

Analysis of Mature Forests in King County, Report 2

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King County

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II. Executive Summary

This report provides an analysis of the impacts of discontinuing harvest on mature forests managed by the Washington State Department of Natural Resources (DNR) and the King County Department of Natural Resources and Parks (DNRP) Parks Division (King County Parks). It includes analyses of revenue impacts, impacts on greenhouse gas (GHG) emissions, impacts related to the social cost of carbon, and the magnitude of GHG impacts relative to targets in King County's Strategic Climate Action Plan (SCAP).

The 20-year revenue impact of discontinuing harvest of mature forests was estimated to be between \$50 million and \$124 million for approximately 3,000 acres of foregone harvest on DNR-managed land and between \$407,000 and \$531,000 for 230 to 300 acres of foregone harvest on King County Parks-managed land. The revenue loss from foregone DNR harvests would be borne by trust beneficiaries of the parcels where harvests are discontinued. The revenue loss from discontinued harvest on King County lands would be borne by King County Parks, where revenue is used to support forest stewardship activities.

Due to differences in methods and available data, the analysis of GHG impacts of discontinuing harvest of mature forest used somewhat higher estimates of mature forest projected to be harvested over the next 20 years and included 3,809 acres of DNR-managed and 300 acres of King County-managed mature forest. GHG emissions under the projected harvest scenario were 1,018,200 tons of CO₂e (carbon dioxide equivalent) over the 20 years modeled. Emissions under the scenario without harvest of those acres were 343,400 tons of CO₂e over 20 years.¹ Therefore, the no-harvest scenario emitted about one-third of the emissions of the projected harvest scenario, constituting an emissions reduction of 674,600 tons of CO₂e over 20 years as a result of discontinuing harvest. More than 95 percent of those emissions reductions would be from DNR-managed lands, which constitute the majority of the acreage and are subject to more intensive harvest than King County-managed lands.

The social cost of carbon (SCC) is an estimate of the cost, in dollars, of the damage done globally by each additional ton of carbon emissions or the benefit of any action to reduce a ton of emissions and includes a range of impacts such as health outcomes, agricultural production, and property values. It is typically used in evaluating the social benefit of proposed regulations relative to the cost of implementing those regulations.² The SCC associated with discontinuing timber harvest of mature forests managed by DNR in King County and by King County Parks was calculated to be a positive benefit for global society of between \$86 million and \$246 million over 20 years (total present value in equivalent 2023 dollars). The majority of this (\$83 million-\$237 million) came from discontinuing harvest on DNR-managed lands, with between \$3 million and \$9 million coming from King County-managed lands. The range in values calculated reflects the use of a range of discount rates (between 1.5 percent and 2.5 percent), which

¹ The no-harvest scenario was a source of emissions because the model included emissions from substitution of the unharvested wood products with alternate materials. These emissions were a one-time occurrence, and the no-harvest scenario would eventually take up enough CO₂ to offset the substitution emissions.

² <https://www.brookings.edu/articles/what-is-the-social-cost-of-carbon/>. Estimates of the SCC can vary by several hundred dollars per ton due to differences in the discount rate (how much the present is valued compared to the future); how impacts on the different indicators are modeled and the value they are assigned; and the geographic scale of the impacts (which are usually global but can be modeled at a national or regional scale).

have a large effect on estimating how future climate change impacts are converted into present-day value.

The impact of GHG reductions from discontinuing harvest of mature forest was converted to metric tons per year and its impact was calculated relative to King County operations and at a countywide scale. Total 2007 baseline emissions for King County government operations were estimated at 354,000 metric tons of CO₂e.³ Therefore, a per-year reduction of 1,100 metric tons of CO₂e from discontinued harvest on King County-managed lands would constitute an approximately 0.32 percent reduction in government operations GHG emissions. At the countywide scale, total King County geographic-based GHG emissions in 2007 were estimated at 24,358,000 metric tons of CO₂e.⁴ Therefore, a per-year reduction of 30,600 metric tons of CO₂e for discontinued harvest on both King County- and DNR-managed lands would contribute approximately 0.13 percent to the 2030 and 2040 reduction targets.

This analysis provides an improved understanding of the relative scale of revenue and GHG impacts of discontinuing harvest. It highlights the tradeoff between revenue impacts, which are local in nature and primarily affect the trust beneficiaries of DNR lands, and the potential gains reflected in the social cost of carbon, which are global in nature. It also puts the GHG impacts in context by calculating their potential contribution to SCAP targets. This analysis provides additional data that can help inform decisions by both King County and DNR.

III. Background

Department Overview

The Department of Natural Resources and Parks supports sustainable and livable communities and a clean and healthy natural environment. Its mission is also to foster environmental stewardship and strengthen communities by providing regional parks, protecting the region's water, air, working lands, and natural habitats, and reducing, safely disposing of, and creating resources from wastewater and solid waste.

The Water and Land Resources Division (WLRD) is at the forefront of King County's efforts to protect and restore clean water and healthy habitat and strengthen the resilience of watersheds and our communities. WLRD has a dedicated workforce of more than 400 supported by a biennial budget of ~\$350 million. Regional programs include strategies to steward working farms and forests, restore habitat, recover salmon, improve water quality, reduce toxic threats, protect open space, and provide residents equitable access to green space. As the primary service provider to the King County Flood Control District, the division works to reduce flood risks to people, property, and infrastructure. WLRD's Environmental Lab and Science sections collect and maintain high-quality data sets to assess water quality and environmental trends and apply science to inform decision making. WLRD's one local service is providing stormwater management for unincorporated residents, reducing drainage problems, improving water quality, and restoring surface waters.

³ <https://your.kingcounty.gov/dnrp/climate/documents/2024/2401-13286w-SCAP-biennial-rpt.pdf>, Performance Measure GHG 2.

⁴ <https://your.kingcounty.gov/dnrp/climate/documents/2022/king-county-geographic-ghg-emissions-inventory-and-wedge-report-09-2022.pdf>, Table 1.

Historical Context

The expansive forests in Western Washington are known for their high productivity, which results from the mild, wet climate.⁵ Before the arrival of Europeans, “vast areas...were covered with old-growth conifer forests, primarily dominated by long-lived Douglas-fir and western hemlock, capable of attaining massive sizes.”⁶ One of the salient features of forests in the region is that productivity remains high, even in mature forests. As noted by Franklin et al. (2017), “...at 100 years Douglas-fir trees have achieved only about two-thirds of their eventual height.”⁷

By the mid-1850s, extensive forest clearing for cities and agriculture had begun, and harvest for wood products became widespread by the late 1800s.⁸ Harvest levels accelerated across forest ownerships after World War II, as the growing housing market created greater demand for lumber.⁹ Initially, the return of forest cover on harvested sites depended on natural regeneration, primarily of Douglas-fir and western hemlock. By the 1930s, replanting after harvest became common practice, eventually leading to widespread cover of Douglas-fir plantations.¹⁰

Currently, mature and old-growth forests make up just over 30 percent of the forested landscape west of the Cascades in Washington. The majority of mature and old-growth forests across the region are on public lands, with those under federal ownership having the highest proportion of forest cover in the older forest stages. This low coverage of older forests and the predominance of young to middle-age forests and plantations across the region has led to increased interest in conservation of existing older forests and forest management practices that accelerate development of older forest conditions.¹¹

Current Context

Mature forest is the stage that precedes old growth, when structural characteristics that are lacking in earlier stages are present and some structural characteristics of old-growth forests are emerging. Mature forests mark the transition from dense young forests — where low light availability leads to a reduction in understory or midstory vegetation and tree trunks below the canopy are devoid of foliage — to old growth.¹² They represent a stage along a continuum of forest stand development and can be defined and identified by their structural characteristics. For Western Washington, two stages of forest development can be grouped together to encompass the mature forest stage.¹³ The first includes forests that originated after large disturbance events following European settlement, characterized by trees at

⁵ Franklin, JF and DC Donato. 2020. Variable retention harvesting in the Douglas-fir region. *Ecological Processes* 9(8): 1-10.

⁶ Puettmann, KJ, A Ares, JI Burton, EK Dodson. 2016. Forest restoration using variable density thinning: Lessons from Douglas-Fir stands in western Oregon. *Forests* 7(310): 1-14.

⁷ Franklin, JF, TA Spies, FJ Swanson. 2017. Setting the stage: Vegetation ecology and dynamics. In: *People, Forests, and Change: Lessons from the Pacific Northwest*. DH Olson and B Van Horne (Eds). Washington DC: Island Press, p.25.

⁸ Franklin et al., 2017.

⁹ Franklin and Donato, 2020.

¹⁰ Puettmann et al., 2016.

¹¹ Donato, DC, JS Halofsky, MJ Reilly. 2020. Corraling a black swan: natural range of variation in a forest landscape driven by rare, extreme events. *Ecological Applications* 30(1): 1-15.

¹² Van Pelt, R. 2007. Identifying Mature and Old Forests in Western Washington. Washington State Department of Natural Resources, Olympia, WA. 104 p.

¹³ Van Pelt, 2007.

60 to 70 percent of their ultimate height. At this stage, growth slows and the upper canopy layer becomes less dense than in the previous stand development stage due to mortality of less vigorous trees and breakage of some trees. This allows more light to reach the forest floor, which supports the growth of shade-tolerant plants and trees, such as western hemlock, and allows for some recovery of the understory. The second stage includes forests that originated following large disturbance events prior to European settlement and is characterized by trees that have reached 80 to 90 percent of their ultimate height. The understory fully returns with abundant regeneration of shade-tolerant trees. Low levels of woody debris are present, since wood from prior disturbances has decayed and new large debris has not formed yet. In response to increased light, trees begin to grow lower branches and foliage on the previously bare trunks. These two stages mark the transition from dense young forests to old growth.¹⁴

Mature forests in King County were mapped using geospatial data related to forest structural characteristics. A total of 152,870 acres of mature forest was identified in King County. More than half (51 percent) of the mature forests are on federal land; almost 20 percent are on city-owned land, primarily within the City of Seattle’s Cedar River Municipal Watershed; 12 percent are privately owned; 11 percent are on DNR-managed land; 3 percent are County-owned; and less than 2 percent are either Tribally owned or owned by a state agency other than DNR.

Most mature forest in King County is considered harvestable based on the broad definition used, which includes final harvests, such as clearcuts and variable retention harvests, as well as intermediate harvests, such as thinning.¹⁵ Harvestable mature forest includes 4,546 acres (or 15 percent) of the forestland managed by King County Parks. Harvesting is permitted across this ownership, but harvests are primarily focused on enhancing ecological conditions of the forests, including managing forests to have greater structural and species diversity and to be more resilient to climate change. Recent and potential King County Parks harvests are guided by a 2020 assessment of high-priority forested areas in need of active management to improve forest health and climate resilience.¹⁶ While many of these harvests take place in younger-than-mature forests, there also can be ecologically motivated reasons to cut mature trees. These include reducing tree stress and mortality in dense conditions, pre-emptive thinning to reduce density to prepare a forest for hotter and drier summers as a result of climate change, mitigating disease such as root rot, and creating openings to allow planting of diverse species in otherwise homogenous stands.

DNR manages 16,534 acres in King County that were classified as legally harvestable. However, this includes 5,245 acres in Natural Area Preserves (NAP) and Natural Resources Conservation Areas (NRCA), which are managed to protect native ecosystems. Allowable timber harvest in these areas is limited to

¹⁴ Van Pelt, 2007.

¹⁵ “Timber harvesting” was defined as the cutting, removal, and sale of timber in a way that would require a Forest Practices Application under [RCW 76.090.050](#).¹⁵ Thinning is considered a timber harvest under this definition, whether it is intended to promote growth of residual standing trees or to achieve ecological outcomes (in which case the sale of logs is often a secondary objective to forest management goals). Areas “subject to timber harvesting” were defined as lands where no state or county law or regulation prohibits timber harvesting.

¹⁶ King County, 2020, <https://kingcounty.gov/legacy/services/environment/climate/actions-strategies/strategic-climate-action-plan.aspx>.

activities, such as ecological thinning, that enhance species or structural diversity.¹⁷ The remaining 11,289 acres represent harvestable mature forest managed by DNR as trust lands in King County. These lands are managed for a variety of different trusts, including 4,373 acres of State Forest Trust Lands for which King County is the trust beneficiary.

Report Methodology

Revenue Impacts

The revenue impacts to trust beneficiaries of discontinuing harvest of mature forests managed by either King County or by DNR as state trust lands were estimated using available revenue data from past harvests and projections for planned future harvests.

For DNR-managed trust lands, revenue estimates were based on estimated values of planned harvests for 2024. In order to evaluate the potential revenue impacts of discontinuing harvest of mature forest, maps of 2024 planned harvests were overlaid on the mature forest map and the number of acres within those harvests that were mapped as mature was calculated. The value of planned harvests that included a large proportion of mature forest was then used to estimate the value per acre of mature forest harvest, which was then used to calculate the value of the mature forest acres that would be removed from planned harvests.

For forests managed by King County Parks, which harvests a much smaller area annually, revenue estimates per acre were taken from averages of previous County projects in mature, mixed, and young conifer forests. In order to estimate the revenue impact of excluding areas of mature forest, the value of mature forest acreage removed from harvest was calculated.

For both DNR and King County, annual estimates were multiplied by 20 in order to provide estimates for changes in revenue over the next 20 years, in line with the time period used for the analysis of greenhouse gas (GHG) impacts. These estimates do not account for inflation or changes in timber value over that time.

GHG Impacts

DNRP contracted with Resilient Forestry to conduct the analysis of GHG impacts. Resilient Forestry used data collected and prepared for past work, including its map of mature forests in King County. For DNR, Resilient Forestry used expected rates of harvest based on the first two decades of DNR's 2019 Sustainable Harvest Calculation. For King County, the consultants assumed harvest of 15 acres per year, which is rounded up from 7 percent of the 200 acres per year that King County Parks plans to harvest. For DNR, projected harvests were modeled as either a medium thin, removing 45 percent of the basal area, or a regeneration harvest, retaining eight trees per acre selected from the largest 25 percent of trees; the simulation included planting 250 trees per acre of Douglas-fir following the regeneration harvest. For King County, projected harvests were modeled as a light thin, removing 30 percent of the basal area. The consultants modeled forest growth and carbon dynamics with and without harvest over 20 years using the Forest Vegetation Simulator with the Fire and Fuels Extension.¹⁸ Resilient Forestry accounted for carbon contained in above-ground and below-ground portions of living and dead plants

¹⁷ DNR, 1992. Natural Resources Conservation Areas Statewide Management Plan. DNR Division of Land Conservation. Olympia, WA, 33 pp.

¹⁸ <https://www.fs.usda.gov/fvs/software/index.shtml>

and the forest floor, carbon stored in wood products and landfills, GHG emissions associated with harvest and manufacturing operations, and the additional emissions associated with substitute products when local wood products are not available due to deferred harvest.

Social Cost of Carbon

The social cost of carbon is an estimate of the cost, in dollars, of the damage done globally by each additional ton of carbon emissions or the benefit of any action to reduce a ton of emissions and includes a range of impacts, such as health outcomes, agricultural production, and property values. It is typically used in evaluating the social benefit of proposed regulations relative to the cost of implementing those regulations. The calculation was made using the U.S. Environmental Protection Agency's (EPA) Workbook for Applying a Social Cost of Greenhouse Gas Emissions.¹⁹ The 20-year cumulative values from the above analysis of the difference in GHG emissions between the projected harvest and no-harvest scenarios were used in the calculation, and it was assumed that emissions changes were equal for each year of the 20-year period.²⁰ These values were converted from short tons to metric tons in order to use the EPA workbook. The EPA workbook tool provides a range of discount rates from 1.5 percent to 2.5 percent. The discount rate determines how much weight is placed on climate impacts that occur in the future; the higher the discount rate, the less significant future effects are considered, compared to any present-day impacts. The choice is a highly impactful variable in estimating how future climate change impacts are converted into present-day value, so this analysis provides the two values for the low and high ends of the range. In addition, the time period used has a substantial effect on the analysis. This analysis did not extend to 100 years, since the EPA tool only includes the years from 2020 to 2080. However, if a 100-year carbon calculation were used, it would stretch out the carbon benefits over a longer time period, decreasing annual carbon reductions.

Contribution to the Strategic Climate Action Plan

Year 2007 GHG emissions, for both County government operations and for countywide GHG emissions, were used as baselines to then estimate how much discontinued harvest could contribute to progress towards GHG emissions reduction goals in future years. The total 20-year cumulative emissions differences calculated above were used to calculate annual emissions reductions, which are assumed to be equal for each year of the 20-year time period.

IV. Report Requirements

A. Revenue Impacts of Discontinuing Harvest of Mature Forests (A.6)

Projected Revenue Impacts for DNR's Planned Harvests

DNR planned five harvests for 2024 on lands that included five different trust beneficiaries, including State Forest Trust Lands, on which King County and junior taxing districts are the beneficiaries. All five are planned as variable retention harvests, which retain at least eight trees per acre in order to maintain large trees and snags but are considered regeneration harvests that remove a large percentage of the

¹⁹ https://www.epa.gov/system/files/documents/2024-03/epa-sc-ghg-workbook_1.0.1.xlsx. For additional details on the methodology EPA uses to estimate the social cost of GHGs, see also: <https://www.epa.gov/environmental-economics/scghg>

²⁰ The calculations were based on carbon dioxide only; for the analysis of impacts of discontinuing timber harvest, changes in emissions of nitrous oxides and methane are de minimis compared to carbon dioxide.

basal area of a stand while attempting to replicate many of the residual forest components left after a natural disturbance. The total estimated value of these five harvests is \$9.4 million, with \$2.7 million (28.7 percent) of that total generated from State Forest Trust Lands.

The total area of planned harvests is 864.4 acres, of which 680.9 acres were mapped as younger-than-mature forest, 149.5 acres (17.3 percent) were mapped as mature forest, and 34 acres were mapped as older-than-mature. The value per acre was estimated using harvests with a high proportion of mature forest, yielding estimates of \$17,000–\$20,000 per acre. Based on this range, the revenue impact of forgoing harvest of 149.5 acres of mature forest would be between \$2.5 and \$3 million.

However, these calculations assume that mature forest can be removed from a planned timber harvest and that the harvest will still occur. In some cases where mature forest constitutes a smaller portion of a proposed harvest area, a planned harvest could still be viable with reduced acreage. However, in some cases, removing mature forest from a harvest area has a large enough impact that the harvest would be cancelled. For example, one of the five planned harvests, El Tigre, is a 94-acre variable retention harvest that has substantial overlap with 292 acres of forestland on Tiger Mountain that were selected to be moved out of trust status (where it would be harvested to generate revenue for trust beneficiaries) and into conservation status under the State Legislature’s Natural Climate Solutions (NCS) proviso. The El Tigre harvest will no longer occur, since a large portion of the harvest area will be moved to conservation status, so the revenue impact would be the full value of the harvest, estimated at \$1.6 million.²¹ Similarly, two of the other planned harvests include a large-enough percentage of mature forest that they may not be viable without it. Taking this into account, the revenue impact would be the full estimated value of three of the planned harvests and the estimated value of the mature forest portion of the other two, totaling \$6.2 million.

If it is assumed that the 2024 planned harvests are representative of future harvest years, both in terms of acreage and value, then the 20-year revenue impact of discontinuing harvest would be between \$50 million and \$124 million (in 2024 dollars) for 2,990 acres of foregone harvest.²²

Projected Revenue Impacts for King County Parks’ Planned Harvests

King County Parks has planned commercial thinning projects on 639 acres over the next four years. Mature forests make up 84 acres (or 13 percent) of that potential harvest area, or an average of 21 acres of mature forest per year. However, many of these acres are small areas within younger stands or are within stands of hardwoods. King County Parks’ harvest prescriptions retain these types of trees during commercial thinning, so 38 acres of mapped mature forest would be retained during harvest (Table 1). On another 46 acres (7 percent of planned harvest area), thinning of mature conifer is likely. Most of this acreage is made up of second-growth forests that were selected for thinning because, although they were mapped as mature forests, they suffer from high density, low diversity, or drought and disease risks. Thinning and planting diverse native trees can alleviate these issues (Table 1).

²¹ In this case, DNR will use the NCS funds to purchase replacement lands, and revenue from the harvest of those lands will make the trust whole. However, if DNR were to eliminate harvest on mature forests outside of a program like NCS, revenue from foregone harvest would be lost rather than replaced.

²² Calculated as 149.4 acres x 20 years = 2,990 acres and \$2.5 million x 20 years = \$50 million and \$6.2 million x 20 years = \$124 million.

Table 1. King County Parks planned commercial thinning projects.

Forest Type	Project Area (Acres)	Mapped as Mature (Acres)	Mapped as Mature (% of Project Area)	Prescription Notes
Young Conifer	208	5	3%	Retain mature conifer (or mapping error and mature areas will be excluded)
Hardwood	337	33	10%	Retain mature conifer (or mapping error and mature areas will be excluded)
Mature Conifer	48	39	82%	Second-growth mature conifer forests selected for thinning to address high density, low diversity, drought/disease risks.
Mixed Conifer	46	7	16%	Mostly young forests but thinning through mature conifers is likely to address high density, low diversity, drought/disease risks.
Total	639	84	13%	

Revenue from mature forests from these thinning projects, which typically remove 30 percent of the basal area of the stand, is estimated at \$1,770 per acre, compared to \$1,110 per acre for mixed conifer and \$835 per acre for young conifer.²³ Therefore, the revenue impact of foregoing harvest on all 84 acres of mature forest would be approximately \$150,000. However, since the existing harvest prescriptions would retain the mature forest within the young conifer and hardwood harvests, a more realistic estimate comes from foregoing 46 acres of mature conifer harvest, which would result in a loss of \$81,420 in revenue over the next four years, or 11.5 acres and \$20,355 per year.²⁴ This annual acreage estimate is slightly lower than the 15 acres per year used in the GHG analysis; at that rate, the revenue impact of foregoing harvest would be \$26,550 per year. Under the assumption that these acreage estimates would be the same for each year over the next 20 years, this would result in a total revenue loss of between \$407,000 and \$531,000 for 230 to 300 acres of foregone harvest.

Revenue Potential from Forest Carbon Credits

There is some potential to generate forest carbon revenue from deferred harvest of mature forest. However, this depends on the existence or creation of a forest carbon project to which those parcels could be added. In the case of DNR, its proposed forest carbon project could generate carbon credits by removing stands from the planned harvest schedule.²⁵ However, the project has not yet moved to the validation and verification stages, so it is unclear whether or when it would be a viable avenue for generating carbon credits. In the case of King County, mature forest parcels could potentially be added to the existing King County Rural Forest Carbon Project, but the very small acreage of mature forest being considered for harvest would likely not generate enough revenue to justify the effort and cost of including them. In addition, these are stands that have been identified for thinning to improve forest resilience, so they would be poor candidates for deferred harvest. A third option would be for King County to acquire parcels from DNR that are projected to be used for commercial timber harvest and shift them into conservation management by DNRP, making them eligible to be added to King County's

²³ These values are stumpage, which is net revenue to the County after deducting logging and transport costs.

²⁴ Calculated as \$1770 x 46 acres = \$81,420. Since this acreage is over four years, annual values are 11.5 acres x \$1770 = \$20,355.

²⁵ <https://www.dnr.wa.gov/CarbonProject>

project. The number of carbon credits generated would depend on the composition, age, and condition of the forest and the area within the acquired parcels that would have been available for harvest, since stream buffers and other areas that are not legally available for harvest are excluded. This approach would require further analysis of specific parcels to assess its feasibility.

B. Greenhouse Gas Impacts of Discontinuing Harvest of Mature Forests (A.7)

The analysis of GHG impacts of discontinuing harvest of mature forest included 3,809 acres of DNR-managed and 300 acres of King County-managed mature forest (totaling 4,109 acres) that are projected to be harvested over the next 20 years. GHG emissions under the projected harvest scenario were 1,018,200 tons of CO₂e over the 20 years modeled. Emissions under the scenario without harvest of those acres were 343,400 tons of CO₂e over 20 years (Table 2). More than 95 percent of these emissions were from DNR-managed lands, which constitute most of the acreage and are subject to more intensive harvest than King County-managed lands.

Both the projected harvest and the no-harvest scenarios exhibited net emissions of GHGs after 20 years, but the no-harvest scenario emitted about one-third of the emissions of the projected harvest scenario, constituting a reduction in emissions of 674,600 tons of CO₂e as a result of discontinuing harvest (Table 2). The reason the no-harvest scenario continued to be a source of emissions is because the model includes substitution for the unharvested wood products, which were replaced with materials from other locations or alternate materials. Since these substitution-related emissions were modeled as a one-time occurrence at the time harvest would have occurred, the no-harvest scenario would eventually sequester enough CO₂ to offset the substitution emissions; however, more than 20 years are needed to reach this point.²⁶ Since this was a simplified substitution analysis that did not include an economic analysis that would capture whether this relatively small change in harvested wood products would lead to the types of substitution included in the model, this could be an overestimate of the emissions in the no-harvest scenario and an underestimate of the emissions reductions resulting from discontinuing harvest.

Table 2. GHG flux after 20 years under a projected harvest scenario and a no-harvest scenario. Positive values represent GHGs added to the atmosphere while negative numbers represent reductions of GHGs.

	GHG Flux tons CO ₂ e/acre (total tons CO ₂ e)		
	King County	DNR	Combined DNR and King County
Projected harvest	120.6 (36,200)	257.8 (982,000)	229.3 (1,018,200)
No harvest	38.5 (11,400)	87.2 (332,000)	77.1 (343,400)
Difference	-82.1 (-24,600)	-170.6 (-659,000)	-152.2 (-674,600)

²⁶ The analysis extended the model out to 100 years (without adding any new harvests), by which point uptake by the unharvested forest exceeded the substitution emissions.

C. Socialized Financial Costs of Discontinuing Harvest of Mature Forests (A.8)

The socialized cost of carbon (SCC) associated with discontinuing timber harvest on the lands above was calculated to be between \$86 million and \$246 million, in total, over 20 years (present value in equivalent 2023 dollars). The majority of this (\$83 million to \$237 million) comes from discontinuing harvest on DNR-managed lands, with between \$3 million and \$9 million coming from King County-managed lands (Table 3). The range in values depends on the discount rate used (from 2.5 percent to 1.5 percent), which results in an average SCC ranging from \$140 to \$401 per metric ton of CO₂.²⁷ These results indicate that there is a potential global societal benefit from reducing emissions by discontinuing timber harvest, but the value far exceeds the current prices of carbon credits in voluntary or compliance markets.

Table 3. Social cost of carbon associated with 20-year reductions in GHG emissions from foregoing mature forest harvest. Analysis was done for 1.5% and 2.5% discount rates.

	King County	DNR	Combined DNR and King County
20-year GHG reduction (metric tons CO₂e)	22,300 (1,100 per year)	589,700 (29,500 per year)	612,000 (30,600 per year)
Total present value of SCC (2.5% discount)	\$3.1 million	\$82.6 million	\$85.7 million
Total present value of SCC (1.5% discount)	\$9 million	\$236.7 million	\$245.7 million

D. Contribution to the Strategic Climate Action Plan from Discontinuing Harvest of Mature Forests (A.9)

King County’s government operations GHG emissions reduction target is to reduce emissions by 50 percent by 2025 and 80 percent by 2030 compared to a 2007 baseline.²⁸ Total 2007 baseline emission for King County government operations were estimated at 354,000 metric tons of CO₂e.²⁹ A per-year reduction of 1,100 metric tons of CO₂e for discontinued harvest on King County owned lands would be an approximately 0.32 percent reduction in government operations GHG emissions.

At the countywide scale, in early 2022, as part of updates to King County Countywide Planning Policies, King County and the 39 cities in the County strengthened shared GHG emissions reduction targets to 50 percent below 2007 levels by 2030; 75 percent below 2007 levels by 2040; and 95 percent below 2007 levels and net-carbon neutral by 2050.³⁰ Total King County geographic-based GHG emissions in 2007

²⁷ These values are substantially higher than those used by the EPA, which in recent years has put the SCC at \$43 to \$190 per ton globally; <https://www.brookings.edu/articles/what-is-the-social-cost-of-carbon/>

²⁸ <http://www.kingcounty.gov/SCAP>, Performance Measure GHG 2.

²⁹ <https://your.kingcounty.gov/dnrp/climate/documents/2024/2401-13286w-SCAP-biennial-rpt.pdf>, Performance Measure GHG 2.

³⁰ https://cdn.kingcounty.gov/-/media/king-county/depts/executive/performance-strategy-budget/regional-planning/cpps/kc_2021_cpps_ord_19660_113021.pdf?rev=dc68c4a4ea67465c8c79de0869fcb867&hash=A3EB1B05E22148F999802F018F0827B3, EN-27.

were estimated to be 24,358,000 metric tons of CO₂e.³¹ Therefore, a reduction of 30,600 metric tons of CO₂e for discontinued harvest on King County Parks and DNR-managed lands in King County would contribute approximately 0.13 percent to the 2030 and 2040 countywide reduction targets.

These emissions reduction estimates are intended to show the magnitude of contributions possible relative to established targets but would not necessarily be calculated as part of King County's ongoing GHG inventories and performance measurement. This is primarily because inventories do not generally include calculations for actions or decisions that reduce or avoid emissions, such as a forest management decision that alters a harvest plan.

V. Conclusion

In King County, there are more than 150,000 acres of mature forests, which represent the transition from dense young forests to forests with open, complex structures and diverse understories. DNR and King County manage 11 percent and 3 percent of the mature forests in the county, respectively, some of which are harvested each year. This analysis provides an improved understanding of the relative scale of revenue and GHG impacts of discontinuing these harvests.

For King County, the GHG impacts of discontinuing harvest are small, both in absolute terms and as a contribution to SCAP targets, due to the small acreage of mature forest harvested annually. The revenue impacts of discontinuing harvest are also small, but the present value of the SCC calculated for this action could have substantially greater value. However, the mature forests within King County's planned harvests are ones that suffer from high density, low diversity, or drought and disease risks. As such, discontinuing harvest on those sites would have a potential cost in terms of long-term forest resilience, since thinning and planting diverse native trees can alleviate these issues.

For DNR, revenue impacts and SCC estimates are much larger, with both ranging from tens to hundreds of millions of dollars, reflecting a tradeoff between local revenue for trust beneficiaries — which funds schools, fire districts, and other services — and the global climate benefits of increased carbon storage. Because these are trust lands and DNR has a fiduciary responsibility to generate revenue for the trust beneficiaries, the foregone revenue from any discontinued harvest would have to be replaced with another source of revenue for those same beneficiaries. In some cases, this might be achieved by harvesting more acreage of younger trees. Evaluation of the GHG impacts of this type of shift was not part of this analysis but a comparison of the projected harvest scenario with an alternate harvest scenario could provide valuable insight.

The analysis and findings in this report can help guide forest management decisions by King County DNRP and DNR as the two agencies work to advance collaborative management. It can support DNRP in meeting the True North Value: "We are responsible stewards."³² DNRP's forestry work focuses on managing forests for a range of values, from ecological to cultural. This work benefits from improved understanding of the impacts of different management choices.

³¹ <https://your.kingcounty.gov/dnrp/climate/documents/2022/king-county-geographic-ghg-emissions-inventory-and-wedge-report-09-2022.pdf>, Table 1.

³² <https://kingcounty.gov/en/legacy/elected/executive/constantine/initiatives/true-north>

VI. Appendix



KING COUNTY

1200 King County Courthouse
516 Third Avenue
Seattle, WA 98104

Signature Report

Motion 16437

Proposed No. 2023-0316.2

Sponsors Upthegrove

1 A MOTION requesting the executive to identify and
2 analyze mature forests in King County, and to transmit two
3 reports.

4 WHEREAS, forests provide multiple benefits on both the local and global scale,
5 and

6 WHEREAS, the Intergovernmental Panel on Climate Change has stated that
7 forest management activities play a key role in the mitigation of climate change, and the
8 Washington state Legislature has found that forests are one of the most effective
9 resources that can absorb carbon dioxide from the atmosphere, and

10 WHEREAS, King County's 2020 Strategic Climate Action Plan states that there
11 are substantial carbon and climate benefits to maintaining, protecting, restoring, and
12 expanding the more than 811,000 acres of forest land in King County, and that recent
13 studies combining carbon sequestration potential and risk of loss due to wildfire, insects,
14 and disease rank the coastal and Cascade forests of Oregon and Washington among the
15 highest priority for protection, and

16 WHEREAS, in 2021, the executive developed a 30-Year Forest Plan, which lays
17 out priorities and goals associated with King County's forests, as well as strategies for
18 achieving those over the next thirty years, and

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19 WHEREAS, in addition to greenhouse gas mitigation benefits, the 30-Year Forest
20 Plan states that King County's forests provide benefits to human health, salmon habitat,
21 and water quality and quantity, in addition to the economic benefits of timber, and

22 WHEREAS, "mature forests" are forests that were logged in the first half of the
23 twentieth century or earlier, that naturally regenerated rather than being replanted, and
24 that retain biological, structural, functional, or genetic legacies of natural and old-growth
25 forests, and

26 WHEREAS, mature forests, on their way to becoming old-growth habitats,
27 embody the species diversity, genetic richness, and intricate structural complexity of their
28 natural predecessors, and

29 WHEREAS, these older forests store more carbon in standing wood, downed
30 woody debris and in the soil compared to younger ecosystems, and the conversion to
31 younger plantation forests results in an immediate release of carbon when logged, as well
32 as a reduction in the overall carbon store because of the current shorter harvest rotation
33 age, and

34 WHEREAS, the significant historical logging impact on Western Washington's
35 old-growth forests necessitates the preservation of the remaining, unprotected mature
36 forests for safeguarding the essential biological, genetic, and ecological heritage that once
37 characterized the Pacific Northwest's forests, as well as retaining all the benefits mature
38 forests provide, and

39 WHEREAS, twenty-one counties, including King County, deeded roughly
40 546,000 acres of forest lands to the state during the 1920s and 1930s and, in exchange,
41 the state committed to managing the properties as trust lands and giving most of the

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42 revenue from timber sales and other revenue-producing activities back to the county and
43 junior taxing districts, and

44 WHEREAS, the state has managed the state forest trust lands within King County
45 to balance economic, environmental, and recreational interests for nearly one hundred
46 years, and

47 WHEREAS, The Washington Supreme Court affirmed in *Conservation*
48 *Northwest, et al. v. Commissioner of Public Lands, et al.* that... there are "myriad ways
49 DNR could choose to generate revenue from the state and forest board lands or otherwise
50 put them to use for the benefit of the enumerated beneficiaries," and

51 WHEREAS, King County has benefited from the state's responsible stewardship
52 of state forest trust lands, which have provided a valuable source of revenue and
53 economic support for the county and its people but, in light of the climate emergency and
54 other benefits that forests provide, some of the state forest trust lands in King County
55 may better serve the community if owned and managed by the county and protected from
56 future timber harvesting;

57 NOW, THEREFORE, BE IT MOVED by the Council of King County:

58 A. The council requests that the department of natural resources and parks
59 undertake a study on mature forests in King County. The study should include, but not
60 be limited to, the following:

61 1. A definition of mature forests using the Washington state Department of
62 Natural Resources definition of Maturation I classification in Guide to Identifying Mature
63 & Old-Growth Forests, Van Pelt 2007, or in any updated definition based on best
64 available forest ecology science;

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- 65 2. An analysis of the total acreage and ownership of mature forests that are
66 subject to timber harvesting;
- 67 3. A map showing the location of mature forests that are subject to timber
68 harvesting;
- 69 4. An analysis of which mature forests are both subject to timber harvesting and
70 either:
- 71 a. owned by King County; or
72 b. managed by the state as any type of state forest trust lands;
- 73 5. Identification of tribal governments that, as comanagers of the mature forests,
74 shall be consulted when considering county applications for the Trust Land Transfer
75 program and the Natural Climate Solutions program or when considering reconveyance
76 of state forest trust lands or substantial changes in management plans for county-owned
77 forest lands;
- 78 6. An analysis of the revenue impacts to the trust beneficiaries, including King
79 County, if timber harvesting were to be discontinued on the lands identified in section
80 A.4. of this motion. The analysis should take into account opportunities to generate
81 revenue from sale of carbon credits and through selective harvesting for forest health;
- 82 7. An analysis of the greenhouse gas impacts if timber harvesting were to be
83 discontinued on the lands identified in section A.4. of this motion. For parcels where
84 site-specific information is available, the analysis should make use of that information in
85 analyzing greenhouse gas impacts. Where no such information exists, the department
86 should estimate based on the best available information;

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87 8. Based on the greenhouse gas impacts identified in through the analysis in
88 section A.7. of this motion, a calculation, using the United States Environmental
89 Protection Agency methodology for calculating the social cost of carbon, of the
90 socialized financial costs if timber harvesting were to be discontinued on the lands
91 identified in section A.4. of this motion;

92 9. An analysis of how preservation of the forests identified in section A.4. of
93 this motion would contribute to achievement of the greenhouse gas reduction targets
94 identified in the county's Strategic Climate Action Plan;

95 10. For any mature forests that are managed by the state as state forest trust
96 lands, an analysis of whether those lands are eligible for reconveyance or another type of
97 transfer to county ownership; and

98 11. Identification of parcels that would be strong candidates for state funding
99 through the Trust Land Transfer program or the Natural Climate Solutions program to
100 mitigate fiscal impacts of preserving the parcels.

101 B. The executive should electronically file two reports. The first report should
102 contain the information in section A.1. through 5. of this motion and section A.10. and
103 11. of this motion, and the second report should contain the information in section A.6.
104 through 9. of this motion. The executive should electronically file the first report and a
105 proposed motion acknowledging receipt of the report no later than June 30, 2024, with
106 the clerk of the council, who shall retain an electronic copy and provide an electronic
107 copy to all councilmembers, the council chief of staff, and the lead staff for
108 transportation, economy and environment committee or its successor. The executive
109 should electronically file the second report and a proposed motion acknowledging receipt


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110 of the report no later than September 30, 2024, with the clerk of the council, who shall
111 retain an electronic copy and provide an electronic copy to all councilmembers, the
112 council chief of staff, and the lead staff for transportation, economy and environment
113 committee or its successor.


Motion 16437 was introduced on 9/12/2023 and passed by the Metropolitan King County Council on 10/3/2023, by the following vote:

Yes: 9 - Balducci, Dembowski, Dunn, Kohl-Welles, Perry, McDermott, Upthegrove, von Reichbauer and Zahilay

KING COUNTY COUNCIL
KING COUNTY, WASHINGTON

DocuSigned by:

E76CE01F07B14EF...
Dave Upthegrove, Chair

ATTEST:

DocuSigned by:

8DE1BB375AD3422...
Melani Hay, Clerk of the Council

Attachments: None