – 20 YEAR HORIZON**

LINE	Predicted Development Yield			
	Construction Investment	Residential Units	Employment Acreage	Employment Capacity
<b>COLUMBIA EAST</b>				
<b>BASELINE</b>				
New Construction	\$53,837,325	0	31.2	981
Rehab/Renovation	\$70,100,701			
Overall Total	\$123,938,026			
<b>NEW TREE REPLACEMENT REQUIREMENTS</b>				
New Construction	\$53,005,284	0	30.7	965
Rehab/Renovation	\$70,148,002			
Overall Total	\$123,153,286			

**SUMMARY OF MODEL RESULTS, COLUMBIA EAST – 100 YEAR HORIZON**

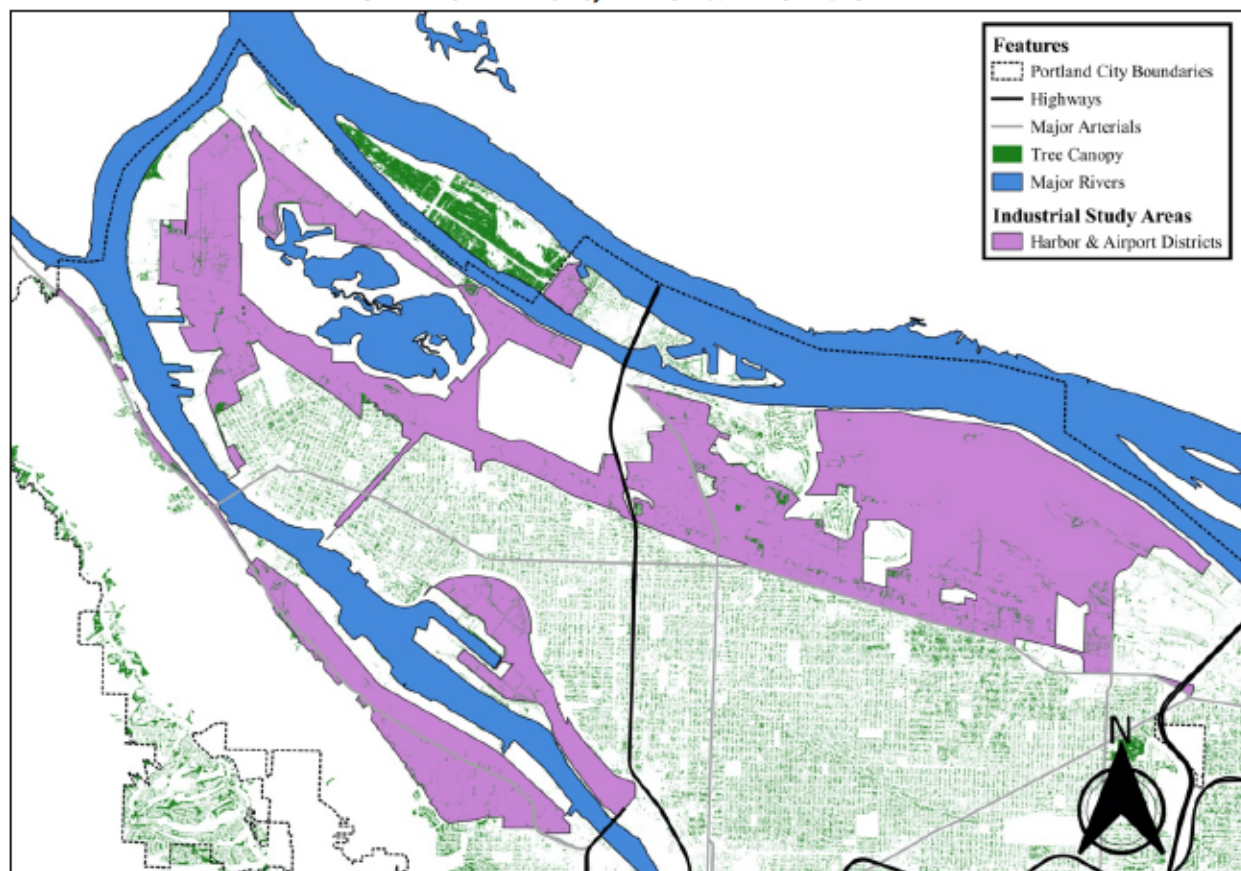
LINE	Predicted Development Yield			
	Construction Investment	Residential Units	Employment Acreage	Employment Capacity
<b>COLUMBIA EAST</b>				
<b>BASELINE</b>				
New Construction	\$280,855,626	0	162.6	5,116
Rehab/Renovation	\$566,963,489			
Overall Total	\$847,819,115			
<b>NEW TREE REPLACEMENT REQUIREMENTS</b>				
New Construction	\$278,138,058	0	161.0	5,066
Rehab/Renovation	\$568,492,341			
Overall Total	\$846,630,399			



**HARBOR - AIRPORT**

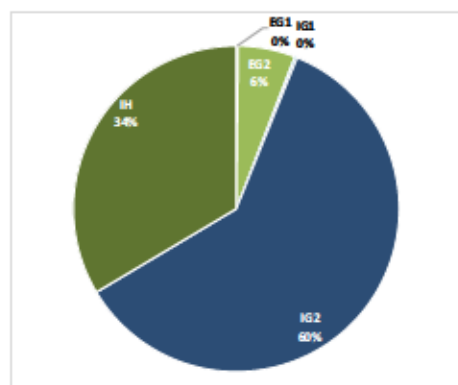
The Harbor-Airport study area includes the Portland International Airport, as well as industrial properties to the west and south along the Willamette River. The area includes Portland Harbor access lands, as well as significant industrial lands north of Columbia Boulevard.

**MAP OF IMPACTED PARCELS, HARBOR & AIRPORT STUDY AREA**



A total of 1,793 sites were identified as impacted, representing 849 acres in the BLI. These sites have 205 acres of identified tree canopy, representing 24.2% of the site area. Impacted sites in this study area were largely zoned IG2(60%) and IH (34%), with some EG2 (6%) as well. Of these, only the IH zoned property is currently exempted from the tree preservation standards. The impact on the IH zoned land is most significant, while the impact on the remaining property is limited to the expansion of the tree preservation requirements to include smaller trees.

**ACREAGE BY ZONING**





### MODEL OUTPUT

Our analysis indicates that the proposed changes would have a much more significant impact on development and redevelopment in the study area than the Columbia East study area. Realized employment capacity is predicted to decline by 616 jobs, reflecting a roughly 17% decrease.

#### SUMMARY OF MODEL RESULTS, HARBOR-AIRPORT STUDY AREA – 20 YEAR HORIZON

LINE	Predicted Development Yield				Net Change in RMV (000s)
	Construction Investment	Residential Units	Employment Acreage	Employment Capacity	
<b>HARBOR - AIRPORT</b>					
<b>BASELINE</b>					
New Construction	\$198,806,570	0	110.6	3,629	\$370,264
Rehab/Renovation	\$113,935,858				
Overall Total	\$312,742,428				
<b>NEW TREE REPLACEMENT REQUIREMENTS</b>					
New Construction	\$178,699,673	0	98.8	3,014	\$346,155
Rehab/Renovation	\$115,006,826				
Overall Total	\$293,706,499				

If the forecast period is extended to 100 years, the decrease in predicted capacity would be approximately 3,165 jobs.

#### SUMMARY OF MODEL RESULTS, HARBOR-AIRPORT STUDY AREA – 100 YEAR HORIZON

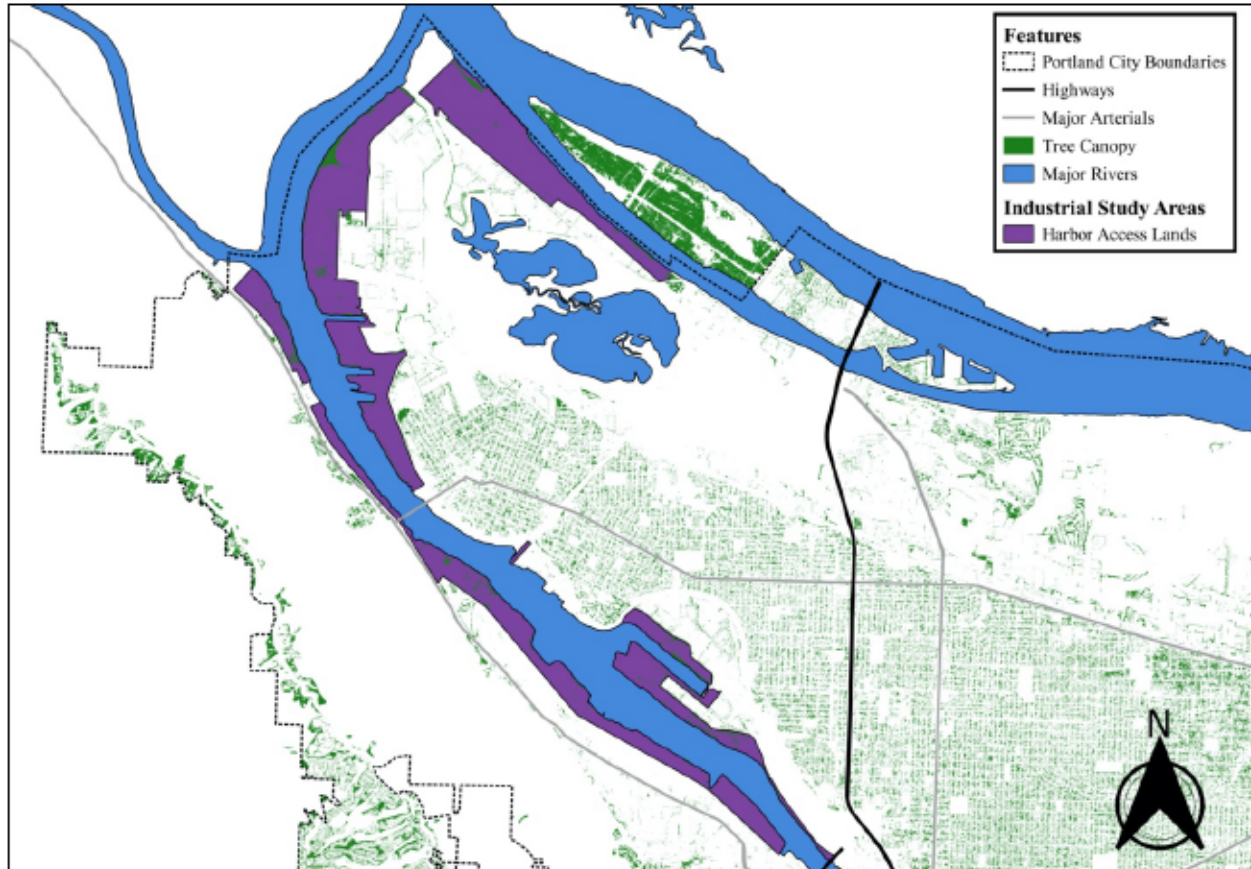
LINE	Predicted Development Yield				Net Change in RMV (000s)
	Construction Investment	Residential Units	Employment Acreage	Employment Capacity	
<b>HARBOR - AIRPORT</b>					
<b>BASELINE</b>					
New Construction	\$1,034,386,610	0	575.8	18,881	\$2,053,289
Rehab/Renovation	\$726,866,541				
Overall Total	\$1,761,253,151				
<b>NEW TREE REPLACEMENT REQUIREMENTS</b>					
New Construction	\$930,777,550	0	515.2	15,717	\$1,982,074
Rehab/Renovation	\$784,488,519				
Overall Total	\$1,715,266,068				



**HARBOR ACCESS LANDS**

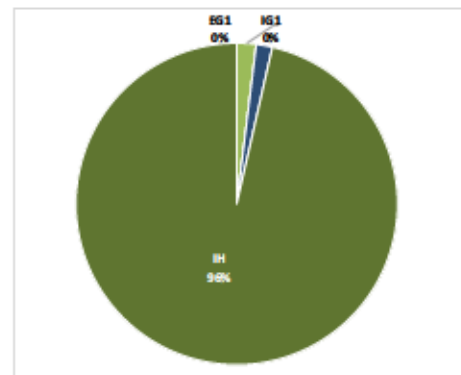
The Harbor Access Lands study area includes properties fronting the Portland Harbor. Harbor access is a limited resource and there is little ability to substitute for these sites. This can allow for higher achievable site pricing for qualified businesses, but not all uses are allowed on sites with marine dependent use restrictions.

**MAP OF IMPACTED PARCELS, HARBOR ACCESS LANDS**



A total of 136 sites were identified as impacted, representing 278 acres in the BLI. These sites have 64.4 acres of identified tree canopy, representing 23.2% of the site area. Virtually all the impacted sites are zoned IH (96%), which is currently exempted from both the tree preservation and tree density standards. As a result, these parcels are significantly impacted by the proposed changes.

**ACREAGE BY ZONING**





### MODEL OUTPUT

Our analysis indicates that the proposed changes would have a significant impact on development and redevelopment in the study area. Realized employment capacity is predicted to decline by over 506 jobs over a twenty-year period, reflecting a roughly 34% decrease.

#### SUMMARY OF MODEL RESULTS, HARBOR ACCESS STUDY AREA – 20 YEAR HORIZON

	Predicted Development Yield				
	Construction Investment	Residential Units	Employment Acreage	Employment Capacity	Net Change in RMV (000s)
<b>HARBOR ACCESS LANDS</b>					
<b>BASELINE</b>					
New Construction	\$82,278,979	0	46.9	1,500	\$127,413
Rehab/Renovation	\$20,123,733				
Overall Total	\$102,402,713				
<b>NEW TREE REPLACEMENT REQUIREMENTS</b>					
New Construction	\$54,537,665	0	31.0	994	\$92,817
Rehab/Renovation	\$20,935,557				
Overall Total	\$75,473,221				

If the forecast period is extended to 100 years, the decrease in predicted capacity would be 2,243 jobs.

#### SUMMARY OF MODEL RESULTS, HARBOR ACCESS STUDY AREA – 100 YEAR HORIZON

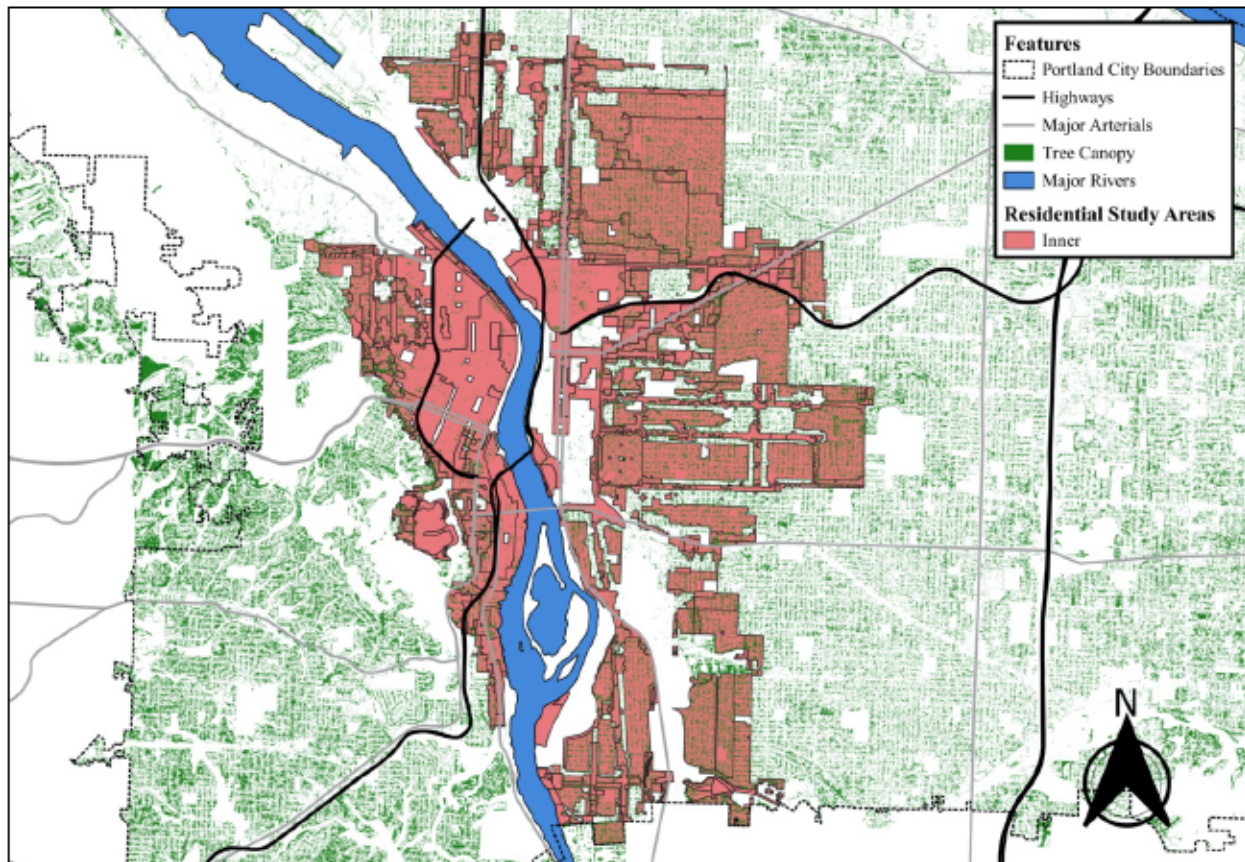
	Predicted Development Yield				
	Construction Investment	Residential Units	Employment Acreage	Employment Capacity	Net Change in RMV (000s)
<b>HARBOR ACCESS LANDS</b>					
<b>BASELINE</b>					
New Construction	\$393,268,464	0	224.3	7,169	\$636,221
Rehab/Renovation	\$126,443,235				
Overall Total	\$519,711,699				
<b>NEW TREE REPLACEMENT REQUIREMENTS</b>					
New Construction	\$270,192,060	0	153.8	4,926	\$524,833
Rehab/Renovation	\$169,779,678				
Overall Total	\$439,971,738				



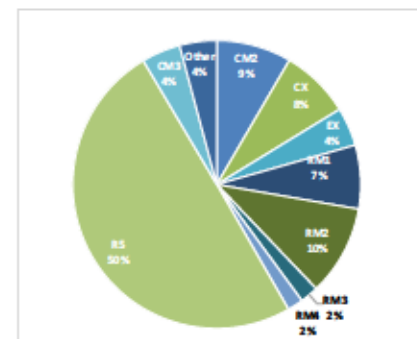
## INNER RESIDENTIAL

The Inner Residential study area includes Portland's CBD as well as relatively high-priced neighborhoods in the close-in eastside, north Portland, South Waterfront, Nob Hill, and John's Landing.

MAP OF INNER RESIDENTIAL STUDY AREA



ACREAGE BY ZONING



A total of 27,482 sites were identified as impacted, representing 4,351 acres. These sites have 972 acres of identified tree canopy, representing 22.3% of the site area. Roughly half of the acreage in the study area is zoned R5, with a wide range of other commercial and industrial zoning represented. The study area has some EX zoned property that is currently exempted from the tree preservation standards. The impact on the remaining property is limited to the expansion of the tree preservation requirements to include smaller trees. This will add to the cost of development and redevelopment on impacted sites.

The expected impact of the proposed code changes would be on residential yield in this study area. Under baseline scenario, the impacted portions of the subarea would be expected to accommodate an additional 62,931 residential units over a twenty-year time horizon. The predicted residential unit yield under the new tree ordinance would decline by only 24 units. This reflects relatively high underlying land values in this





market, which allows the cost of the tree ordinance requirements to be addressed through a modest reduction in residual land value.

#### SUMMARY OF MODEL RESULTS, INNER RESIDENTIAL STUDY AREA – 20 YEAR HORIZON

	Predicted Development Yield				Net Change in RMV (000s)
	Construction Investment	Residential Units	Employment Acreage	Employment Capacity	
<b>INNER RESIDENTIAL</b>					
<b>BASELINE</b>					
New Construction	\$14,271,362,156	62,931	21.0	1,094	\$27,258,710
Rehab/Renovation	\$9,137,027,195				
Overall Total	\$23,408,389,350				
<b>NEW TREE REPLACEMENT REQUIREMENTS</b>					
New Construction	\$14,265,390,475	62,907	21.0	1,094	\$27,252,150
Rehab/Renovation	\$9,137,554,004				
Overall Total	\$23,402,944,478				

If the forecast period is extended to 100 years, the decrease in predicted capacity would be close to 150 residential units.

#### SUMMARY OF MODEL RESULTS, INNER RESIDENTIAL STUDY AREA – 100 YEAR HORIZON

	Predicted Development Yield				Net Change in RMV (000s)
	Construction Investment	Residential Units	Employment Acreage	Employment Capacity	
<b>INNER RESIDENTIAL</b>					
<b>BASELINE</b>					
New Construction	\$77,860,517,107	341,875	101.4	5,284	\$166,522,680
Rehab/Renovation	\$68,236,571,563				
Overall Total	\$146,097,088,669				
<b>NEW TREE REPLACEMENT REQUIREMENTS</b>					
New Construction	\$77,824,602,765	341,725	101.4	5,284	\$166,500,067
Rehab/Renovation	\$68,256,534,532				
Overall Total	\$146,081,137,296				

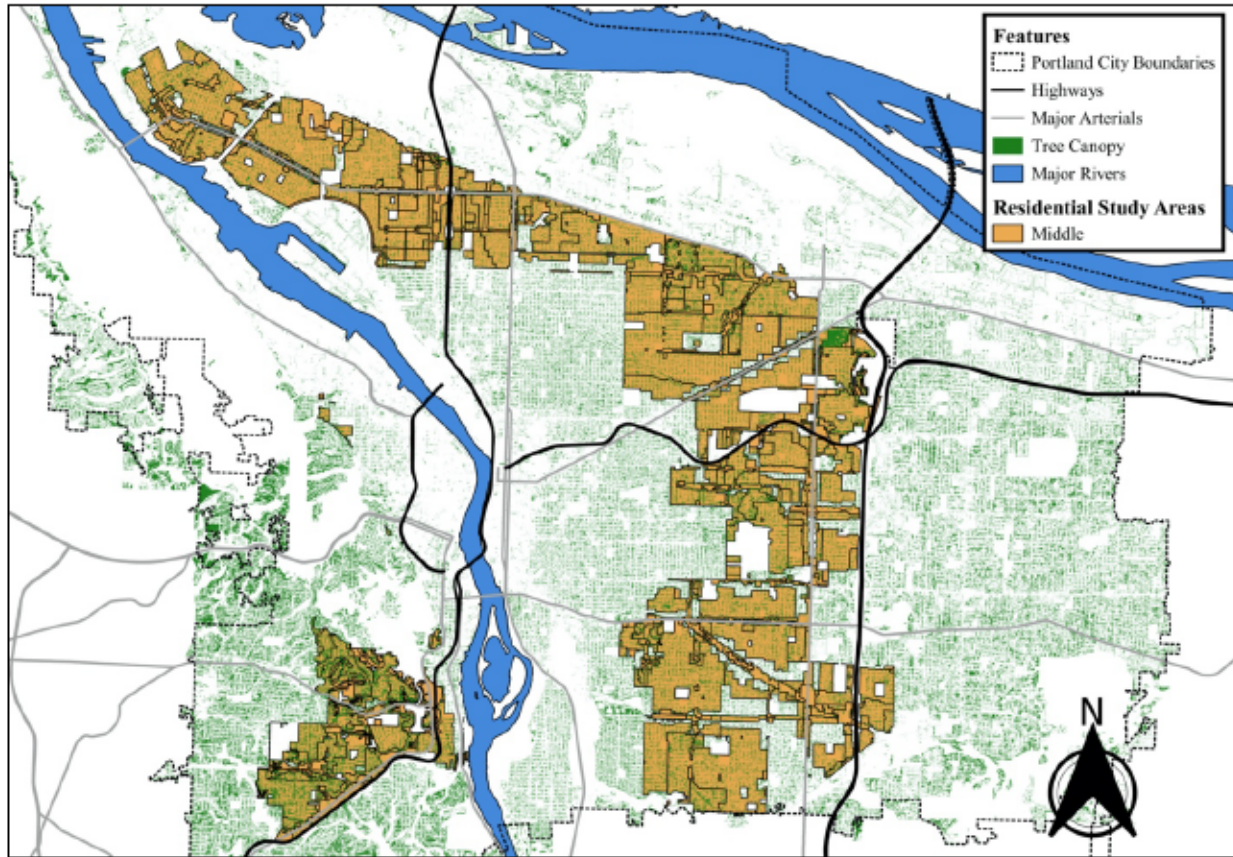
It is important to recognize that a marginal reduction in the price that new development is able to pay for land (residual land value) may lead to some short-term reductions in development activity as the market comes to terms with the new supportable pricing.

#### MIDDLE RESIDENTIAL

The Middle Residential study area includes largely residential areas surrounding the Inner Residential study area. Price points for residential product are somewhat lower than in the more central markets. Neighborhoods in this area include Saint Johns, Concordia, Rose City, Montavilla, Mount Tabor, Foster/Powell, Lents, Brentwood/Darlington, Hillsdale, and Multnomah Village.

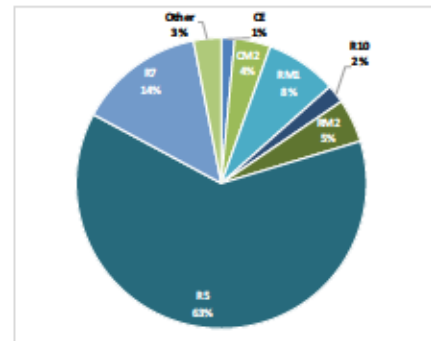


**MAP OF MIDDLE RESIDENTIAL STUDY AREA**



A total of 40,756 sites were identified as impacted, representing 6,327 acres. These sites have 1,582 acres of identified tree canopy, representing 25.0% of the site area. Land zoned R5 represents 63% of the impacted acreage in the study area, followed by R7 (14%) and RM1 (8%). The study area contains no impacted property that is currently exempted from the tree preservation standards.

**ACREAGE BY ZONING**



As with the Inner Residential study area, the anticipated reduction in capacity associated with the proposed regulatory changes in this submarket is negligible. Under the baseline scenario the impacted area is expected to realize an incremental gain of 4,294 residential units. This decreases by only 8 units over a twenty-year planning period.



**SUMMARY OF MODEL RESULTS, MIDDLE RESIDENTIAL STUDY AREA – 20 YEAR HORIZON**

	Predicted Development Yield				Net Change in RMV (000s)
	Construction Investment	Residential Units	Employment Acreage	Employment Capacity	
<b>MID-RESIDENTIAL</b>					
<b>BASELINE</b>					
New Construction	\$1,077,937,045	4,294	2.4	123	\$8,139,729
Rehab/Renovation	\$6,794,472,767				
Overall Total	\$7,872,409,812				
<b>NEW TREE REPLACEMENT REQUIREMENTS</b>					
New Construction	\$1,075,727,503	4,286	2.4	123	\$8,137,497
Rehab/Renovation	\$6,794,793,977				
Overall Total	\$7,870,521,480				

If the forecast period is extended to 100 years, the decrease in predicted capacity would be close to 50 units.

**SUMMARY OF MODEL RESULTS, MIDDLE RESIDENTIAL STUDY AREA – 100 YEAR HORIZON**

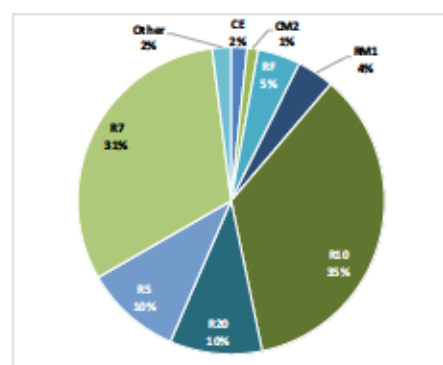
	Predicted Development Yield				Net Change in RMV (000s)
	Construction Investment	Residential Units	Employment Acreage	Employment Capacity	
<b>MID-RESIDENTIAL</b>					
<b>BASELINE</b>					
New Construction	\$5,606,780,884	22,375	12.1	622	\$68,988,721
Rehab/Renovation	\$62,041,690,509				
Overall Total	\$67,648,471,393				
<b>NEW TREE REPLACEMENT REQUIREMENTS</b>					
New Construction	\$5,594,713,262	22,326	12.1	622	\$68,992,825
Rehab/Renovation	\$62,059,587,026				
Overall Total	\$67,654,300,287				

**OUTER RESIDENTIAL STUDY AREA**

The Outer Residential Study Area includes a diverse mix of neighborhoods. To the east of I-205 are neighborhoods such as Parkrose, Hazelwood, Powellhurst/Gilbert, and Centennial. To the west are neighborhoods that can support relatively higher residential pricing, including Northwest Heights, Bridlemile, Sylvan, and Maplewood. The study area also includes portions of Hayden Island and areas west of Forest Park.

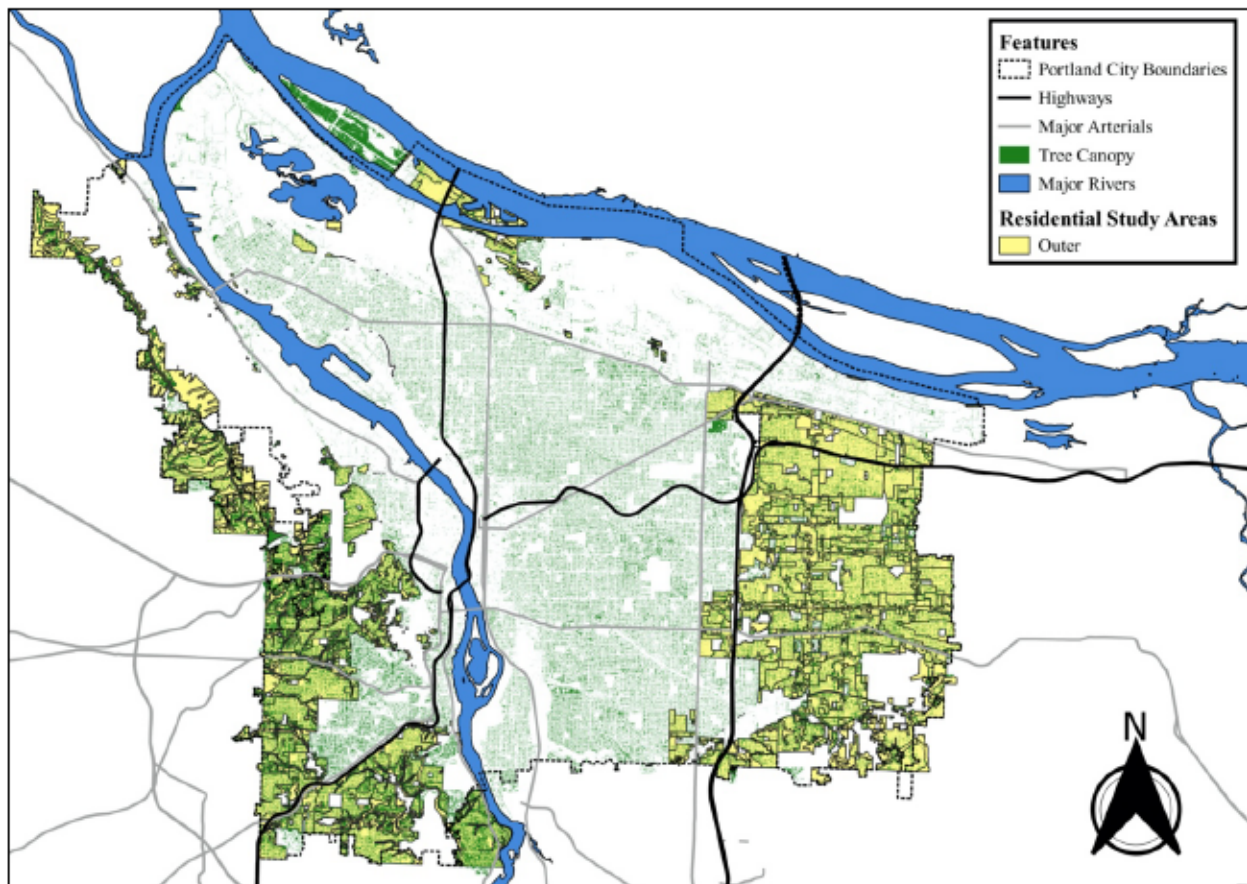
A total of 24,468 sites were identified as impacted, representing 9,450 acres. These sites have 2,913 acres of identified tree canopy, representing 30.8% of the site area. The zoned density in this study area is significantly lower, with 35% of the land zoned R10 and 31% zoned R7. Both R5 and R20 represent 10% of the total impacted land area.

**ACREAGE BY ZONING**





MAP OF OUTER RESIDENTIAL STUDY AREA



Under baseline scenario, the impacted portions of the subarea would be expected to accommodate an additional 11,722 residential units and 588 jobs. The impact of the new tree ordinance is projected to reduce residential yield by only 22 units in the study area over a twenty-year horizon.

**SUMMARY OF MODEL RESULTS, OUTER RESIDENTIAL STUDY AREA – 20 YEAR HORIZON**

	Predicted Development Yield				Net Change in RMV (000s)
	Construction Investment	Residential Units	Employment Acreage	Employment Capacity	
<b>OUTER RESIDENTIAL</b>					
<b>BASELINE</b>					
New Construction	\$2,792,161,692	11,772	11.2	588	\$8,873,932
Rehab/Renovation	\$5,175,265,435				
Overall Total	\$7,967,427,127				
<b>NEW TREE REPLACEMENT REQUIREMENTS</b>					
New Construction	\$2,786,675,315	11,750	11.2	587	\$8,867,772
Rehab/Renovation	\$5,175,738,144				
Overall Total	\$7,962,413,460				

If the forecast period is extended to 100 years, the decrease in predicted capacity would be 119 residential units.



### SUMMARY OF MODEL RESULTS, OUTER RESIDENTIAL STUDY AREA – 100 YEAR HORIZON

	Predicted Development Yield				Net Change in RMV (000s)
	Construction Investment	Residential Units	Employment Acreage	Employment Capacity	
<b>OUTER RESIDENTIAL</b>					
<b>BASELINE</b>					
New Construction	\$14,080,891,789	59,501	56.2	2,936	\$64,232,846
Rehab/Renovation	\$45,677,171,423				
Overall Total	\$59,758,063,212				
<b>NEW TREE REPLACEMENT REQUIREMENTS</b>					
New Construction	\$14,052,161,073	59,382	56.1	2,933	\$64,224,317
Rehab/Renovation	\$45,702,980,836				
Overall Total	\$59,755,141,908				

## VIII. RESIDENTIAL PRICING IMPACT

While the model does not predict substantive changes in residential carrying capacity associated with the changes in the tree ordinance, the incremental increase in development costs is expected to influence the residential market and potentially have an inflationary impact on housing prices. The proposed changes are expected to increase residential construction costs by over \$20 million over the next twenty years, but this represents only 0.11% of overall predicted residential investment in the City (new construction). As a result, the proposed changes are not expected to substantively impact affordability.

### SUMMARY OF IMPACTS OF PROPOSED CHANGES ON RESIDENTIAL CONSTRUCTION

Subarea	Residential Units	Unit Change	Cost of Changes	% of Total Construction
INNER RESIDENTIAL	62,907	(24)	\$8,403,860	0.06%
MID-RESIDENTIAL	4,286	(8)	\$4,566,430	0.42%
OUTER RESIDENTIAL	11,750	(22)	\$7,532,151	0.27%
TOTAL	78,943	(54)	\$20,502,441	0.11%

One of the reasons that cost of the proposed changes is relatively low for residential development is that the modelling structure tends to avoid development on parcels with relatively high costs. This is reflective of the market, and sites that are more negatively impacted are less likely to develop. While the marginal cost to those that do develop is low in the model, avoidance behavior will likely reduce and/or alter the nature of new development in the study area. This may less directly influence market pricing through a partial constraint on supply.

Calculating the actual impact on pricing is a function of the market's ability to shift the increased costs to the end market. In general, over a longer-term horizon increases in cost will be shifted towards the market (increased prices) and/or reflected in lower residual land values for development sites. In the short term, it is likely that some property owners and/or developers could be more negatively by an unanticipated change in the regulatory environment.



APPENDIX: DETAILED MODEL OUTPUT

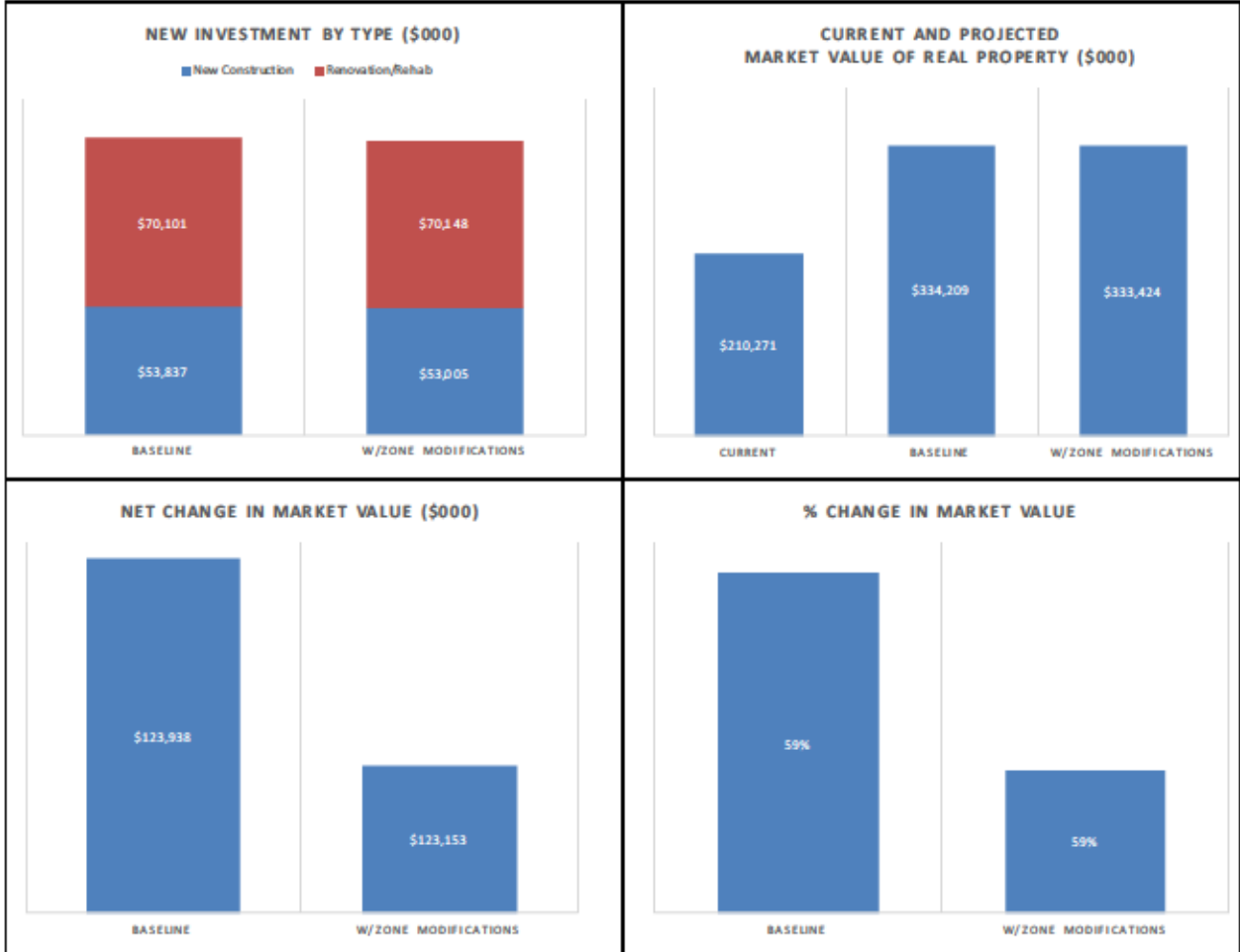


**SUMMARY OF PREDICTED DEVELOPMENT ACTIVITY OVER STUDY PERIOD  
WITH PROPOSED MODIFICATIONS IN TREE ORDINANCE  
20 Year Study Period , No Pricing Changes**

LINE	Predicted Development Yield				Marginal Cost on Impacted Properties		
	Construction Investment	Residential Units	Employment Acreage	Employment Capacity	Loss of Exemption	Change in Coverage	Tree Density
<b>COLUMBIA EAST</b>							
<b>BASELINE</b>							
New Construction	\$53,837,325	0	31.2	981			
Rehab/Renovation	\$70,100,701						
Overall Total	\$123,938,026						
<b>NEW TREE REPLACEMENT REQUIREMENTS</b>							
New Construction	\$53,005,284	0	30.7	965	\$0	\$153,598	\$0
Rehab/Renovation	\$70,148,002						
Overall Total	\$123,153,286						
<b>HARBOR - AIRPORT</b>							
<b>BASELINE</b>							
New Construction	\$198,806,570	0	110.6	3,629			
Rehab/Renovation	\$113,935,858						
Overall Total	\$312,742,428						
<b>NEW TREE REPLACEMENT REQUIREMENTS</b>							
New Construction	\$178,699,673	0	98.8	3,014	\$535,448	\$459,901	\$199,363
Rehab/Renovation	\$115,006,826						
Overall Total	\$293,706,499						
<b>HARBOR ACCESS LANDS</b>							
<b>BASELINE</b>							
New Construction	\$82,278,979	0	46.9	1,500			
Rehab/Renovation	\$20,123,733						
Overall Total	\$102,402,713						
<b>NEW TREE REPLACEMENT REQUIREMENTS</b>							
New Construction	\$54,537,665	0	31.0	994	\$379,823	\$133,648	\$852,175
Rehab/Renovation	\$20,935,557						
Overall Total	\$75,473,221						
<b>INNER RESIDENTIAL</b>							
<b>BASELINE</b>							
New Construction	\$14,271,362,156	62,931	21.0	1,094			
Rehab/Renovation	\$9,137,027,195						
Overall Total	\$23,408,389,350						
<b>NEW TREE REPLACEMENT REQUIREMENTS</b>							
New Construction	\$14,265,390,475	62,907	21.0	1,094	\$79,381	\$508,748	\$582,272
Rehab/Renovation	\$9,137,554,004						
Overall Total	\$23,402,944,478						
<b>MID-RESIDENTIAL</b>							
<b>BASELINE</b>							
New Construction	\$1,077,937,045	4,294	2.4	123			
Rehab/Renovation	\$6,794,472,767						
Overall Total	\$7,872,409,812						
<b>NEW TREE REPLACEMENT REQUIREMENTS</b>							
New Construction	\$1,075,727,503	4,286	2.4	123	\$30	\$477,459	\$66
Rehab/Renovation	\$6,794,793,977						
Overall Total	\$7,870,521,480						
<b>OUTER RESIDENTIAL</b>							
<b>BASELINE</b>							
New Construction	\$2,792,161,692	11,772	11.2	588			
Rehab/Renovation	\$5,175,265,435						
Overall Total	\$7,967,427,127						
<b>NEW TREE REPLACEMENT REQUIREMENTS</b>							
New Construction	\$2,786,675,315	11,750	11.2	587	\$12,943	\$2,166,422	\$43,526
Rehab/Renovation	\$5,175,738,144						
Overall Total	\$7,962,413,460						



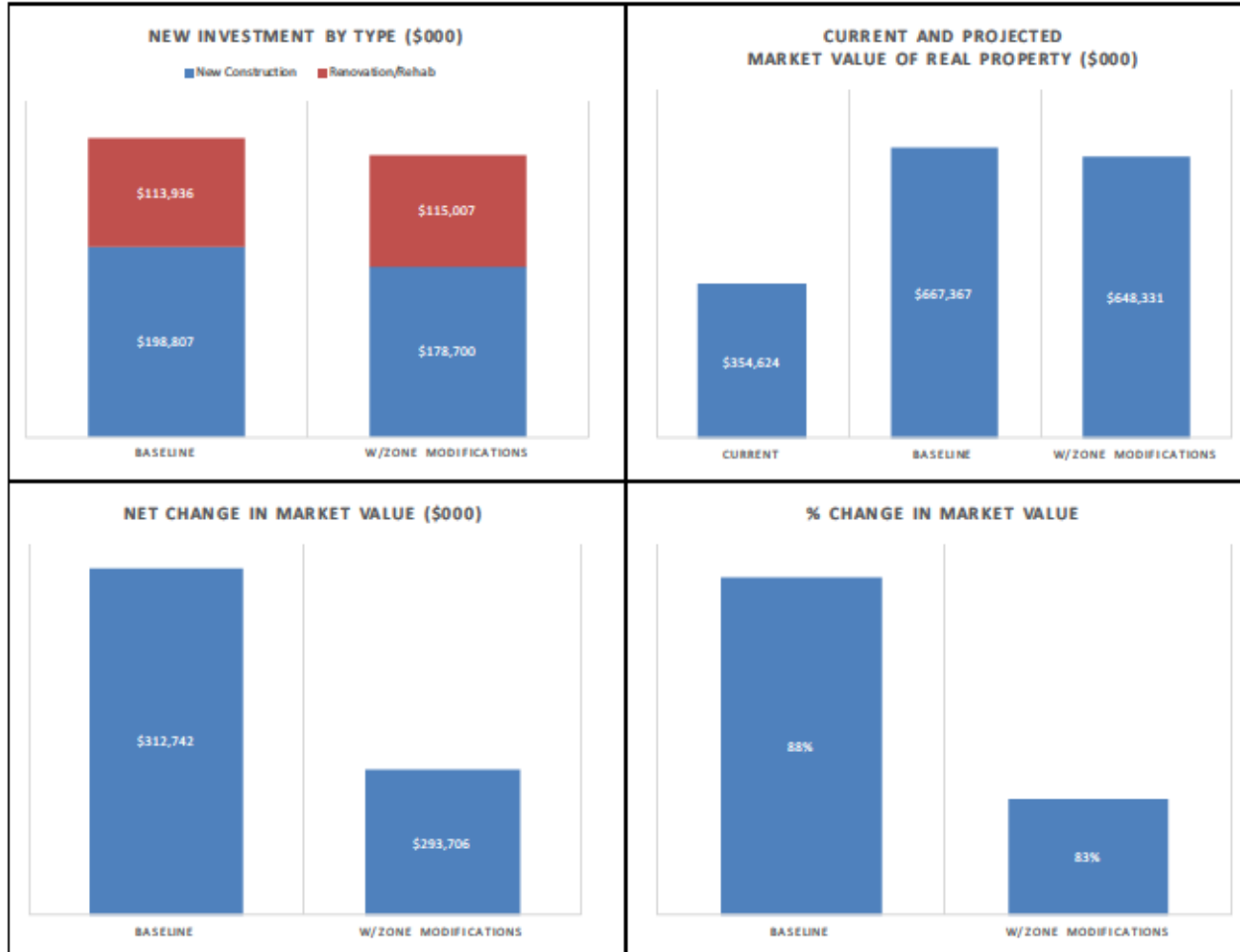
**COLUMBIA EAST  
SUMMARY OF MODEL OUTPUT  
MAGNITUDE OF INVESTMENT AND RESIDUAL PROPERTY VALUES**





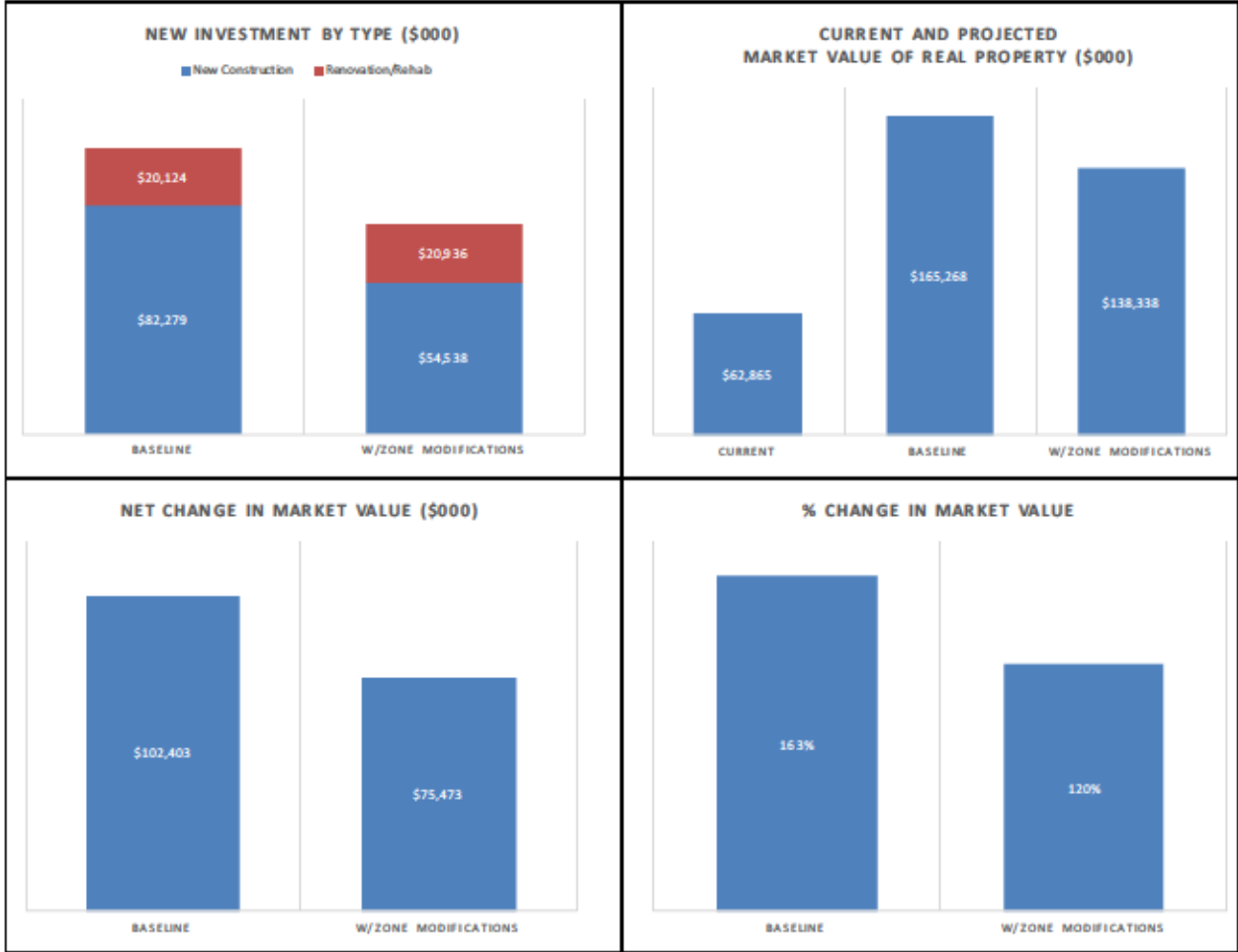


**HARBOR - AIRPORT  
SUMMARY OF MODEL OUTPUT  
MAGNITUDE OF INVESTMENT AND RESIDUAL PROPERTY VALUES**



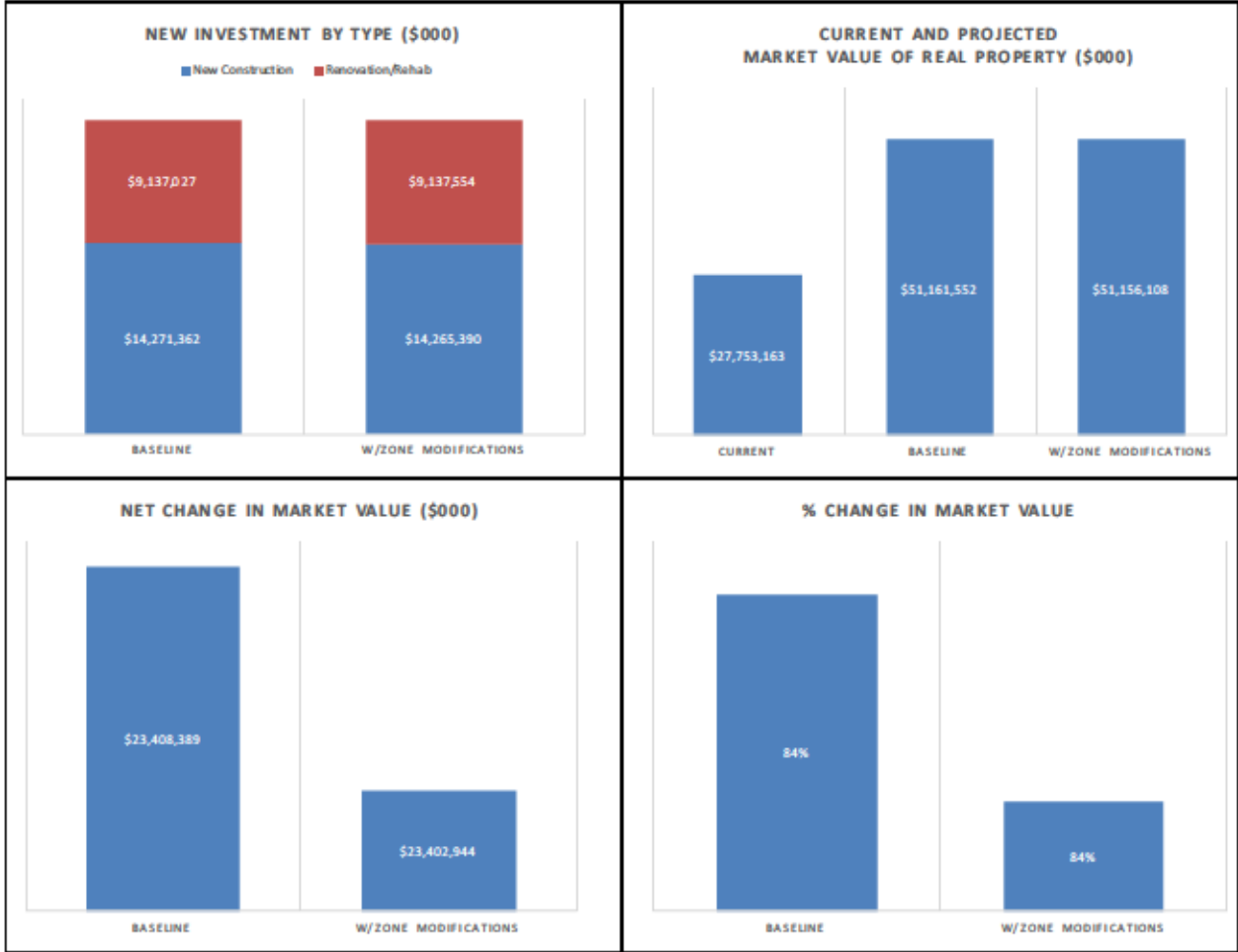


**HARBOR ACCESS LANDS  
SUMMARY OF MODEL OUTPUT  
MAGNITUDE OF INVESTMENT AND RESIDUAL PROPERTY VALUES**



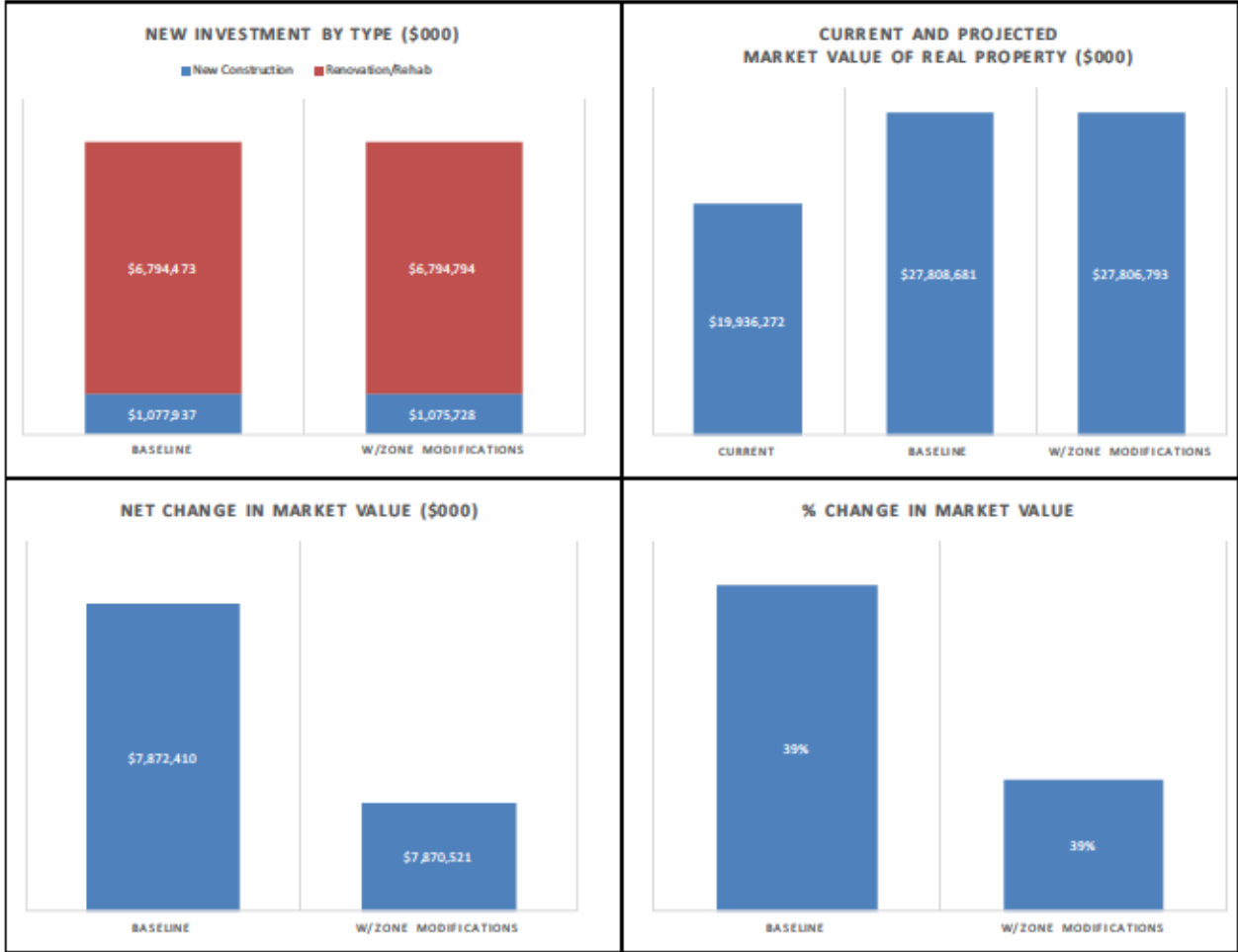


**INNER RESIDENTIAL  
SUMMARY OF MODEL OUTPUT  
MAGNITUDE OF INVESTMENT AND RESIDUAL PROPERTY VALUES**



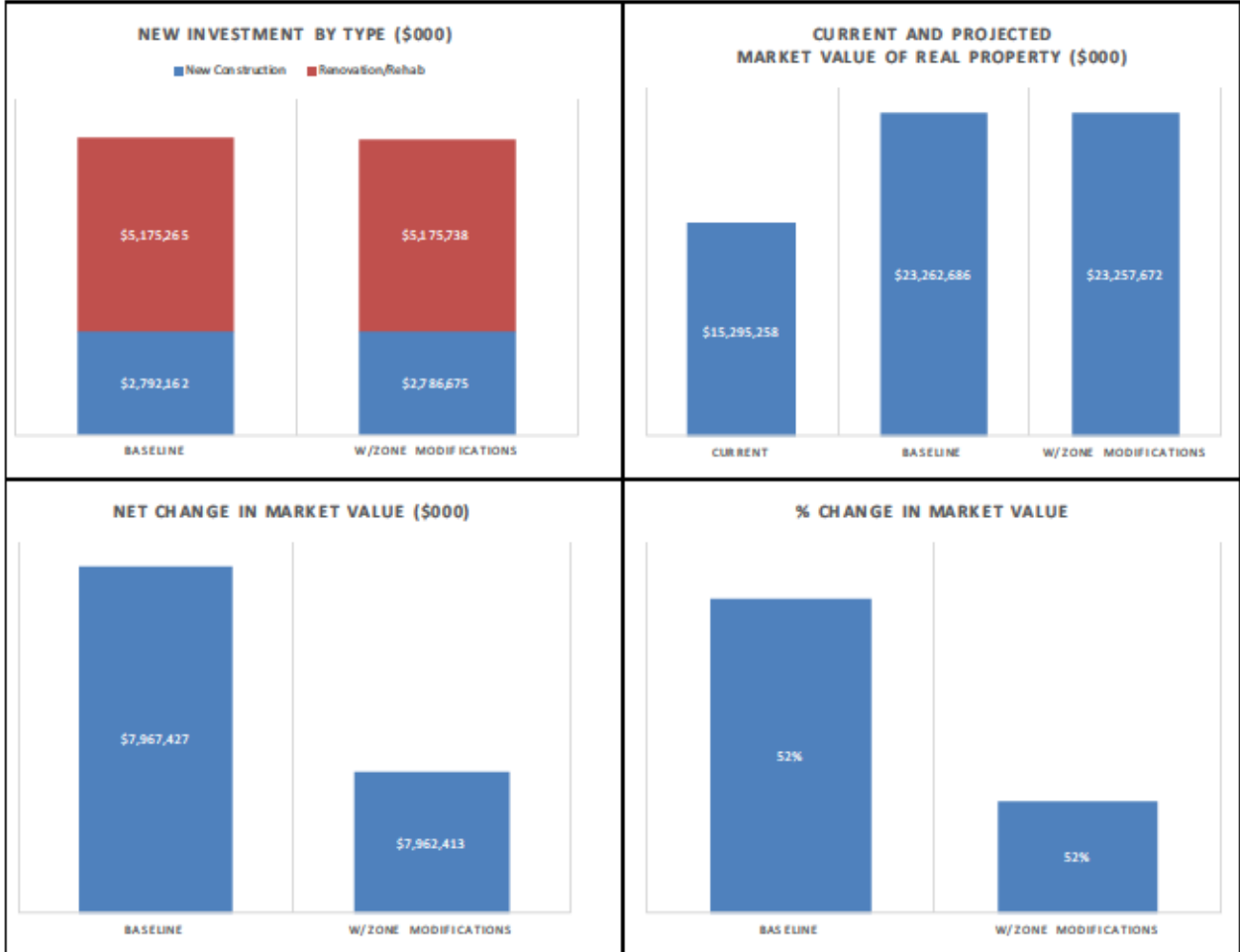


**MID-RESIDENTIAL  
SUMMARY OF MODEL OUTPUT  
MAGNITUDE OF INVESTMENT AND RESIDUAL PROPERTY VALUES**





**OUTER RESIDENTIAL  
SUMMARY OF MODEL OUTPUT  
MAGNITUDE OF INVESTMENT AND RESIDUAL PROPERTY VALUES**





**SUMMARY OF PREDICTED DEVELOPMENT ACTIVITY OVER STUDY PERIOD  
WITH PROPOSED MODIFICATIONS IN TREE ORDINANCE - IH ZONED PROPERTY  
20 Year Study Period , No Pricing Changes**

LINE	Predicted Development Yield		
	Construction Investment	Employment Acreage	Employment Capacity
<b>HARBOR - AIRPORT</b>			
<b>BASELINE</b>			
New Construction	\$70,024,954	40.5	1,276
Rehab/Renovation	\$27,176,003		
Overall Total	\$97,200,957		
<b>PROPOSED CODE CHANGES</b>			
New Construction	\$56,505,364	32.7	926
Rehab/Renovation	\$27,868,765		
Overall Total	\$84,374,129		
<b>HARBOR ACCESS LANDS</b>			
<b>BASELINE</b>			
New Construction	\$78,697,976	45.6	1,433
Rehab/Renovation	\$19,006,167		
Overall Total	\$97,704,143		
<b>PROPOSED CODE CHANGES</b>			
New Construction	\$51,891,688	30.0	945
Rehab/Renovation	\$19,809,334		
Overall Total	\$71,701,022		



**SUMMARY OF PREDICTED DEVELOPMENT ACTIVITY OVER STUDY PERIOD  
WITH PROPOSED MODIFICATIONS IN TREE ORDINANCE - IG1 ZONED PROPERTY  
20 Year Study Period, No Pricing Changes**

LINE	Predicted Development Yield			
	Construction Investment	Residential Units	Employment Acreage	Employment Capacity
<b>HARBOR - AIRPORT</b>				
<b>BASELINE</b>				
New Construction	\$45,344	0	0.0	1
Rehab/Renovation	\$6,311,734			
Overall Total	\$6,357,078			
<b>PROPOSED CODE CHANGES</b>				
New Construction	\$45,344	0	0.0	1
Rehab/Renovation	\$6,311,734			
Overall Total	\$6,357,078			
<b>HARBOR ACCESS LANDS</b>				
<b>BASELINE</b>				
New Construction	\$0	0	0.0	0
Rehab/Renovation	\$0			
Overall Total	\$0			
<b>PROPOSED CODE CHANGES</b>				
New Construction	\$0	0	0.0	0
Rehab/Renovation	\$0			
Overall Total	\$0			
<b>CENTRAL CITY</b>				
<b>BASELINE</b>				
New Construction	\$44,448,669	0	1.8	632
Rehab/Renovation	\$5,854,593			
Overall Total	\$50,303,262			
<b>PROPOSED CODE CHANGES</b>				
New Construction	\$44,442,282	0	1.8	632
Rehab/Renovation	\$5,854,838			
Overall Total	\$50,297,120			
<b>NON-CENTRAL</b>				
<b>BASELINE</b>				
New Construction	\$386,866	0	0.2	7
Rehab/Renovation	\$7,080,451			
Overall Total	\$7,467,318			
<b>PROPOSED CODE CHANGES</b>				
New Construction	\$386,699	0	0.2	7
Rehab/Renovation	\$7,080,458			
Overall Total	\$7,467,156			