Oregon Department of Forestry Draft Habitat Conservation Plan and Forest Management Plans

A Comparative Analysis

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Prepared for:

Oregon Department of Forestry

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Acknowledgments

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ECONorthwest and ICF prepared this report for the Oregon Department of Forestry, with substantial contributions from Greg Latta who developed and operated the Policy Level Forest Management Model. Numerous ODF staff contributed extensively to these analyses as well as review by Richard Haynes.

That assistance notwithstanding, ECONorthwest and ICF are responsible for the content of this report. The authors prepared this report based on their general knowledge of the Habitat Conservation Plan and Forest Management Plan existing details and preparation processes, as well as biology and habitat requirements, forestry and forest economics, policy analysis, and financial analysis, and on information derived from government agencies, statistical services, the reports of others, interviews of individuals, or other sources believed to be reliable. ECONorthwest has not independently verified the accuracy of all such information and makes no representation regarding its accuracy or completeness. Any statements nonfactual in nature constitute the authors' current opinions, which may change as more information becomes available.

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List of Abbreviations

BOF	Board of Forestry
BOFL	Board of Forestry Lands
CA	Comparative Analysis
CFTLC	Council of Forest Trust Land Counties
CSFL	Common School Forest Lands
cFMP	current Forest Management Plan
dFMP	draft revised Forest Management Plan
DSL	Oregon Department of State Lands
ELD	Estimated Landscape Design
ESA	Endangered Species Act
GPV	Greatest Permanent Value
HCA	Habitat Conservation Area
HCP	Habitat Conservation Plan
HSI	Habitat Suitability Index
LD	Landscape Design
MMBF	million board feet
MBF	thousand board feet
NEPA	National Environmental Policy Act
NOAA	National Oceanic and Atmospheric Administration
ODF	Oregon Department of Forestry
RCA	Riparian Conservation Area
SLI	Stand Level Inventory
TAS	Terrestrial Anchor Site
USFWS	U.S. Fish and Wildlife Service

Executive Summary

The Oregon Department of Forestry (ODF) commissioned a Comparative Analysis (CA) to assist the Board of Forestry (BOF) in deciding whether it is in the best interest of the state to continue to pursue a Habitat Conservation Plan (HCP) and enter the NEPA process. The CA evaluates the expected outcomes and tradeoffs expected across three potential future scenarios for the permit area:[1]

1. **cFMP Scenario**: continue implementation of the current Forest Management Plan (cFMP) and associated take avoidance approach to ESA compliance;
2. **dFMP Scenario**: implement the draft revised FMP (dFMP) and associated take avoidance approach to ESA compliance; and
3. **HCP Scenario**: implement the HCP, which would include a companion draft FMP that would address measures to inform management of State Forest Lands for other non-timber resource values.

Key Findings

- *The HCP Scenario generates the greatest total harvest volume over the 75-year timeframe.*
- *ODF's costs are lowest under the HCP Scenario.*
- *Net revenue is greatest for the HCP Scenario, followed by the dFMP and finally the cFMP.*
- *The HCP Scenario would result in the protection and stewardship of more suitable habitat for covered species <u>within areas designated for conservation</u> relative to the cFMP and dFMP.*
- *The cFMP and HCP both have strong conservation outcomes for terrestrial species. The cFMP results in increased suitable habitat for covered species in the <u>entire permit area</u>.*
- *HCP conservation areas protect larger, less fragmented occupied and suitable habitat for covered species.*
- *Strategies for aquatic species for all three scenarios are strong; however, the HCP provides the best potential outcomes.*
- *Carbon sequestration is highest under the cFMP, due to anticipated reductions in harvest levels over time.*
- *All management scenarios provide benefits for recreation opportunities and culturally-significant uses. However, the funding stability afforded by the HCP provides more opportunities for investment.*

[1] The Permit Area is the Board of Forestry Lands (BOFL) and the Common School Forest Lands (CSFL) in Western Oregon. It does not include lands in the Klamath-Lake district or in eastern Oregon, nor does it include the CSFL in Douglas and Coos counties that are part of the Elliott State Forest.

Under the take avoidance scenarios (cFMP and dFMP), acres available for harvest will be reduced due to new species listings and change/expansion of acres occupied by existing covered species. These scenarios would progressively reduce harvest levels, which would make it difficult to achieve ODF's mandate of Greatest Permanent Value (GPV) for the citizens of Oregon. The HCP mitigates risk for both harvest and conservation objectives because acres designated for harvest (available acres) and for conservation in Habitat Conservation Areas (HCAs) would be secured, allowing focused management towards harvest objectives outside of HCAs and conservation management within HCAs.

There is also a greater likelihood that suitable habitat for covered species will be created and improved in a shorter time frame with the HCP compared to the take avoidance approaches. This difference is because the HCP includes active management and implementation of conservation measures coupled with systematic monitoring and adaptive management that provides information on species' responses to conservation actions. The cFMP operational surveys conducted for take avoidance do little to inform or improve conservation efforts because they primarily focus on establishing the presence or absence of currently listed species and are not designed to monitor trends in habitat or populations.

The **Summary of Relative Ranking of Key Outcomes** on the following page shows the relative ranking of the cFMP, dFMP, and HCP scenarios for key metrics evaluated in the Comparative Analysis in an at-a-glance format. The HCP clearly out-performs the other two scenarios on most metrics, with the dFMP second and the cFMP least favorable. The cFMP offers the most carbon storage, followed by the dFMP and HCP which are roughly equivalent.

Summary of Relative Rankings of Key Outcomes (High = Most Preferred)[2]

		cFMP	dFMP	HCP
Conservation	Covered Terrestrial Species Habitat Quality	High	Low	Medium
	Covered Aquatic Species Habitat Quality	Tied	Tied	High
	Quantity and Quality of Monitoring	Low	Medium	High
Economic	Acres Available for Harvest	Low	Medium	High
	Annual Harvest Volume	Low	Medium	High
	ODF Costs	Low	Medium	High
	Net Revenue	Low	Medium	High
Social	Carbon Storage	High	Tied	Tied
	Recreation and Culture	Low	Medium	High

Notes:

- Shading is used to show relative rank: black=high; dark gray=medium; light gray=low
- "Tied" indicates there is no significant difference between the outcomes of each scenario
- Covered Terrestrial Species Habitat Quality includes modeled, stand-level habitat quality and conservation area configuration

[2] Note the table presents a ranking of results of the Comparative Analysis for key metrics in terms of which scenario performs best over the full analysis timeframe.

Introduction and Background

COMPARATIVE ANALYSIS OVERVIEW

The Oregon Department of Forestry (ODF) manages state forestlands in western Oregon for Greatest Permanent Value (GPV) to the citizens of Oregon: the central, guiding principle that informs ODF management strategies (see side panel). The definition of GPV includes economic, environmental, and social benefits across multiple uses. Timber harvests support local communities in western Oregon by creating family-wage jobs, supporting milling operations, and through revenue sharing with the Council of Forest Trust Land Counties (CFTLC). Harvest activities financially support state forest management, staffing and operational activities, with little to no funding from tax-payer dollars. State forest management activities in western Oregon are guided by the current Northwest and Southwest Oregon Forest Management Plans (cFMP), and the Elliott State Forest Management Plan.[3] The cFMP governs management activities for over 613,000 acres of state forests known as Board of Forestry Lands (BOFL). ODF also manages 25,755 acres of Common School Forest Lands (CSFL) for the Oregon Department of State Lands (DSL) in the permit area. The cFMP was adopted in 2001 and revised in 2010. It contains management strategies that are applied through Implementation Plans at the district level, and covers state forestlands in the North Coast and Willamette Valley. ODF staff have developed a draft Forest Management Plan (dFMP) for all western Oregon forestlands, intended to improve upon the pursuit of GVP by advancing conservation outcomes and the financial viability of the state forests management.

The plan will recognize that the goal for management of Board of Forestry Lands is to secure the Greatest Permanent Value (GPV) to the citizens of Oregon by providing healthy, productive, and sustainable forest ecosystems that over time and across the landscape provide a full range of social, economic, and environmental benefits to the people of Oregon. The goal for management of Common School Forest Land is the maximization of income to the Common School Fund over the long term.

Northwest Oregon Forest Management Plan, 2010

These forest management activities take place in the context of habitat for several fish and wildlife species protected under the Endangered Species Act (ESA). As such, forest management activities including timber management and harvest must comply with ESA requirements, ensuring that no "take" of listed species occurs.[4] Without an incidental take permit ODF currently employs a "take avoidance" approach to ESA compliance. This current approach costs ODF millions of dollars in survey and monitoring expenses annually, creates uncertainties in timber harvest levels, and increases the risk of litigation associated with ESA compliance. Additionally, the cost of operational surveys do not provide a conservation benefit

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[3] Note that an additional 18,073 acres are currently managed under the and 2010 Southwest Oregon Forest Management Plan, 48 percent of which are Common School Forest Lands owned by the Department of State Lands. Other than their geographic focus, the FMPs are otherwise the same.

[4] Take is defined as "harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct" (16 U.S. Code [USC] 1532)

to the species. As the number of listed species on ODF–managed lands increases and the colonization of new areas by currently listed species expands, the agency faces growing challenges to generate a sustainable and predictable stream of revenue from timber harvest activities while avoiding harm to listed species, and complying with the ESA.

The Board of Forestry (BOF) directed ODF staff to explore programmatic options to ESA compliance, in this case an HCP.[5] The State Forests Division (the Division) developed a three-phased approach to explore the possibility of securing a Western Oregon Habitat Conservation Plan.

- Phase 1: HCP Initiation included a Business Case Analysis (BCA) designed to evaluate the financial implications of an HCP for western Oregon state forests versus the take avoidance approach used in the cFMP. Based on the findings of the BCA, the BOF directed ODF staff to proceed to Phase 2.
- Phase 2: HCP Strategy Development. Development of the HCP entailed extensive involvement of the Scoping Team to define the terms of the HCP, ODF staff and the ICF Consulting team. Concurrently, ODF was directed to complete a draft Forest Management Plan (dFMP) that continued to use a take avoidance approach. On October 6, 2020 the BOF will decide if the Division should continue into Phase 3.
- Phase 3: Complete the administrative Draft HCP and begin the National Environmental Policy Act (NEPA) Review.

This Comparative Analysis (CA) builds upon the 2018 BCA to evaluate the potential conservation, economic, and social outcomes from the HCP, the cFMP, and the dFMP over time. The purpose of the CA is to provide a systematic assessment of the tradeoffs across these management scenarios to provide a better understanding of the ***relative*** differences across all categories of value that these forests are mandated by law to provide.

The CA is based on the best available and current understanding and information regarding the relative differences in outcomes projected over the next 75 years (5 years beyond the 70- year permit period for the proposed HCP). It serves as a tool to assist the BOF in deciding whether it is in the best interest of the state to continue to Phase 3 and complete the administrative draft HCP and NEPA review. If so directed, the ODF staff will work with NOAA Fisheries (lead NEPA Agency) and USFWS to complete the NEPA process, and bring a fully vetted HCP and associated NEPA analysis to the BOF for consideration in summer of 2022. Concurrently, a companion FMP would be developed that would address measures to inform management of State Forest Lands for other non-timber resource values (e.g., non-covered species, cultural resources, recreation).

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[5] The Board of Forestry is a citizen Board appointed by the Governor and confirmed by the state Senate, with a mission to lead Oregon in implementing policies and programs that promote sustainable management of Oregon's public and private forests.

Although the CA builds on the previous BCA, there are important differences in both the scenarios evaluated and the data which underpin the analyses. When the BCA was prepared, the HCP and the species-specific conservation strategies had not been developed, so the analysis relied on a series of assumptions regarding conservation strategies and the area likely to be affected by new species listings. The analyses have been refined in several, more expansive ways including: consideration of the range of outcomes that can differ across cFMP, dFMP and HCP scenarios, development of refined values for economic and conservation outcomes based on spatially-explicit modeling of each scenario, and analysis of additional conservation and social values that contribute to GPV.

A key underlying driver of differences in results for revenue and cost-related analyses between the BCA and this CA are the more refined estimates of acres available for harvest under each scenario, due to both the HCP development process and the detailed spatial modeling. In addition, the BCA assumed that under the HCP some of the acres constrained under the cFMP would free up over time creating a shifting mosaic of conservation and management across the landscape and over time. While the BCA was built from a foundation of the existing cFMP at the time, the HCP development process has produced a distinct conservation strategy that diverges from that assumed in the BCA.

FOREST MANAGEMENT PLAN AND HABITAT CONSERVATION PLAN CONTEXT

It is important to recognize that ODF operates under legal mandates. Most significantly, BOFL are managed to meet GPV. This includes providing a full range of social, economic, and environmental benefits to the people of Oregon. A key component of GPV is to maintain these lands as forest lands and actively manage them in a sound environmental manner to provide sustainable timber harvest and revenues to the state, counties, and local taxing districts. Revenue generated from BOFL are split, with 63.75 percent distributed to counties in which the revenue is generated and 36.25 percent designated for ODF's management of the lands, including fire protection, operating costs, and investments in the forest to support GPV.

The Forest Management Plan provides the overarching policy for management of state forestlands over a multi-decade timeframe. State forestlands have been managed under the cFMP using a structure-based management approach since 2001. This approach sets goals for developing a diverse range of forest conditions across the landscape—with more complex forest conditions providing high-quality habitat for many wildlife species. Key to the approach is the notion that active management creates complex forest structure more quickly than if left unmanaged. A shifting mosaic would allow for the harvest of complex stands as new areas of the landscape develop complex forest conditions. Over time, as current complex stands became occupied by threatened and endangered species, harvesting those stands is no longer an option.

Due to a number of factors, over time it has become increasingly difficult for the Division to cover forest management costs with their share of the revenue. In 2013, the BOF directed staff to develop an alternative FMP (dFMP) that would improve financial viability and conservation outcomes, and to explore programmatic approaches to comply with the ESA instead of the current approach of take avoidance. ODF staff developed the dFMP using an ecological forestry approach and delivered it to the BOF in April 2020.

Over the past several years, ODF has faced increasing uncertainties, costs, and regulatory compliance challenges in managing state forests consistent with a take avoidance approach to ESA compliance. Avoiding take requires extensive and expensive field surveys. Currently, ODF spends over $2 million annually on these field surveys, and as new areas are surveyed, new sites with listed species are identified. Listed species may shift their centers of activity from year-to-year and are expected to expand their populations and colonize new areas as recovery efforts take hold and begin to improve the species' status. In addition, more species are expected to become listed in the future as threats such as climate change and invasive species continue to expand. The timing and extent of these expansions by listed species and new species listings are highly uncertain. These factors contribute to growing uncertainty in future harvest locations and harvest levels and increasingly create difficult and unpredictable regulatory environment in which ODF manages these lands.

The analysis in this report quantitatively and qualitatively describes how future values from the state forests will differ under the cFMP, dFMP, or HCP in ***relative*** terms. As with any modeling exercise, assumptions must be made regarding future conditions. These assumptions are applied consistently across the scenarios. Many values may differ among the cFMP, HCP, and dFMP (available acres, harvest objectives, forest management strategy and assumptions), but only those outcomes that differ are relevant to this analysis. This analysis should not be interpreted as a precise projection of future harvest and conservation; rather, it provides a relative sense of potential outcomes associated with the three management approaches based on current assumptions.

Scope of the Analysis

Timeframe. The analysis considers a 75-year planning timeframe (2023-2097) under all scenarios, which is approximately equivalent to the proposed permit time period for the HCP as well as one 5-year time step beyond, and assumes consistent management throughout. Future costs and benefits are discounted at a 3 percent real rate. Values are in constant 2020 dollars (without inflation).

Geography. The analysis covers BOFL in western Oregon, including those in all six districts from Astoria in the north to Southwestern Oregon to the south. It does not include lands in the Klamath-Lake district in eastern Oregon, nor does it include the CSFL in Douglas and Coos counties that are part of the Elliott State Forest. It does include ODF-managed CSFL. The included land is referred to as the "permit area".

Covered Species. The permit area includes a range of forest resources that support a variety of species, including several species that are either currently listed as threatened or endangered, or are candidates for listing, under state and federal endangered species protection laws.

Table 1 provides a list of covered species included in the HCP; 16 species will be covered, including nine fish species and seven wildlife species. Six of the species are not currently listed as federal threatened or endangered species. However, there is a high probability these species will be listed within the 70-year permit term.

Table 1. List of Covered Species for the HCP

Aquatic Species (NOAA Fisheries Jurisdiction)
Oregon Coast coho (*Oncorhynchus kisutch*) Oregon Coast spring chinook (O. tshawytscha)* Lower Columbia River coho (*O. kisutch)* Upper Willamette River spring chinook (*O. tshawytscha)* Upper Willamette River winter steelhead (*O. mykiss)* Lower Columbia chum (*O. keta)* South Oregon/Northern California coho (*O. kisutch)* Lower Columbia chinook (*O. tshawytscha)* Eulachon *(Thaleichthys pacificus)*
Wildlife Species (USFWS Jurisdiction)
Oregon slender salamander (*Batrachoseps wrighti*)* Columbia torrent salamander (*Rhyacotriton kezeri*)* Cascade torrent salamander (*R. cascadae)** Northern spotted owl (*Strix occidentalis)* Marbled murrelet (*Brachyramphus marmoratus)* Red tree vole (*Arborimus longicaudus)** Coastal marten (*Martes caurina caurina)**

Note: * Indicates species that are not currently listed as federal threatened or endangered, but which are expected to become listed during the analysis timeframe. As of the date of this analysis, USFWS has announced that the Coastal Marten will be listed as threatened, but publication of the decision Federal Register has been delayed.

Methods and Assumptions for the Analysis

Scenarios. This analysis defines and models differences in outcomes across three scenarios: 1) continuing take avoidance under the current FMP (the "**cFMP Scenario**"); 2) continuing take avoidance under the draft FMP (the "**dFMP Scenario**"); and 3) preparing and implementing an HCP (the "**HCP Scenario**"). The primary purpose of this analysis is to help the BOF decide whether to continue to move forward in developing an HCP. Spatially-explicit modeling completed for development of the HCP extends to the comparative analysis. In contrast to the BCA, the spatially explicit modeling allows for a more detailed understanding of the relative conservation, economic and social effects across all three scenarios.

This analysis relies on the outputs of two types of spatially-explicit models:

1. Policy level forest management model (harvest model)
2. Four habitat suitability models (habitat models), one each for northern spotted owl, marbled murrelet, red tree vole, and Oregon slender salamander.

The forest management model emulates how the forest would be managed. It projects harvest volumes, revenues, and forest stand age across the landscape based on the 2017 version of ODF's Stand Level Inventory (SLI) and a series of model rules or parameters related to harvest objectives, planning unit scale, landscape design, and acres available for harvest. Due to uncertainty about operational feasibility all harvest units less than 10 acres have been removed from all results. Model results portray what relative outcome is anticipated based on the three different policy possibilities. In order to implement a forest management plan, additional implementation modeling will occur to set actual harvest levels and associated outcomes. Over a 75-year period, the habitat model projects relative habitat conditions and the current and future location of habitat suitable for covered species based on ODF's SLI data, the forest management model outputs, and known habitat requirements for each species. The four species for which habitat is modeled are all strongly associated with late-seral conifer forests. As such, the models include parameters that characterize attributes of late-seral forests, particularly those that provide key habitat features, such as old trees used by marbled murrelets, northern spotted owls, and red tree voles for nesting.

To develop the analysis, the project team worked closely with ODF staff to identify and interpret relevant data on costs, forest inventory, and management activities; develop assumptions about future conditions; and review model inputs and outputs. All three scenarios utilize the same SLI data and underlying physical operating constraints (e.g. areas that are not feasible to log). The cFMP and dFMP both use current take avoidance policies for northern spotted owls and marbled murrelets, and estimated future encumbrances arising from future listing of the red tree vole. The cFMP and dFMP used different landscape designs for future complex forest structure development intended to support native wildlife that use late seral forest habitats. The cFMP landscape design reflects current Implementation Plans. The dFMP was estimated using a mix of current management constraints and conservation commitments. The HCP landscape design is primarily based on Habitat Conservation Areas (HCAs) that have been designated specifically to incorporate most known covered species locations and current highly suitable habitats, as well as provide for large, functional patches and connectivity in the future. It is critical to note that the dFMP landscape design estimate is the least formalized of the three, and would require significant refinement to truly provide for the species covered in the HCP and operational feasibility.

Key Assumptions. Assumptions applied in this analysis include future species conditions and policy (both currently listed species and future listings), market conditions, and a range of negotiated terms of a potential HCP. Although these assumptions hold a degree of inherent uncertainty, they are based on review of the best available data, and are described in more detail in the main report.

Key assumptions for the CA are:

- Agency administration staff costs will increase at a real (inflation adjusted) rate of 1.6 percent annually for the first ten years, and then level off.

- Under the cFMP and dFMP scenarios, ESA staff administration costs will continue to rise due to increased effort over time at about 2.8 percent annually to maintain the take avoidance approach to ESA compliance.
- Pre-harvest survey costs in the take avoidance scenarios are based on estimates extrapolated from actual costs for northern spotted owl, marbled murrelet initially, and increase over time to reflect survey costs associated with red tree vole.
- Initial constraints are based on take avoidance protections associated with sites currently occupied by listed species.
- Future land use acreage constraints are implemented as discussed in the corresponding section below.
- Timber prices are assumed to stay constant in a real sense (inflation adjusted) and reflect the most recent prices available by district (from 2019).
- ODF staff based their estimates of harvest costs on actual average costs per thousand board feet (MBF) by district.
- Summed future costs and benefits are time discounted using a real (inflation-adjusted) discount rate of 3 percent. Data in charts over time do not include discounting.

Relative differences across scenarios, particularly with respect to the HCP versus take avoidance strategies under the cFMP or dFMP, are likely to affect only a subset of actions that ODF engages in while fulfilling its mission. The analysis focuses on those actions that may result in changes in conservation, timber harvest, financial costs, and social outcomes of relevance. Results and analyses are based on actual empirical data and detailed forest modeling, complemented where necessary with the expert judgement of the project team and input from ODF staff.

Table 2. Metrics for Comparative Analysis

Variable	Units of Measure
Conservation	
Quality and Quantity of Terrestrial Habitat (Covered Species)	Acres of suitable and highly suitable habitat
Quality and Quantity of Aquatic Habitat (Covered Species)	Acres by stand age within riparian buffers
Covered species management and assurances	Acres subject to management and assurances
Covered species monitoring and assurances	Acres subject to monitoring and assurances
Quality and Quantity of Non-Covered Species Habitat	Acres by stand age and qualitative metrics
Habitat Fragmentation	Patch size (acres), Distance between patches (feet), and Interior: perimeter ratio
Economic	
Area Available for Harvest	Acres
Annual Harvest Volume	MMBF (million board-feet)
Annual Timber Revenue	Dollars
Timber Management Costs	Dollars
ESA Administration Costs	Dollars
Species Management Costs (Restoration)	Dollars
ODF Annual Operating Costs	Dollars
Timber Inventory	MMBF (million board-feet)
Revenue Payments to Counties: Pool of Revenue	Dollars
Social	
Carbon Storage	CO_2e metric tons (metric tons of carbon dioxide equivalent)
Recreation Opportunities	Facility/resource units and qualitative description
Cultural Benefits	Qualitative description

Metrics. To do this analysis, ODF staff and the project team reviewed all identifiable categories of potential differences in effects among the three scenarios (HCP, cFMP, and dFMP). These effects were then aligned with measurable and describable quantitative metrics and qualitative conditions. The objective was to utilize available data, modeling, and new analysis to best communicate differences in outcomes for each variable, thereby providing the BOF and others with a comprehensive understanding of the potential tradeoffs. These variables for analysis fall into three categories – economic, conservation, and social – shown in Table 2. The analysis and results sections of this report are organized by these categories reflecting the mandate to provide for GVP from the management of these lands.

The report documents the analyses and results for the purpose of assessing the relative bottom-line outcomes into the future associated with the decision either to implement an HCP or to continue the current approach to ESA compliance.

Projected Land Management and Acreage Constraints

Land management categories and acreage constraints are foundational assumptions for this analysis. Across all ODF lands there are areas where timber harvest does not occur because those areas are either not forested, or they are forested but classified in ways that prohibit harvest. Under all scenarios, the area of land available for harvest is expected to decrease relative to existing conditions (Figure 1). However, more acres are expected to be available for harvest with an HCP than without by the end of the 70-year implementation timeframe.

Figure 1. Projected Acreage Designations by Scenario

[1] Inoperable acres either do not hold forest or would be impractical to harvest.
[2] Policy constrained acres are either unavailable for harvest or severely limited for harvest by policy and regulatory constraints (e.g., Oregon Forest Practices Act, federal Endangered Species Act and FMP stream buffers).
[3] Available acres would be available for harvest according to appropriate policy requirements.

The largest change is associated with constraints within terrestrial landscape that result from continued implementation without an HCP and associated increasing take avoidance restrictions. Under the cFMP and dFMP, continued implementation of the take avoidance strategy is projected to reduce future acres available for harvest. Specifically, as forest stand age increases, the overall areas affected by northern spotted owl and marbled murrelet are expected to increase, both from new occurrences and development of habitat at existing sites, based on northern spotted owl and marbled murrelet habitat models. Protections for future listed species in areas where previous protections were not needed are also included, based on modeled estimates of red tree vole habitat. The acres available for harvest are directly proportional to future constraints posed by covered species. The net effect of future encumbrances is 82,000 acres and 95,000 acres for the cFMP and dFMP, respectively removed from available acres.

The expansions of listed species and newly listed species are still expected to occur, but initial constraints under the HCP (the HCAs) would not increase as a result. With an HCP in place, ODF will retain operational flexibility to harvest in areas that would otherwise be constrained. It is important to recognize that an HCP may require harvest practices that minimize environmental impacts in these areas, nonetheless, it is expected that those requirements would be greater without and HCP and therefore more acres will be available for harvest over the long-term with an HCP than without.

Although much more is known about the HCP conservation actions now than reported in the original BCA, projecting all three management scenarios into the future still required the application of assumptions regarding future conditions. Key information regarding acreage constraints is as follows:

- Under the cFMP and dFMP scenarios, constrained acreage due to habitat requirements for the northern spotted owl, marbled murrelet, and red tree vole would increase after the first 10 years, resulting in a decrease in available acres by 82,000 and 95,000 acres for the cFMP and dFMP, respectively.[6] These acres would be removed from the acres available or harvest.
- Riparian buffers are utilized in all three scenarios. While the size, and thus overall acreage in riparian buffers differs between the HCP and the FMP scenarios, modeled management prescriptions (no riparian management) in riparian areas are the same across all three scenarios.[7]
- Under the HCP Scenario, increased riparian buffers would decrease acres available for harvest by about 3,000 acres immediately.
- Terrestrial strategies in the three scenarios provide for a functional arrangement of forest habitat conditions across the landscape (i.e., landscape design). This analysis focused on forest stand types important to the covered species, which vary by scenario:
    - HCP uses Habitat Conservation Areas (HCAs)
    - cFMP uses Terrestrial Anchor Sites (TAS) and areas of future layered and older forest structure types from current district Implementation Plans, plus existing and projected species sites
    - dFMP uses Estimated Landscape Design (ELD), plus existing and projected species sites

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[6] Red tree vole is identified as a species likely to be listed within the next 15-years. Red tree vole was used to estimate the impacts of new listings based on the magnitude of the potential impact and because a habitat suitability model was available for making projections. Other species that could potentially be listed during the HCP permit term include Oregon slender salamander, Columbia torrent salamander,

Cascade torrent salamander. The USFWS has announced that it will list the coastal marten as threatened. The HCP would include take protections for these species as well.

[7] Policy in the cFMP allows harvest within riparian buffers in some circumstances, but operationally this is rarely done.

- Under the HCP Scenario, areas currently managed with limited harvest as a part of landscape design and conservation (Terrestrial Anchor Sites) would be replaced by HCAs. In total, approximately 275,000 acres (43 percent) of the permit area would be managed within HCAs.[8] These acres are primarily drawn from areas currently occupied, or projected to be occupied over the permit period.
- Under the HCP Scenario, conservation acreage designated in HCAs would include existing northern spotted owl and marbled murrelet suitable and highly suitable habitat, where forest management activities would be limited. Just under half of the forests within HCAs will be actively managed to maintain and develop late-seral structure stands as they relate to specific habitat needs for individual covered species. Forest management implemented to improve habitat over time would include thinning and harvest in marginal or low-quality habitat. Activities would include harvest and reforestation of Swiss needle cast stands and targeted alder stands (conifer restoration).
- Under the dFMP, a new ELD encompassing just over 217,000 acres (34 percent of the permit area) was developed.[8] The dFMP includes 6,000 more acres available for harvest than the cFMP.

Figure 1 shows that acres available for harvest are greater under the HCP scenario than the No HCP scenarios. This increase in available acres was assumed to happen in the year 2034, the point at which new species encumbrances were introduced into the forest management model. These resulting acreage ranges are based primarily upon estimated acreage requirements for northern spotted owl, marbled murrelet, and red tree vole. These ranges correspond to available acres in the permit area at 35 and 36 percent (about 225,000 and 231,000 acres), for the cFMP and dFMP scenarios, respectively, and 43 percent (about 277,000 acres) for the HCP scenario.

Conservation Outcomes

Factors Influencing Conservation Outcomes

Constraints on Harvest. In addition to the acres with complete and limited constraints to harvest presented in Figure 1, the cFMP and dFMP have different landscape design policies that will have implications for harvest. The cFMP was originally designed to be coupled with an HCP and an associated Incidental Take Permit. The cFMP uses a "shifting mosaic" approach where stands that are classified as complex structure (i.e., layered and older forest structures) are able to be harvested in the future when other stands develop into complex structure. This requires more acres to be planned for complex structure development in order provide for replacement stands of complex structure. When the stands develop into complex structure, they may become occupied by a listed species. Without an Incidental Take Permit, these stands are

[8] Gross Acres based on the model polygon layer.

not available for harvest, leading to an increase in the amount of land in these classifications beyond what is intended when the cFMP was adopted.

The dFMP replaces the structure targets and shifting mosaic concept with an estimated landscape design that includes durable conservation areas and goals for a range of seral stages, which is expected to provide more flexibility for harvest while also improving habitat quality. As a result, the acres available for harvest under the dFMP are higher than available acres under the cFMP. The HCAs designated by the HCP are designed to conserve, maintain, and enhance habitat within and adjacent to existing occupied habitat, as well as to increase overall habitat values for covered species at the landscape level (e.g. habitat connectivity and configuration).

Pace and Scale of Upland Habitat Restoration. Under the cFMP, ODF does not normally conduct habitat restoration actions for specific listed terrestrial species, although ODF does implement management practices intended to promote a variety of forest structure conditions on the landscape, including those that provide habitat for listed terrestrial species. After 18 years of operating under the cFMP, some aspects have become increasingly challenging to implement. In some places, silviculture that achieves structure-based management goals has not produced expected outcomes and some aspects have been financially unsustainable. The dFMP includes goals for forest restoration and long-term investments to improve forest health and improve species habitat through implementation of ecological forestry planning and silviculture. Implementation of both the cFMP and dFMP is primarily funded through timber harvest revenues, which vary with cyclical economic trends; full implementation of all strategies of the FMPs is contingent on funding available at any given time. Under the dFMP, funding would only be available for reinvestment that includes a modest amount of forest restoration activities, and only if there is a strong revenue forecast and/or an operating fund balance at or above the prudent balance established in Division policy.

The HCP would outline expectations for habitat management that would occur during the permit term in order to meet the biological goals and objectives established by the HCP. This will ensure the effects of the taking of the covered species from covered activities will be minimized and mitigated. These activities will primarily include harvest and restoration of stands that have marginal habitat suitability or are not currently suitable, or that are unlikely to develop into better habitat during the permit term without management (e.g., stands infected with Swiss needle cast). Management actions (conservation actions) for terrestrial species would include silvicultural activities that result in higher quality habitat over time. Examples of habitat management activities expected to occur in HCAs include:

1. Forest thinning to maintain forest buffer to occupied habitat and to promote development of habitat components in young stands.
2. Variable retention harvest to promote faster tree growth to achieve canopy stratification or other advanced structure.
3. Regeneration harvest to remove stands that are not likely to grow into suitable habitat during the permit term and thus would benefit from re-initiation (e.g., stands with

severe Swiss needle cast and hardwood dominated stands that are nearing senescence and have little conifer component).

4. Creation of snags or downed wood to create habitat for prey species and covered species such as Oregon slender salamander.

While funding for HCP activities will also primarily come from timber harvest, implementation of conservation actions would be buffered from cyclical economic trends. The elimination of timelines associated with species surveys for take avoidance will allow the auction of timber to be better timed to market conditions, and the establishment of a dedicated conservation fund will ensure there is funding available to help finance important habitat enhancement, even when markets are down. The HCP will include a funding plan to cover all HCP implementation costs over the entire, 70-year permit term. Moreover, ODF will be required to monitor and track implementation of conservation actions in the HCP and report them annually to the USFWS and NOAA Fisheries to ensure compliance with the HCP and permits.

Constraints on Harvest in Riparian Areas. Constraints on harvest within riparian areas would be the same under all scenarios, no commercial harvest would be allowed. The primary difference is an increase in the size of riparian buffers and a policy change that precludes management within the HCP's Riparian Conservation Areas (RCAs) as compared to cFMP riparian policies.

Pace and Scale of Aquatic Habitat Restoration. Some specific, targeted stream enhancement activities occur and would continue to occur on ODF lands under all scenarios with the goal of improving stream habitat for anadromous fish, including several listed species. Actions include removing fish barriers, adding large wood structures to the stream in areas identified as lacking large wood, and improving or vacating roads in the riparian zone to reduce sediment delivery. These projects are informed by the Oregon Department of Fish and Wildlife Statewide Fish Passage Priority List.[9] As with terrestrial restoration, the HCP includes specific commitments related to aquatic habitat restoration, this would include:

- A commitment to repairing or replacing at least 167 culverts that do not currently meet NOAA Fisheries fish passage requirements to provide passage over the course of the 70-year permit term. In the past 5 years, there has been an average of 5-6 fish passage improvement projects per year. This average is expected to continue and increase in some years as opportunities are available.
- Supporting restoration projects through the development of an HCP conservation fund, which can be used by ODF and partners to execute restoration projects. Stream enhancement projects would focus on improvements that address limiting factors of the fish species covered by the HCP, which could range from simple projects like

[9] Oregon Department of Fish and Wildlife. 2019. *Fish Screening and Passage Program*. 2019 Statewide Fish Passage Priority List. April, 19. 43pp.

installation of large wood to more complex floodplain reconnections or channel restoration projects.

Improvements to aquatic habitat associated with implementation of these practices are expected to provide strong conservation outcomes across all scenarios. The HCP is expected to perform somewhat better than the cFMP and dFMP, and also includes a strong regulatory requirement to track instances where road construction or maintenance activities were not able to meet requirements outlined in the HCP, and reporting those variances on an annual basis. With the HCP, if trends are identified in the variances reported over time that show the populations are not improving in the way they are expected to, adaptive management would be used to examine alternative strategies, and if necessary, adjust future management actions.

Habitat Quality and Quantity – HCP-Covered Species

This CA focuses on 16 species that are covered by the HCP and groups those species as terrestrial or aquatic. Non-covered species benefit from the habitat protections designed for covered species, and will be more directly addressed in a companion Forest Management Plan. In order to allow for a comparison between scenarios with respect to habitat quality and quantity over time, consistent data upon which to base the comparison was necessary. As such, species habitat models were developed for four terrestrial species to evaluate how each scenario influences changes in habitat. For aquatic species an evaluation of acres within riparian buffers, and the age of forest inside those buffers over time, is used as a surrogate for changes in aquatic habitat quality over time.

The following section describes and presents the habitat modeling, the metrics used to categorize the ability of the habitat to support each covered species, and the results of habitat modeling for northern spotted owl and marbled murrelet for each scenario at the beginning and end of the period of analysis (year 2023 to 2097).

TERRESTRIAL SPECIES

Species Habitat Modeling

Habitat suitability models were developed for northern spotted owl, marbled murrelet, red tree vole, and Oregon slender salamander[10]. The habitat suitability models were developed using SLI data so that each forest stand could be assigned a habitat suitability category based on key attributes accounted for in the inventory data that were used in the forest management model. Published species habitat models were utilized as background and important parameters identified in those published models were represented, as feasible, using the same or correlative attributes in the SLI data. These habitat models generally included parameters for tree height, tree size, number of trees per acre, stand age, and for the Oregon slender salamander, amount and type of downed wood. Because of the similarities in model parameters all of the terrestrial

[10] The Executive Summary only reports the results for northern spotted owl and Marbled Murrelet at the beginning and end of the period of analysis (2023-2037 and 2083-2097, respectively). Results for all four species are provided in the full report.

habitat models behave similarly over time. As forests get older, they generally become higher quality habitat for all four species.

Each forest stand was assigned a habitat suitability category based on the characteristics of the stand. As those characteristic change over time, the habitat suitability category may change as well. For example, if a stand is not harvested and grows older, it will very likely become higher quality habitat for covered species. Similarly, if a stand is harvested, habitat suitability would be reduced initially, and then increase over time as the stand regrows. The underlying stand characteristics that equate to each suitability category varies by species, but the habitat suitability categories can generally be described as:

- **Highly suitable:** high probability that the habitat characteristics required by the species are present and that habitat provides core natural history functions such as nesting, foraging, and resting habitat. Habitat is likely associated with more frequent observed occurrences.
- **Suitable:** probable that all or most of the habitat characteristics required by the species are present and that habitat provides some, but not all, natural history functions such as nesting, foraging, and resting habitat. Habitat associated with some observed occurrences.
- **Marginal:** probable that many of the key habitat attributes required by the species are either missing/not present or are sporadic on the landscape. Few or no observation of this species would be expected in stands with these characteristics. The one caveat would be that marginal habitat could provide habitat for infrequent or short-term uses, such as movement between higher quality habitat patches.
- **Not suitable**: forest stand does not provide for key habitat attributes required by the species and observation of this species in these stands would be uncommon.

By linking the habitat suitability models to the SLI and the forest management model, habitat suitability can be assessed at any point during the HCP permit term. Suitable habitat growth and harvest are both accounted for in the forest management model, allowing ODF to estimate the overall potential gain in quality and quantity of habitat. This process ensures that habitat commitments in the HCP can be achieved. In the CA, the habitat suitability models have been used to compare changes in habitat quality and quantity over time for the HCP, cFMP, and dFMP.

Comparison of Scenarios for Conservation Objectives

The HCP intentionally delineates a larger proportion of the landscape for the conservation of terrestrial species' habitat within HCAs. The design of the HCAs includes areas that have a high probability of developing into suitable habitat over time as estimated by the forest management model. These HCAs inform the acres limited to harvest in the forest management model.

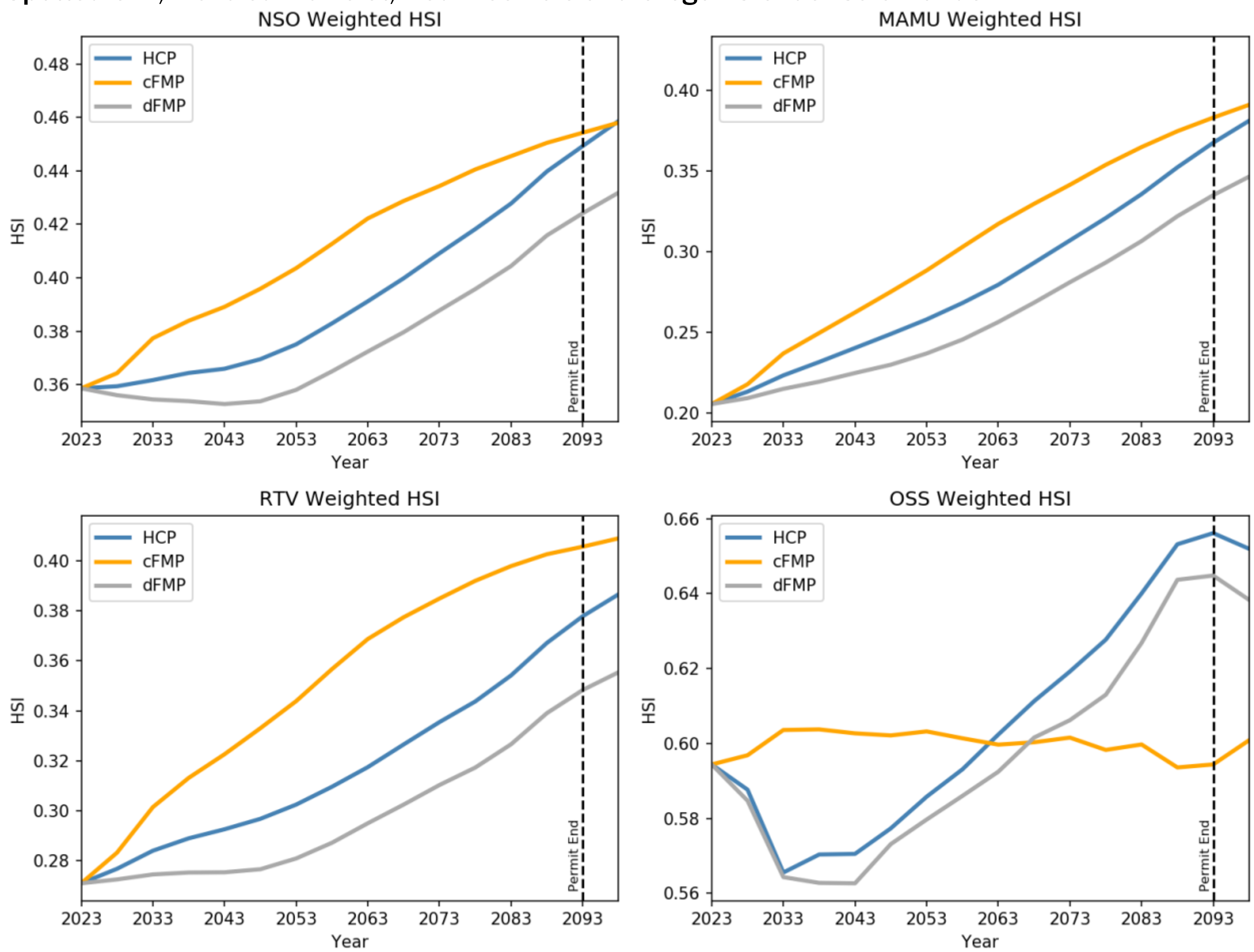
The habitat models were used to identify areas with high conservation value for each covered species. They were also used to assess forest management model projections of habitat development over time, through growth. However, there are limitations to the habitat and forest management models. The habitat models characterize habitat using only a few key stand level attributes, and do not directly include spatial attributes at the landscape level for each species. As a result, they do not describe the full potential habitat quality for a species. Specifically, as long as there is not a regeneration harvest in a stand, it is predicted to develop into suitable habitat over time. As a result, the predicted development of suitable and highly suitable habitat for the HCP scenario is likely an underestimate, as it does not fully account for both site-specific and landscape level factors that will be targeted for enhancement. Note that while landscape patch attributes were not modeled for each species, patch statistics are presented for conservation areas generally under "Habitat Configuration and Fragmentation" below.

Similarly, the forest management model was designed to produce policy level outputs to compare scenarios generally, and has a limited set of silvicultural prescriptions from which to draw. This generalized prescription set results in a potential overestimate of the development of suitable habitat outside areas designated for conservation (LD, ELD, HCAs), and a potential underestimate of habitat developed within HCAs, due to its lack of more nuanced silviculture aimed specifically at habitat enhancement. Also, for the cFMP and dFMP, the forest management model does not add acres back into the inventory of available acres once they are initially removed for implementation of take avoidance. In reality, some of these acres could become available for harvest again over time, due to species' sites becoming vacant. This results in potential inflation of the habitat predicted to develop over time for both the cFMP and dFMP.

These dynamics are illustrated in the predicted area weighted habitat suitability over time for northern spotted owl, marbled murrelet, red tree vole, and Oregon slender salamander across the permit area for the three scenarios. Figure 2 shows overall habitat suitability increasing over time for all four species as the relative age of forests in the permit area increase (see Figure 5 and Figure 6 for more information on forest age over time). The cFMP outperforms the HCP on habitat suitability for all species but Oregon slender salamander, which is directly related to the amount of harvest; less harvest under the cFMP results in older stands and higher habitat suitability score. The gap between the cFMP and the HCP narrows over time for northern spotted owl, marbled murrelet, and red tree vole as younger stands protected within HCAs at the beginning of the permit term mature into suitable habitat for these species. The HCP outperforms the FMPs for Oregon slender salamander because future take avoidance acres were determined based on the habitat for red tree vole and there is very little overlap in suitable habitat for Oregon slender salamander and red tree vole.

An important difference between the HCP and FMPs that is not shown by these figures is the relative level of certainty around the quality and quantity of habitat associated with these scenarios. There is more certainty around the future quality and quantity of habitat with the HCP given the commitments in the HCP versus either of the FMPs. The regulatory environment of take avoidance is centered on specific species' sites, which may become vacant or move, making long-term investments in habitat enhancement more risky and less likely. Commitments to habitat protection and enhancement on specific areas of the landscape, coupled with the assurances of an HCP, make these investments less risky and more likely under an HCP, both for ODF and the covered species.

Figure 2. Comparison of the Area Weighted Habitat Suitability Index (HSI) Over Time for Northern Spotted Owl, Marbled Murrelet, Red Tree Vole and Oregon Slender Salamander



AQUATIC SPECIES

The RCAs are designed to support and protect the ecological process that address the limiting factors and the Biological Goals and Objectives for covered aquatic species. They were built using the best available data, including current and historic occurrence data, SLI, LiDAR, and habitat models.

The HCP would result in a 5 percent (3,437 acres) increase in the number of acres included in permanent, no harvest riparian areas (RCAs). Buffers would generally be increased over current standards (cFMP). Buffers along fish-bearing streams would increase by 5 feet, and small, perennial non-fish streams and seasonal streams would receive various additional protections, depending on their relationship to fish-bearing waters. The increase in buffers is designed to protect against stream warming in perennial stream reaches upstream of fish bearing streams and to improve large wood recruitment. However, because there was no harvest or active forest management activities modeled within riparian buffers under all three scenarios, the stand age outcomes show very little difference in forest stand age distribution across the three scenarios. Figure 3 and Figure 4 show predicted stand age distribution in 2023 and 2097, respectively. As shown in these figures, stands within riparian areas become older and the only difference between the HCP and the FMPs shown by the models is related to the number of acres in the RCAs. The modeling results show the HCP outperforming the FMPs, which are tied. In addition, habitat restoration and enhancement in the RCAs will further increase habitat quality under the HCP scenario.

Figure 3. Riparian Age Class Distribution, 2023–2037

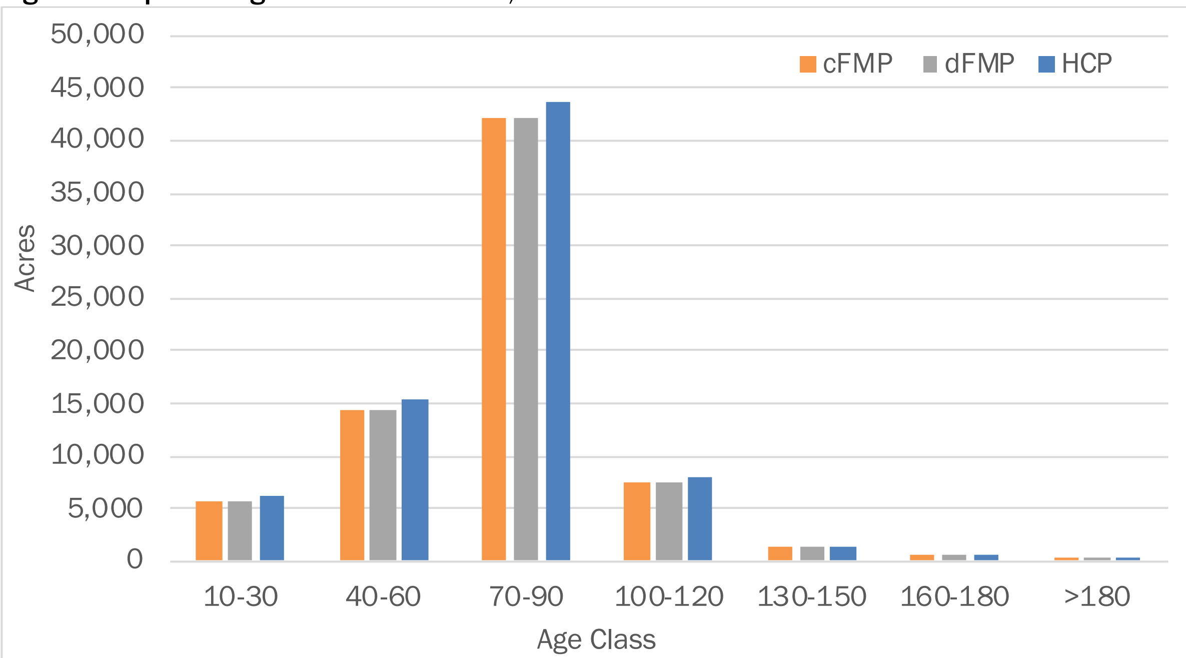


Figure 4. Riparian Age Class Distribution, 2083–2097

Monitoring and Adaptive Management

Monitoring and adaptive management is important for covered species habitat quality and quantity outcomes because it can provide a way to verify the effectiveness of forest management and conservation actions on both parameters. It can also provide valuable information on habitat occupancy and species populations. Assurances for and components of monitoring and adaptive management would vary widely between the HCP and FMP scenarios. The HCP monitoring program will include compliance monitoring and effectiveness monitoring and will apply to the entire area included within the HCAs and RCAs as well as targeted monitoring outside of HCAs and RCAs. It includes a process to determine whether the habitat parameters required for covered species are present in areas identified as suitable habitat by the habitat models. The monitoring program will also assess how habitat parameters change over time and will allow for adaptive management. Monitoring would be coupled with active management in HCAs designed to restore late-seral forest habitat characteristics.

Under the FMPs, annual and operational species-specific surveys would continue to focus on detecting the occupancy of listed species. If a listed species is present, timber sales are modified or abandoned to support implementation of the take avoidance. Although species surveys are valuable for ensuring compliance with the ESA, they fall short of providing a net benefit to the species; the take avoidance approach restricts ODFs ability to manage these lands for habitat or harvest, and is one of the primary drivers of uncertainty for both conservation and forest management over time. The cFMP includes active management specifically designed to improve habitat for all native wildlife species (including the listed species), through the concepts of Structure Based Management. The dFMP also includes active management concepts designed to provide these benefits through concepts of ecological forestry. While both FMPs have a monitoring and adaptive management component, they are more general and would not include a formal commitment to monitor habitat quality for the covered species within specific conservation areas over time, or test the effectiveness of management activities related to habitat enhancement. This is largely due to a lack of funding to be able to conduct both the required surveys for take avoidance and effectiveness monitoring. The savings incurred from not having to conduct take avoidance surveys under the HCP allows for more meaningful investments in monitoring and adaptive management.

Habitat Quality and Quantity – Non-Covered Species

TERRESTRIAL SPECIES

The forest age distribution is used as a proxy to assess the presence and quantity of a diverse range of habitats within the permit area, represented by area of forest stands at different ages over time. For example, terrestrial species that favor an open canopy for grazing and forage such as ungulate species would favor young forest conditions. Figure 5 and Figure 6 provide a snapshot of average stand ages at the beginning (2023–2037) and end (2083–2097) of the analysis period, respectively, inside and outside areas designated for conservation (LD, ELD and HCAs). As shown in Figure 5, most forests in the plan area are less than 100 years old and all three scenarios are very similar, although the HCP includes more acres of young stands up to 60-years in age in the HCAs than the FMPs include inside the LD and ELD. This difference is because HCAs are focused on improving landscape-level habitat by creating larger patches and including younger stands adjacent to suitable habitat and between existing species sites that will grow into suitable habitat over time. Figure 6, shows that over time, the distribution of stand ages is similar and is predicted to even-out with the amount of forest over 100 years in age, old forests are primarily located within areas designated for conservation and young stands are almost exclusively located outside areas designated for conservation. The results for the HCP and dFMP are similar, but the result for the cFMP show fewer stands in the 40 to 90-year age classes.

Figure 5. Average Forest Stand Age Class Distribution in the Permit Area Inside and Outside Areas Designated for Conservation, 2023–2037

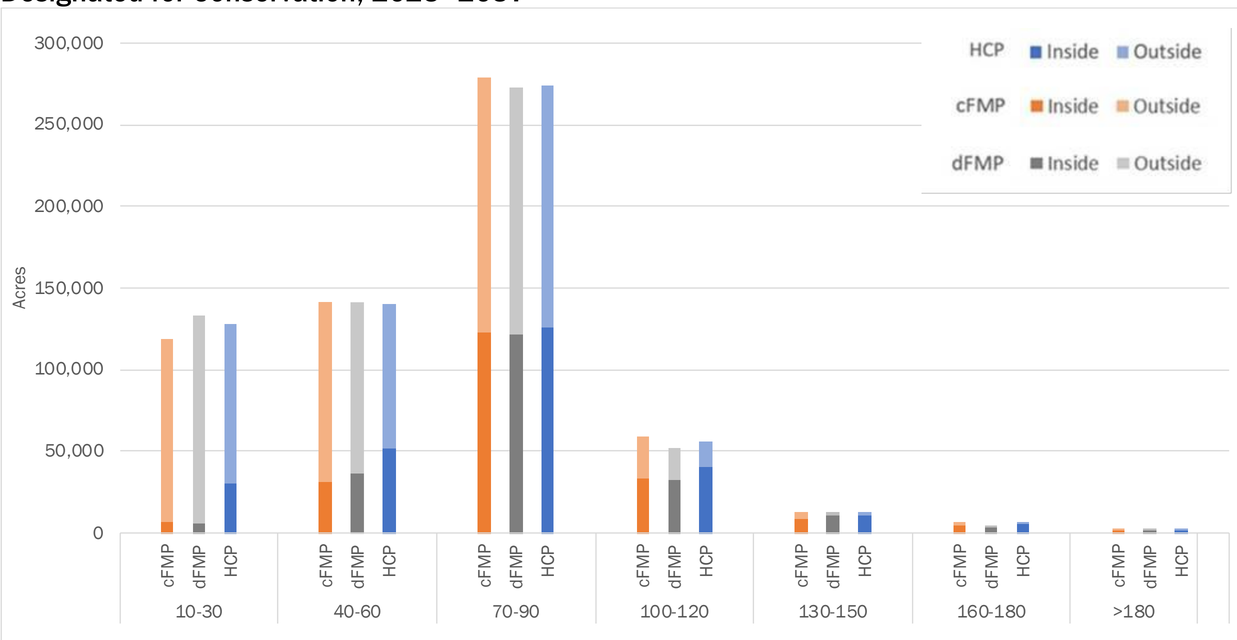
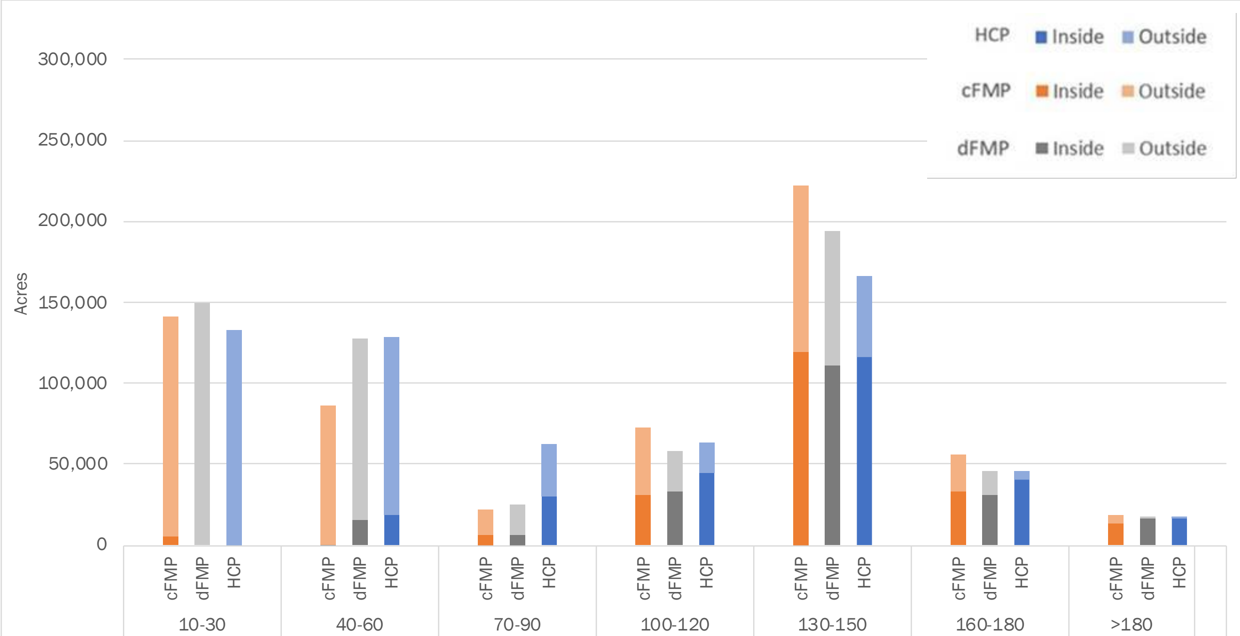


Figure 6. Average Forest Stand Age Class Distribution in the Permit Area Inside and Outside Areas Designated for Conservation, 2083–2097



Habitat Configuration and Fragmentation

The configuration of the habitat is important because it provides information about the degree of habitat continuity, or the inverse, habitat fragmentation. Fragmented habitats present challenges for landscape connectivity due to the increased resistance in the movement of individuals between patches. Decreased movement can result in genetic decay (inbreeding) or demographic decay and increases the likelihood of patch-level extirpation. Within a fragmented landscape, the distance between patches can be an important measure of the degree of fragmentation and can influence the degree and pace of genetic and demographic decay. In addition, for old-forest specialist species, like the northern spotted owl and marbled murrelet, habitat patch size is important, with larger patches of forested habitat likely to provide more functional habitat than the same amount of habitat configured into smaller patches. Reducing the "edge effect" (i.e., providing a lower perimeter to area ratio) on suitable habitat through the establishment of larger habitat patches affords covered species protection against threats like nest predators, windthrow and changes in microclimate.

Over the 75-year period of analysis, the configuration of areas designated for conservation will have a significant influence on how the continuity of suitable habitat for covered species changes over time. Lands outside these designated areas are available for harvest, unless there are other constraints such as operability, access or regulatory limitations. Harvest of these areas would reduce overall patch size of habitat, and create edge effects. In contrast, active management and implementation of other conservation measures in the HCAs are designed to increase the rate at which habitat suitable for covered species develops, increasing patch size and reducing the relative amount of edge. Figure 7 shows a comparison of the cFMP landscape design, including terrestrial anchors (LD), dFMP estimate landscape design (ELD), and HCP HCAs relative to modeled suitable habitat in 2023 for northern spotted owl and marbled murrelet in the Tillamook District. As shown, the HCAs cover larger, more even-edged and contiguous areas than the LD and ELD. The ELD is the most complex, comprised of a larger number of small, disconnected areas across the area.[11]

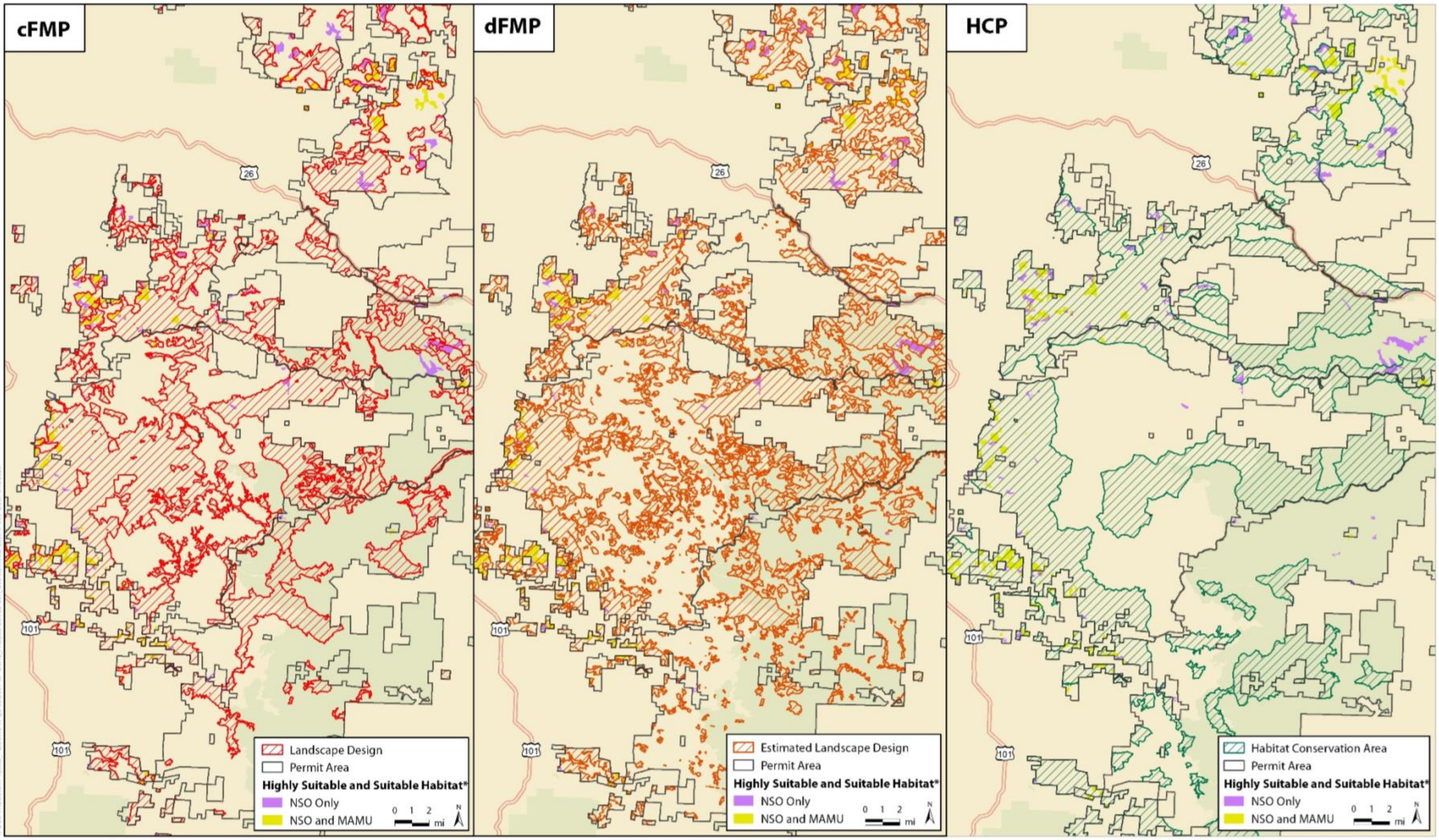
An analysis of the number, size, and distance between areas included in the LD, ELD and HCAs further illustrates the difference between the configuration of areas designated for conservation in the cFMP, dFMP and HCP. The design of these areas has implications for the relative development and fragmentation of future potentially suitable habitat. As shown in Table 3, the HCAs are much larger and the ratio between perimeter and area is lower than the cFMP LD and the dFMP ELD (lower ratio signifies less fragmentation). Patches included in the ELD are smallest and more numerous, with over 1,100 patches averaging only 150 acres each. The cFMP and HCP perform much better in this respect, with the cFMP having 231 patches averaging 770 acres, and the HCP having 255 patches averaging 1,100 acres. The ratio between perimeter to area is also the highest for the ELD, indicating a higher level of fragmentation, as opposed to the HCP which performs the best of the three scenarios (Table 3). From a conservation perspective, the ELD could potentially result in a more highly fragmented landscape that would present both logistical management complexities and poor habitat configuration for species with large home ranges or poor dispersal abilities.

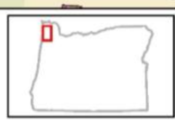
Table 3. Comparison of the Size and Configuration of Areas Designated for Conservation under the FMPs and HCP

Scenario	Number of Patches	Mean Distance between Patches (meters)	Mean Patch Size (acres)	Maximum Patch Size (acres)	Ratio of Perimeter to Area
cFMP	231	500 (± 1,300)	770 (± 3,200)	41,300	6.2
dFMP	1146	180 (± 620)	150 (± 1,200)	28,800	9.2
HCP	255	2,400 (± 6,200)	1,100 (± 4,300)	47,700	2.9

[11] The ELD is "estimated" based on constraints and inoperable areas at this point in the dFMP planning process and does not currently include landscape considerations in the design. It would be subject to change if the Board directs ODF to continue development of the dFMP.

Figure 7. Comparison Between the Landscape Design (cFMP), Estimated Landscape Design (dFMP) and Habitat Conservation Areas (HCP) Using Northern Spotted Owl and Marbled Murrelet Modeled Habitat (Tillamook District)





**According to habitat suitability models developed by ODF*

Table 4 shows the level of alignment between areas designated for conservation and current suitable habitat across the permit area, and Figure 7 shows examples of these areas for the Tillamook District. Across the entire permit area, the ELD is best aligned with currently modeled habitat, encompassing all of the marbled murrelet habitat and 99 percent of the northern spotted owl habitat. In comparison, the HCP does not protect all of the existing habitat, but provides for targeted development of larger patches of interior habitat during the permit term.

Table 4. Alignment of Areas Designated for Conservation (LD, ELD and HCAs) Relative to Modeled Suitable Habitat for Northern Spotted Owl and Marbled Murrelet 2023 within the Permit Area

	Northern Spotted Owl			Marbled Murrelet		
	Highly Suitable	Suitable	Total	Highly Suitable	Suitable	Total
Acres	3,400	21,900	25,200	1,600	11,000	12,700
Amount protected by cFMP LD	3,100 (92%)	16,500 (75%)	19,600 (78%)	1,500 (91%)	9,200 (83%)	10,600 (84%)
Amount protected by dFMP ELD	3,400 (100%)	21,500 (99%)	24,900 (99%)	1,600 (100%)	11,000 (100%)	12,700 (100%)
Amount protected by HCP HCAs	3,300 (98%)	16,900 (77%)	20,200 (80%)	1,600 (100%)	10,000 (90%)	11,600 (91%)

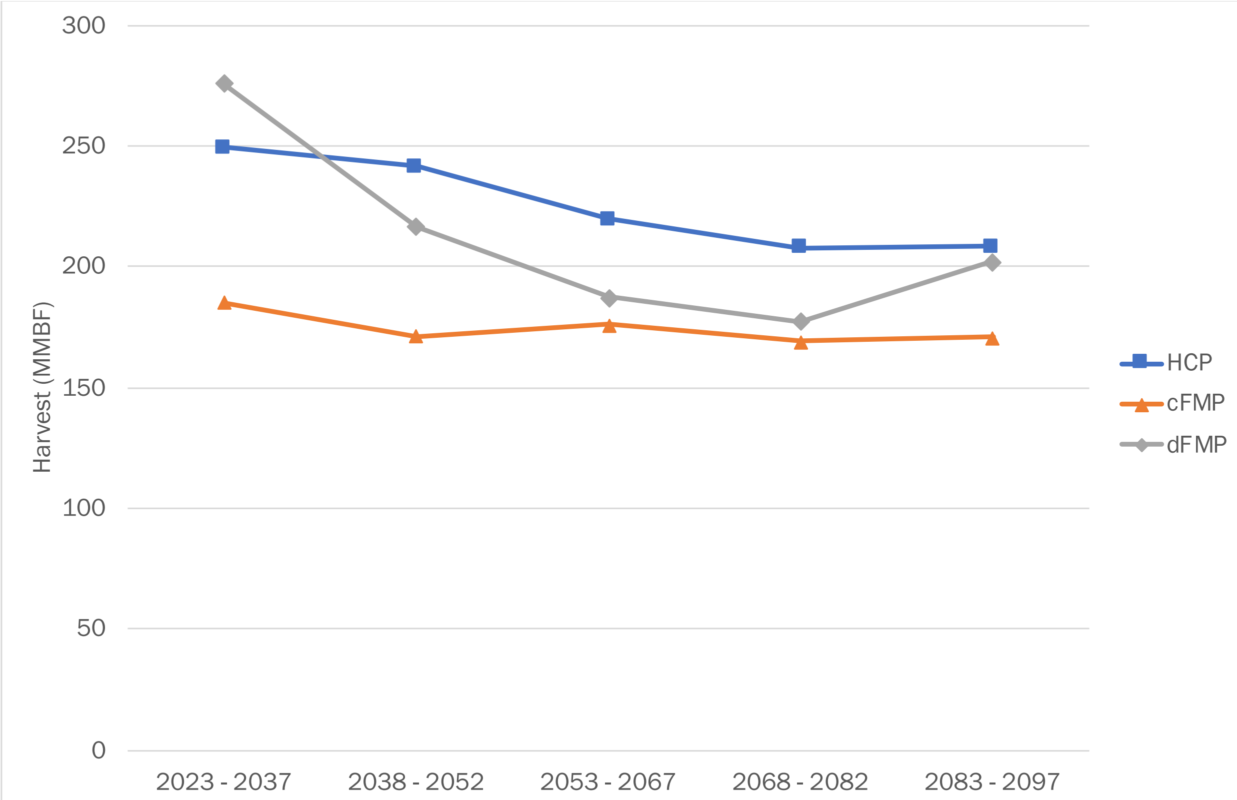
Timber Harvest and Net Revenue Outcomes

Harvest Volume

The three scenarios each involve distinct timber management and harvest approaches. The cFMP pursues Structure-Based Management to achieve specific landscape and forest structure conditions, and harvests are implemented to maintain non-declining even-flow of harvest volume. The dFMP and HCP are modeled for this analysis to involve departure from non-declining even-flow under the cFMP to achieve a balance across forest age classes and respect habitat constraints while pursuing the highest net value timber product harvest. The key difference is that the dFMP and HCP pursue net revenue maximization within a series of landscape scale constraint, while the cFMP pursues non-declining even-flow of harvest volume while coordinating harvests to achieve specific forest characteristics across all acres.

Annual harvest volume is expected to be greatest under the HCP, with an average over the 75-year timeframe of 225 MMBF annually, compared to 175 MMBF for the cFMP and 212 for the dFMP. Under all scenarios, harvests are expected to initially decline at a gradual rate for several years and then level off over time (Figure 8). This decline is primarily due to increases in constraints on available acres (for harvest) due to HCAs under the HCP and expected expansion of areas constrained by currently and yet-to-be listed species. Note that annual variability will cause actual harvest trends to vary more than the chart suggests, although the harvests are expected to be more consistent under an HCP than otherwise. In general, these volumes are expected to be highly uncertain over time under the cFMP and dFMP, and more predictable and manageable under an HCP.

Figure 8. Annual Harvest Volume by Scenario, 2023 to 2097



Note: Points represent 15-year averages.

ESA Compliance and Species Management Costs

Annual ESA compliance costs are expected to decline substantially with implementation of an HCP. Under the cFMP and dFMP, starting in 2023 ESA compliance is expected to cost ODF an average of over $7 million annually in direct administration and species survey costs in the future due to increasing effort over time (Table 5). This amount includes $2.5 million of current species survey costs increasing over time as well as an additional estimated $1.7 million due to future listings and increased regulations. Under an HCP, ESA administration staff costs and monitoring costs are expected to be $3.4 million annually. The annual savings under an HCP is expected to be nearly $4 million. Species management costs include stream restoration and barred owl control, much or all of which can potentially be provided via grants and partner agency contributions, reducing these costs potentially to zero. Monitoring activity is also much more useful in terms of achieving conservation outcomes than the compliance-related surveys under take avoidance. In general, these costs are expected to be highly uncertain over time under the cFMP and dFMP, and highly certain under an HCP.

Table 5. Average Annual ESA Compliance Costs for ODF by Scenario

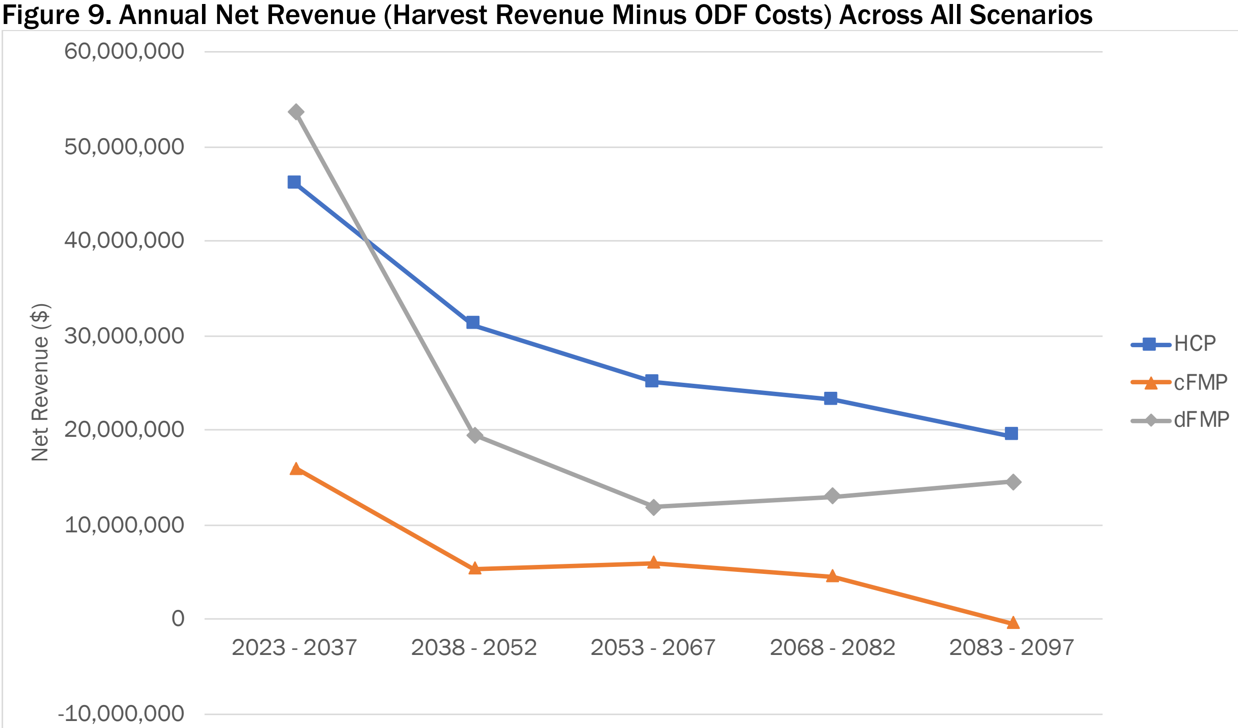
Cost Category	cFMP and dFMP	HCP	Annual HCP Cost Savings
ESA Administration	$3,165,000	$348,000	$2,816,000
Species Management [a]	$4,216,000	$3,095,000	$1,121,000
Total	$7,381,000	$3,444,000	$3,937,000

Notes: [a] Assumes new species listing would result in over $1.7 million of additional annual survey costs for cFMP and dFMP. Some totals affected by rounding.

Net Revenue

Similar to harvest volume, net revenue is greatest under the HCP, followed by the dFMP and then the cFMP. Net revenue in this case is gross timber revenue minus ODF costs (before county payments). Average annual net revenue (before revenue distributions) is expected to be $29 million under the HCP, $23 million under the dFMP, and $6 million under the cFMP. Over time, net revenue is expected to decline across all scenarios (Figure 9). These trends are due to the declining harvest volumes across all scenarios combined with increasing costs under the cFMP and dFMP. Average annual costs over the 75-year timeframe are lowest for the cFMP and highest for the dFMP, largely due to the corresponding levels of harvest (lowest for cFMP and highest for dFMP). Net operating income to ODF after county payments is expected to be negative across all three scenarios (Figure 10). These net revenues are expected to be highly uncertain over time under the cFMP and dFMP, and much more predictable under an HCP.

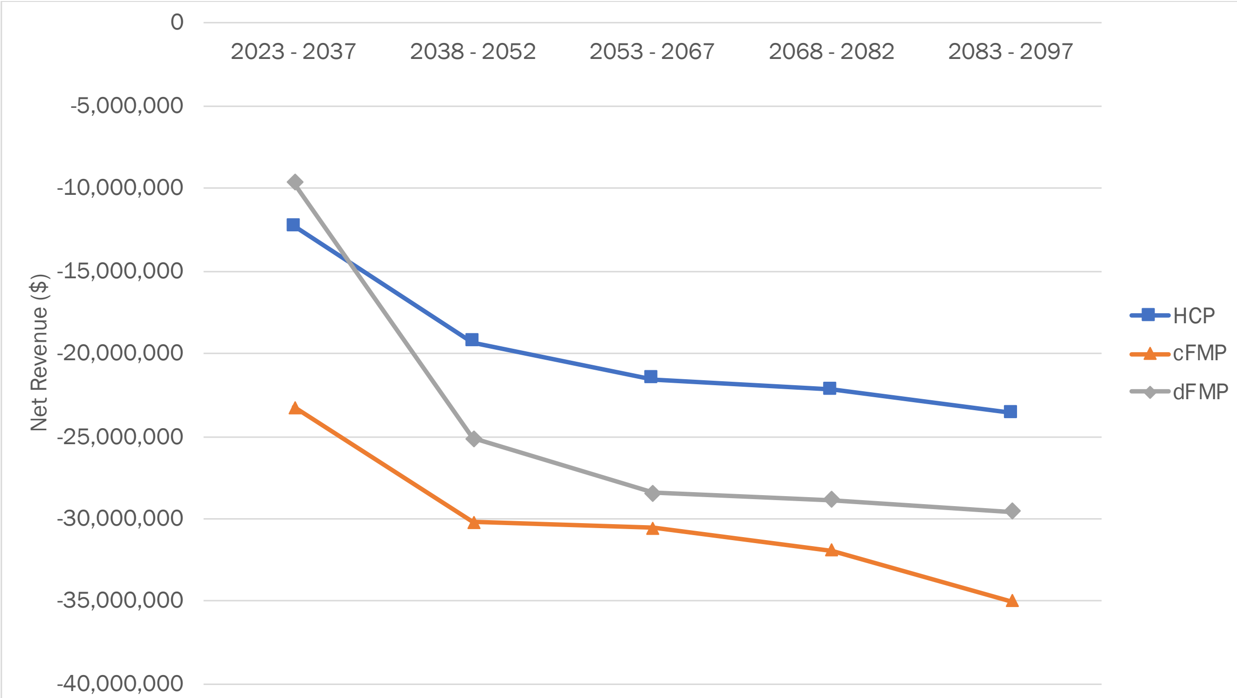
Figure 9. Annual Net Revenue (Harvest Revenue Minus ODF Costs) Across All Scenarios



Note: Points represent 15-year averages.

Summed over the 75-year timeframe of 2023 to 2097 and discounted at 3 percent, the net revenue before county payments based on these calculations is expected to be $1.1 billion for the HCP, $1.0 billion for the dFMP, and $297 million for the cFMP. After revenue distributions, annual revenue retained by ODF (net operating income) is expected to be greatest under the HCP Scenario, followed by the dFMP Scenario. It is expected to be negative and declining across all three scenarios.

Figure 10. Annual Net Operating Income for ODF after Revenue Distributions



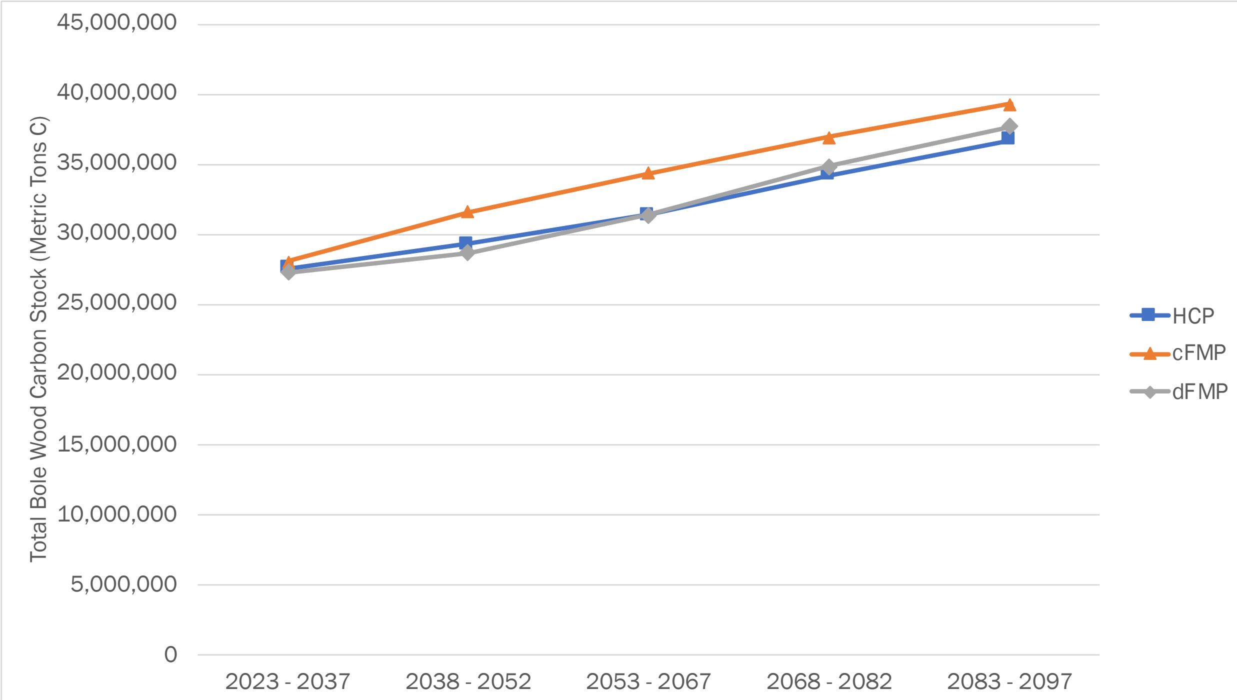
Note: Points represent 15-year averages.

Social Outcomes

This analysis included consideration of carbon sequestration volumes, outdoor recreation, and cultural values. Social outcomes across the management scenarios did not result significant quantitative differences, except for carbon sequestration. Carbon sequestration was measured by the weight of carbon dioxide (CO_2, metric tons) within the main trunk of standing trees. All scenarios resulted in an increase in carbon sequestration over time, and was greatest under cFMP. The HCP and dFMP had relatively equal stocks over time (Figure 11).

Recreation outcomes similarly were not found to be substantially affected in terms of differences across the three scenarios. The improved predictability for planning expected under an HCP would potentially improve the opportunity and costs (lowered) for maintaining and improving recreation facilities and development. Since an HCP would provide more reliable net revenue for ODF over time, there is more opportunity for strategic investments in recreation. Protection of cultural resources is expected to be consistent among the three scenarios. ODF's commitment to improve working relationships with tribes will continue under all scenarios. More predictable long-term funding opportunities under an HCP would likely allow for strategic management actions for cultural objectives. Similarly, to the extent that an HCP would provide more reliable plant and animal populations on ODF-managed lands, when those species provide cultural benefits the benefits would likely be greater with an HCP than without.

Figure 11. Carbon Stock in ODF-Managed Forests, by Scenario



Note: Points represent 15-year averages.

HCP Risk Management Benefits

A key finding across the investigations included in this study is the wide-ranging risk-management benefits of the HCP. The operating conditions ODF would experience under an HCP would be more certain and predictable and provide ODF with more operational flexibility in marketing and implementation of timber sales with the current and future levels of uncertainty and constraints associated with the cFMP and dFMP scenarios (Table 6). A take avoidance approach to ESA compliance fundamentally leaves ODF vulnerable to disruption of management activities when listed species habitat is discovered during pre-harvest surveys or new species listings occur. With the reduction of these risks, more predictable use of resources and long-term dedication of acreage to specific priorities has benefits for conservation and timber harvest objectives. Similarly, the HCP design process identifies and ensures that the most suitable habitat is protected over time, as opposed to a take avoidance approach where protections must be pursued when opportunities arise in conjunction with timber sale surveys. These improvements in long-term predictability and dedication of land use conditions provide a more stable context for other investments as well, such as outdoor recreation facilities.

Table 6. HCP Risk Management Benefits Relative to cFMP and dFMP

Risk Management Outcome	Rationale
Reduced habitat risk	Long-term commitments to habitat protection for covered species
Reduced timber harvest risk	Certainty of encumbrances from currently listed species and new species listings
Reduced litigation risk	Defined conservation commitments as well as timber management commitments
Reduced timber market vulnerability	Improved timber sale process to better time market and capture high market prices
Reduced disturbance event vulnerability	More resilient and connected habitat conditions for storms, wildfires, and other disturbances
Reduced outdoor recreation investment vulnerability	More predictable long-term land use designations provide a more predictable setting to plan and implement outdoor recreation investments such as facilities and trails.

One of the most significant benefits of an HCP is the potential for reduced litigation risk. An HCP provides substantially increased protection for ODF from lawsuits brought under the ESA; otherwise, such suits could threaten timber harvest activities in some of the most productive state forests that ODF manages. Similarly, an HCP removes potential ambiguities regarding areas that can and cannot be harvested; these ambiguities can lead to challenges from stakeholders for ODF to harvest at higher levels than planned. The settled and defined land use definitions under an HCP therefore can reduce the risk of the costs and disruptions potentially imposed by lawsuits from both environmental and timber objectives.

Conclusions

These analyses suggest that conservation, economic (harvest, costs, revenue), and social outcomes would be more reliable and provide greater benefits when considering uncertainties under an HCP than under the dFMP or cFMP scenarios. The HCP provides the opportunity to identify and protect the highest quality habitat on ODF-managed forests in western Oregon. The cFMP may yield a higher stand-level habitat quality for covered terrestrial species, but the HCAs yield a better configuration of future suitable habitat. Furthermore, monitoring and management under the HCP provides more confidence in future habitat quality. The HCP also yields better conservation results specifically for covered aquatic species. The high degree of uncertainty without the assurances of an HCP mean that conservation outcomes will likely be less with either FMP than those guaranteed under an HCP. In addition, timber harvest volumes and ESA-related expenses have more certainty with an HCP. These results are sensitive to assumptions regarding future constraints on acres available to harvest, and driven by uncertainties inherent to a take avoidance approach to ESA compliance. Acreage available for timber harvest and harvest volume are greatest under the HCP scenario based on the best available estimates of future species take-avoidance constraints. Costs, other than those directly associated with harvest activity, are lowest under the HCP. Financial challenges for ODF do remain across all three scenarios, but the HCP provides the best ESA compliance framework for moving forward.

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1 Introduction

1.1 Background

The plan will recognize that the goal for management of Board of Forestry Lands is to secure the greatest permanent value to the citizens of Oregon by providing healthy, productive, and sustainable forest ecosystems that over time and across the landscape provide a full range of social, economic, and environmental benefits to the people of Oregon. The goal for management of Common School Forest Land is the maximization of income to the Common School Fund over the long term.

Northwest Oregon Forest Management Plan, 2010

The Oregon Department of Forestry (ODF) manages state forestlands in western Oregon for the Greatest Permanent Value (GVP) to the citizens of Oregon, which is the central, guiding principle that informs ODF management strategies (see side panel). The definition of GVP includes economic, environmental, and social benefits across multiple uses. Timber harvests support local communities in western Oregon by creating family-wage jobs, supporting milling operations, and through revenue sharing with the Council of Forest Trust Land Counties (CFTLC). Harvest activities financially support state forest management, staffing and operational activities, with little to no funding from tax-payer dollars. State forest management activities in western Oregon are guided by the current Northwest and Southwest Oregon Forest Management Plans (cFMP), and the Elliott State Forest Management Plan[1] The cFMP governs management activities for over 613,000 acres of state forests known as Board of Forestry Lands (BOFL). ODF also manages over 25,755 acres of Common School Forest Lands (CSFL) for the Department of State Lands in the permit area. The cFMP was adopted in 2001 and revised in 2010. It contains management strategies that are applied through Implementation Plans at the district level, and covers state forestlands in the North Coast and Willamette Valley. ODF staff have developed a draft Forest Management Plan (dFMP) for all western Oregon forestlands, intended to improve upon the pursuit of GVP by advancing conservation outcomes and the financial viability of the state forests management.

These forest management activities take place in the context of habitat for several fish and wildlife species protected under the Endangered Species Act (ESA). As such, forest management activities including timber management and harvest must comply with ESA requirements, ensuring that no "take"[2] of listed species occurs. Without an incidental take permit provided by a Habitat Conservation Plan (HCP), the Oregon Department of Forestry

[1] Note that an additional 18,073 acres are currently managed under the and 2010 Southwest Oregon Forest Management Plan, 48 percent of which are Common School Forest Lands owned by the Department of State Lands. Other than their geographic focus, the FMPs are otherwise the same.

[2] Take is defined as "harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct" (16 U.S. Code [USC] 1532)

(ODF) currently employs a "take avoidance" approach to ESA compliance. Additionally, the cost of operational surveys do not provide a conservation benefit to the species. As the number of listed species on ODF–managed lands increases and the colonization of new areas by currently listed species expands, the agency faces growing challenges to generate a sustainable and predictable stream of revenue from timber harvest activities while avoiding harm to listed species, and complying with the ESA.

The Board of Forestry (BOF)[3] directed ODF staff to explore programmatic options to ESA compliance, including an HCP. The State Forests Division (the Division) developed a three-phased approach to explore the possibility of a Western Oregon Habitat Conservation Plan.

- Phase 1: HCP Initiation included a Business Case Analysis (BCA) designed to evaluate the financial implications of an HCP for western Oregon state forests versus the take avoidance approach used in the cFMP. Based on the findings of the BCA, the BOF directed ODF staff to proceed to Phase 2.
- Phase 2: HCP Strategy Development. Development of the HCP entailed extensive involvement of the Scoping Team to define the terms of the HCP, ODF staff and the ICF Consulting team. Concurrently, ODF was directed to complete a draft Forest Management Plan (draft FMP) that continued to use a take-avoidance approach. On October 6, 2020 the BOF will decide if the Division should continue into Phase 3.
- Phase 3: Complete the administrative Draft HCP and begin the National Environmental Policy Act (NEPA) Review.

1.1.1 Project Purpose

This Comparative Analysis (CA) builds upon the 2018 BCA to evaluate the potential conservation, economic, and social outcomes from the HCP, the cFMP and the dFMP over time. The purpose of the CA is to provide a systematic assessment of the tradeoffs across these management scenarios to provide a better understanding of the ***relative*** differences across all categories of value that these forests are mandated by state law to provide. It may also serve as a tool to assist the BOF in deciding whether it is in the best interest of the state to continue to Phase 3: National Environmental Policy Act (NEPA) Review Process. If so directed, the ODF staff would work with NOAA Fisheries (lead NEPA Agency) and USFWS (together referred to as "the Services") to complete the NEPA process, and bring a fully vetted HCP to the BOF for consideration. Concurrently, a companion FMP would be developed that would address measures to inform management of State Forest Lands for other, non-timber resource values (e.g., non-covered species, cultural resources, recreation).

The analysis in this report includes an attempt to quantitatively and qualitatively forecast how future values from the state forests will differ under the dFMP relative to the cFMP.

[3] The Board of Forestry is a citizen Board appointed by the Governor and confirmed by the state Senate, with a mission to lead Oregon in implementing policies and programs that promote sustainable management of Oregon's public and private forests.

Consequently, both the cFMP and dFMP can have implications for the full range of values, but only those outcomes that differ are relevant to this analysis.

1.1.2 Policy Context for the Forest Management Plans

It is important to recognize that ODF operates under certain legal mandates, most significantly, BOFL are managed to meet GPV. This requirement includes providing a full range of social, economic, and environmental benefits to the people of Oregon. A key component of GPV is to maintain these lands as forest lands and actively manage them in a sound environmental manner to provide sustainable timber harvest and revenues to the state, counties, and local taxing districts. Under the current revenue distribution law, approximately one-third of the revenue generated from the timber harvest goes to ODF for operating costs and the remaining revenue goes to the counties and local taxing districts.

The Forest Management Plan provides the overarching policy for management of state forestlands over a multi-decade timeframe. State forestlands have been managed under the cFMP using a structure-based management approach since 2001. The cFMP is the culmination of a plan and updates over the past 20 years. In 2013, the BOF directed staff to develop an alternative FMP that would improve financial viability and conservation outcomes, and to explore programmatic approaches to comply with the ESA instead of the current approach of take avoidance. This set of intended improvements is represented by a new set of goals, strategies and measurable outcomes, developed by ODF staff and presented to the BOF in 2019. Following on these updated goals, strategies and measurable outcomes, ODF staff developed a draft FMP using an ecological forestry approach and delivered it to the BOF in April 2020.

1.1.3 Policy Context for the Habitat Conservation Plan

All forest management activities on state forests must abide by requirements under the ESA. Section 9 of the ESA prohibits the “taking” of species listed as threatened or endangered. Take is defined as “harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct” (16 U.S. Code [USC] 1532). Harm is further defined as including “significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering” (50 Code of Federal Regulations [CFR] 17.3). Despite employing policies to avoid take of federally listed species, ODF runs the risk of such take, incidental to its forest management activities, including timber harvest.

The species listed under the ESA fall under the jurisdiction of one of two federal agencies. Anadromous fish and most marine species are regulated by NOAA Fisheries, which is part of the Department of Commerce. All other species are under the jurisdiction of the U.S. Fish and Wildlife Service (USFWS) in the Department of the Interior.

The take prohibitions of Section 9 of the ESA are strict, and come with stiff penalties for violations. Furthermore, citizens have the ability to sue to enforce the ESA if they believe NOAA Fisheries or USFWS is not properly enforcing it. Because of the risks of non-compliance, landowners and other non-federal entities must either avoid take of listed species or obtain take authorization from NOAA Fisheries or USFWS in one of two ways.

- If their project or activity requires a federal permit, has federal funding, or occurs on federal land, then the authorization for take can be provided by NOAA Fisheries or USFWS through a formal consultation with the federal agency involved. This consultation is conducted through Section 7 of the ESA and results in a "Biological Opinion" and incidental take permit.
- If no such federal nexus exists, non-federal entities, including state agencies, must obtain take authorization by applying for an incidental take permit under Section 10 of the ESA. The incidental take permit application must include an HCP that describes the requested take authorization and the avoidance, minimization, and mitigation measures the applicant proposes to offset the take of each species covered by the HCP. The HCP must also describe a monitoring and adaptive management program and provide assurances to the federal agencies that the applicant is able to fully fund HCP implementation, among other requirements.

Over the past several years, ODF has faced increasing uncertainties, costs, and regulatory compliance challenges in managing state forests consistent with a take avoidance approach to ESA compliance. Avoiding take requires extensive and expensive field surveys. ODF biologists must determine where these listed species are present in order to determine where timber harvest can and cannot occur. Currently, ODF spends over $2 million annually on these field surveys, and as new areas are surveyed, new sites with listed species are identified. Listed species such as northern spotted owl, marbled murrelet, and coho salmon may shift their centers of activity from year-to-year and are expected to expand their populations and colonize new areas as recovery efforts take hold and begin to improve the species' status. In addition, more species are expected to become listed in the future as threats such as climate change and invasive species continue to expand. The timing and extent of these expansions by listed species and new species listings are highly uncertain. The Humboldt marten and red tree vole are current examples of species that could gain ESA-listing which would impact ODF operations. Without any incidental take permits, the growing challenges of expanding species and new species listings will make ODF's current efforts to avoid take increasingly expensive and restrictive. Survey and monitoring costs under the current approach are expected to increase dramatically with each new species listing.[4]

The timing and extent of these expansions by listed species and new species listings are highly uncertain. The growing uncertainty in future harvest locations and harvest amounts creates an increasingly difficult and unpredictable regulatory environment in which ODF tries to operate. Furthermore, take avoidance policies and procedures alone do not constitute a meaningful long-term conservation benefit for listed species.

[4] For more historical context on ESA compliance efforts for ODF, see the 2018 Business Case Analysis.

Continued timber harvest on state forests managed by ODF is critical to the local economies surrounding the forests. Two-thirds of all revenues from BOF lands are distributed to counties where harvests take place (who in turn distribute to local taxing districts). The amount of local revenue is therefore directly proportional to the amount of timber harvest and the current market price of timber (stumpage price). Continuing the current take avoidance strategy is expected to further limit timber harvest for the reasons described above.

Habitat conservation plans are increasingly common around the country as an ESA compliance tool. To date, there have been over 1,000 HCPs approved, including many in Oregon, Washington, and California by timber companies and state land management agencies. Many are of a similar scale and cover similar activities to those under consideration by the BOF.[5] Habitat conservation plans offer the potential for important efficiency gains in terms of both improvements in conservation and timber harvest outcomes (as well as other objectives). Without an HCP, covered species habitat protection and improvement is generally constrained to opportunistic interventions when timber sales occur within the vicinity and voluntary improvements that are subject to the current policy context and funding opportunities, both of which can change any time. Without an HCP, timber harvest activities are subject to the high uncertainty of when and where covered species habitat might be found, and when new species could be added to those protected under the ESA. Coordinating both objectives (conservation and timber) in a comprehensive and long-term way, with explicit consideration of tradeoffs, should provide the opportunity for more gain on both objectives than an ad-hoc approach as generally occurs with take-avoidance.

A fundamental aspect of an HCP and the collaborative process to design the HCP is that the USFWS, NOAA Fisheries and ODF are in agreement that implementation of the HCP would provide the best outcome for achieving the Biological Goals and Objectives for the covered species as well as the Forest Goals and Objectives for management over time. Habitat and conservation objectives benefit from a landscape-scale, long-term set of protections as well as investments in direct habitat improvement. From the timber harvest perspective, harvest activities are more predictable and reliable to plan and implement with an HCP. Furthermore, by definition, the permit allows for incidental take as opposed to the required objective of take avoidance without such a permit.

1.2 Overview of the Analysis

This Comparative Analysis is intended to inform the BOF decision regarding whether it is in the best interest of the state to continue working toward an HCP and move into the NEPA process. It builds on the previous BCA in several more expansive ways including: consideration of the range of outcomes that can differ across FMP and HCP scenarios, including realistic values for economic outcomes, and considerations for additional conservation and social values that contribute to Greatest Permanent Value. It is based on the best available current understanding and information regarding the differences in outcomes relative to these decisions, projected

[5] For more detail on similar HCPs elsewhere, see the 2018 Business Case Analysis.

over the 70-year permit period for the proposed HCP. This analytical exercise involves estimating a range of potential implications for outcomes of the various scenarios through to outcomes of concern to the BOF. In general this analysis involves comparison of three scenarios: the HCP Scenario, the cFMP Scenario, and the dFMP Scenario. If the BOF chooses to continue with and ultimately implement the HCP, an accompanying FMP would be developed, consistent with the HCP.

The analysis in this report quantitatively and qualitatively describes how future values from the state forests will differ under the cFMP, dFMP, or HCP in relative terms. As with any modeling exercise, assumptions must be made regarding future conditions. These assumptions are applied consistently across the scenarios. Many values may differ among the cFMP, HCP, and dFMP (available acres, harvest objectives, forest management strategy and assumptions), but only those outcomes that differ are relevant to this analysis. This analysis should not be interpreted as a precise projection of future harvest and conservation; rather, it provides a relative sense of potential outcomes associated with the three management approaches based on current assumptions.

1.2.1 Variables for Analysis

To do this analysis, ODF staff and the project team reviewed all identifiable categories of potential differences in effects among the three scenarios (HCP, cFMP and dFMP). These effects were then aligned with measurable and describable quantitative metrics and qualitative conditions. The objective was to utilize available data, modeling, and new analysis to best communicate differences in outcomes for each variable, thereby providing the BOF and others with a comprehensive understanding of the potential tradeoffs. These variables for analysis fall into three categories – economic, conservation, and social – shown in Table 1-1. The analysis and results sections of this report are organized by these categories of variables.

The report documents the analyses and results for the purpose of assessing the bottom-line outcomes into the future associated with the decision either to implement an HCP or to continue the current approach to ESA compliance.

Table 1-1. Evaluation Variables for Comparative Analysis

Variable	Units of Measure
Conservation	
Quality and Quantity of Terrestrial Habitat (Covered Species)	Acres of suitable habitat and acres and proportion of high and medium suitability habitat
Quality and Quantity of Aquatic Habitat (Covered Species)	Acres, acres of forest within various age classes. and qualitative metrics
Acres subject to covered species management and assurances	Acres
Acres subject to covered species monitoring and assurances	Acres
Quality and Quantity of Non-Covered Species Habitat	Acres of forest within various age classes and qualitative metrics
Habitat Fragmentation	Patch size (acres), Distance b/t patches (feet), and Interior:perimeter ratio
Economic	
Acres Available for Harvest	Acres
Annual Harvest Volume	MMBF (million board-feet)
Annual Timber Revenue	$ (Dollars)
Timber Management Costs	$ (Dollars)
ESA Administration Costs	$ (Dollars)
Species Management Costs (Restoration)	$ (Dollars)
ODF Annual Operating Costs	$ (Dollars)
Timber Inventory	MMBF (million board-feet)
Revenue Payments to Counties: Pool of Revenue	$ (Dollars)
Social	
Carbon Storage	CO_2e metric tons (metric tons of carbon dioxide equivalent)
Recreation Opportunities	Facility/resource units and qualitative description
Cultural Benefits	Qualitative description

This report documents the analyses and results for the purpose of assessing the bottom-line outcomes into the future associated with the decision either to implement an HCP or to continue the current approach to ESA compliance.

1.2.2 Analytical Differences between the BCA and the CA

Although the CA builds on the previous BCA, there are important differences in both the scenarios evaluated and the data underpinning the analyses presented in it. When the BCA was prepared, the HCP and the species-specific conservation strategies had not been developed, so the analysis relied on a series of assumptions regarding these conservation strategies and the area likely to be affected by new species listings. The analyses have been refined in several, more expansive ways including: consideration of the range of outcomes that can differ across cFMP, dFMP and HCP scenarios, development of refined values for economic and conservation outcomes based on spatially-explicit modeling of each scenario, and analysis of additional conservation and social values that contribute to GPV. A key underlying driver of differences in results for revenue and cost-related analyses between the BCA and this CA are the more refined estimates of acres available for harvest under each scenario, due to both the HCP development process and the detailed spatial modeling. In addition, the BCA assumed that some of the take-avoidance acres would free-up over time, under the presumption that the conservation acres would be a shifting mosaic over time. This no longer is expected to be the case, as the Services prefer more stable and durable conservation commitments. The CA is based on the best available current understanding and information regarding the relative differences in outcomes projected over the next 75 years (5 years beyond the 70- year permit period for the proposed HCP).

The CA draws on content developed for various draft sections of the HCP based on analyses and progressive discussions and agreements within ODF and with NOAA and USFWS, thereby providing a much more precise and accurate characterization of the effects of the HCP for state forest management outcomes. The CA similarly benefits from a policy-level, structural forest management model and habitat models (described in more detail in *Chapter 3. Methods and Key Assumptions*). In comparison, the BCA utilized a simple approach to forecasting future harvests based on existing district-level implementation plans. The CA modelling includes more detailed spatially-explicit parameters for future harvest projections. As a result, the analysis of inventory and timber harvests presented in this document is quite different from the BCA and shows corresponding differences in timing and levels of harvest. There are some specific implications of the difference in forest management modeling between the BCA, discussed in more detail in the modeling section (*Chapter 3. Methods and Key Assumptions*).

1.3 Organization of this Report

This report documents our assumptions and analytical methods, and presents our findings for the Comparative Analysis. The report is organized into the following sections:

Chapter 2. Context for the Analysis describes the conditions relevant to our analysis. These include the spatial scale, temporal scale (including how we address discounting future values), covered species and habitats, ODF management activities and other effects considered for review, and forest land categories used throughout the analysis. It includes the description of key effects for the three scenarios analyzed: the **cFMP Scenario,** the **dFMP Scenario**, and the **HCP Scenario,** organized across the categories of variables and effects outlined in Chapter 2.

Chapter 3. Methods and Key Assumptions describes the modeling methods and key assumptions applied to conduct the analyses.

Chapter 4. Projected Land Management and Acreage Constraints defines and describes land management categories and acreage constraints used to analyze each scenario.

Chapter 5. Conservation Outcomes describes and quantifies the conservation outcomes associated with management activities across the three scenarios. This includes current expectations for HCP-related outcomes.

Chapter 6. Timber Harvest and Net Revenues Outcomes describes and quantifies the effects of timber harvest activities and associated timber harvest costs by scenario. It also provides calculations of revenue and net operating income.

Chapter 7. Social Outcomes summarizes the expected effects of the scenarios regarding quantifiable social outcomes involving carbon storage, recreation and other cultural benefits.

Chapter 8. Costs summarizes the effects of the scenarios across all financial cost categories to ODF and final calculation of total costs to ODF.

Chapter 9. Sensitivity Considerations discusses issues of uncertainty associated with each scenario and management implications.

Chapter 10. Conclusions summarizes the full set of effects across each scenario for comparison of the overall consequences and tradeoffs.

2 Context for the Analysis

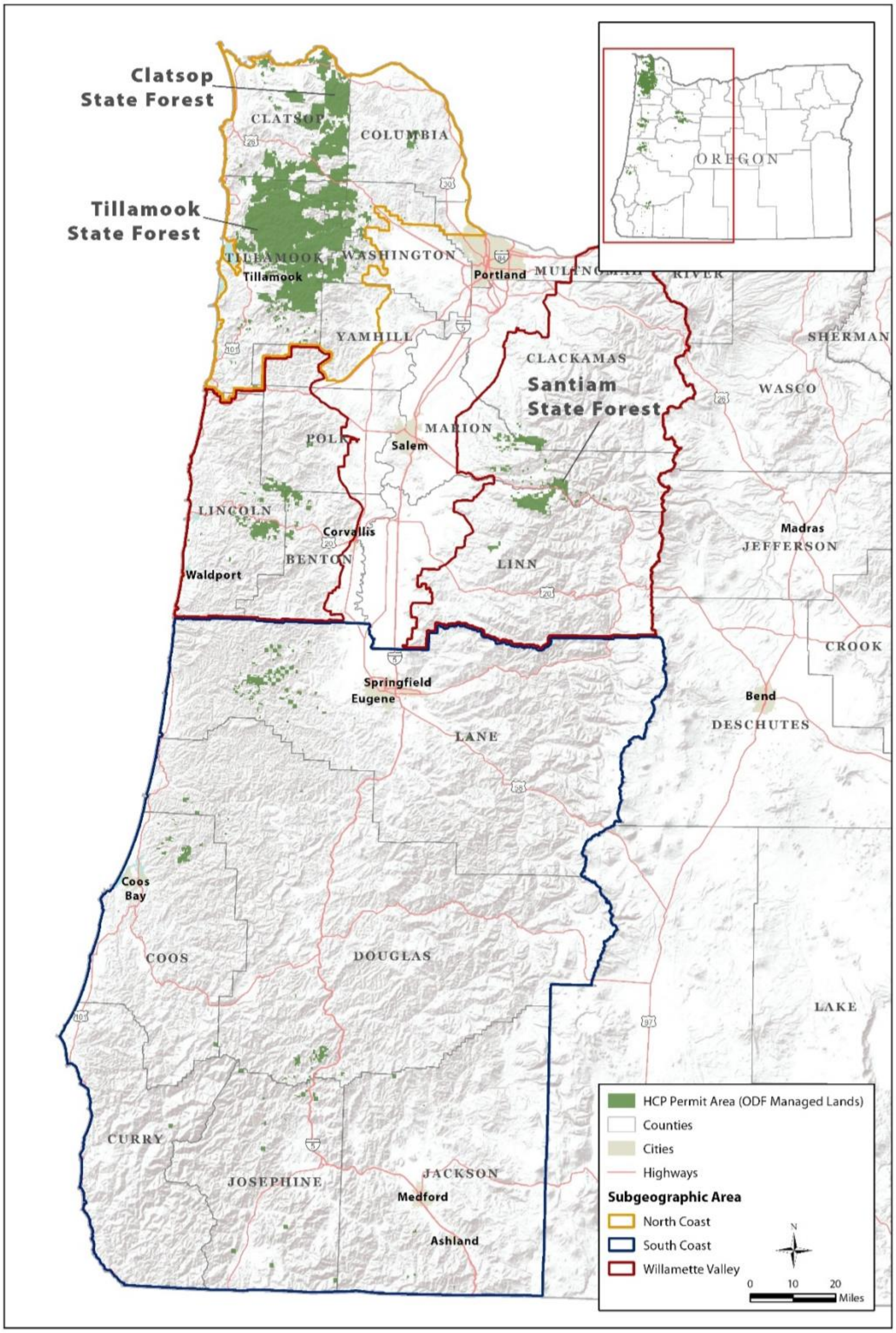
2.1 Spatial Scale

The analysis covers BOF and CSFL forests in western Oregon, including those in all 6 districts from Astoria in the north to Southwestern Oregon to the south. It does not include lands in the Klamath-Lake district or in eastern Oregon, nor does it include the CSFL in Douglas and Coos counties that are part of the Elliott State Forest. Throughout the analysis, the included land is referred to as the "permit area". Figure 2-1 identifies the combined acreage of the BOF and CSFL lands included in the analysis. The Comparative Analysis has been applied at the planning area-level as a whole and for each subregion: North Coast, South Coast and Willamette Valley. As shown in Figure 2-1 and Table 2-1, the North Coast subregion contains the largest and most contiguous area, with the other two subregions including a smaller number of acres and less contiguous areas. Results in this study are generally provided at the scale of the full permit area, although some results are provided in with more detail in Appendix B.

Table 2-1. Western Oregon State Forests by Subregion

Permit Area/Subregion	Area (Acres)
North Coast	**502,365**
Astoria	136,876
Forest Grove	115,261
Tillamook	250,228
South Coast	**53,025**
Coos	10,976
Southwest	16,793
Western Lane	25,257
Willamette Valley	**84,098**
North Cascade	47,465
West Oregon	36,632
Total	**639,489**

Figure 2-1. Map of Western Oregon State Forests HCP Plan and Permit Area



Source: Oregon Department of Forestry

2.2 Temporal Scale and Discounting

This analysis employs a 3 percent discount rate for the purpose of equalizing effects during different years when considering tradeoffs between management scenarios. The discount rate can be interpreted as the rate at which society as a whole is indifferent between 100 dollars of value for the resources at stake today versus 103 dollars of the resource one year from now. The discount rate is only applied to monetary values (e.g., not applied to timber harvest volumes). This approach is a standard convention for economic analyses of this sort, and is explicitly required in comparable guidance for economic analyses provided by federal agencies.[6] Furthermore, 3 percent has become a convention for resource management agencies that must consider a variety of goods and services (market and non-market) across potentially long time-horizons covering multiple generations.[7] Results in this analysis are not particularly sensitive to the choice of discount rate because the three scenarios do not result in substantially different timing of costs and benefits. This study does provide results at different discount rates, up to 7 percent, in the sensitivity analysis section of this report.

The analysis provides assessment of benefits and costs over a 75-year timeframe from 2023 to 2097. It recognizes two remaining years of HCP planning (2021 to 2022) followed by a 70-year implementation timeframe (2023 to 2092) for each scenario, which is equivalent to the time period the HCP will provide permit coverage, if adopted. It also recognizes that the dFMP would require additional preparation time and expense from 2021 to 2022 as well. Costs and benefits with financial implications occurring within this timeframe are discounted at a 3 percent real rate. Values are reported in constant 2020 dollars (without inflation). Results are forecast over a 75-year timeframe which goes beyond the 70-year permit term of the HCP.

2.3 cFMP and dFMP Overview

2.3.1 Current FMP Goals and Management Highlights

The current Forest Management Plan (cFMP) is designed to achieve a set of guiding principles, described in the plan. These guiding principles inform a series of identified management strategies for ODF.

Structure-Based Management

The cFMP is based on a management approach termed Structure-Based Management (SBM), defined as: "the application of silvicultural tools in a manner that is designed to attain a desired landscape condition, which in turn will meet the land management objectives of the FMP.

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[6] For example, Office of Management and Budget. 2003. Circular A-4. https://www.whitehouse.gov/sites/whitehouse.gov/files/omb/circulars/A4/a-4.pdf; U.S. Environmental Protection Agency. 2010, revised 2014, 2016. Guidelines for Preparing Economic

Analyses. December. https://www.epa.gov/environmental-economics/guidelines-preparing-economic-analyses.

[7] The OMB and EPA guidance referenced above generally recommend 3 percent for social discount rates, with sensitivity analyses at 7 percent. U.S. Department of Interior

Specifically, it is designed to produce and maintain an array of forest stand structures across the landscape in a functional arrangement that provides for the social, economic, and environmental benefits called for in the management direction for these lands. The benefits include a high level of sustainable timber and revenue, diverse habitats for indigenous species, a landscape level contribution to properly functioning aquatic systems, and a forest that provides for diverse recreational opportunities."

While management in individual stands varies with SBM, in theory over the long-term, many stands may move through the entire management pathway and return to a regeneration stand type through a final harvest. When the desired future condition is achieved, the landscape is a dynamic mosaic of slowly shifting stand types, but with relatively stable quantities of each. However, after 20 years (2001 – 2020) of implementing the FMP, some SBM aspects have been challenging to implement, ineffective at achieving expected conservation outcomes, or financially unsustainable. In some districts, silvicultural pathways available to achieve the desired "array of forest stand structures" do not achieve expected results due to local landscape conditions. In some geographic areas, timber management costs have exceeded revenues to the Division, and specific silvicultural practices required for managing for older forest or layered forest conditions (complex structure) can be prohibitively expensive. An improved understanding of costs versus timber revenues has demonstrated the challenge in providing sufficient funding for full FMP implementation.

Forest Management Inputs

In addition to establishing the overall vision and management approach, the cFMP sets resource management goals for conservation outcomes (e.g., fish, wildlife, biodiversity, water quality, etc.). In particular, it contains specific forest management inputs for landscape design to achieve desired future conditions and creation of terrestrial and aquatic anchors, which are described below. In contrast, the cFMP does not explicitly address timber harvest goals or strategies. The plan calls for active management for social and economic benefits, but does not differentiate between active management for creating structure and active management for economic benefits.

LANDSCAPE DESIGN

To ensure state forests are managed to achieve a diverse array of stand types, including the desired future condition of complex structure, the cFMP specifies five distinct stand structure types and targets for the proportion of acres in each type to be achieved across the landscape. The structure targets are implemented at the district-level and each individual district has a separate and tailored ten year implementation plan to achieve these forest characteristics while pursuing the objective of greatest permanent value.

These structural targets have been difficult to achieve because they ignore the continual development of habitat and structural characteristics over time and the complex ways in which structural elements are distributed on the landscape. Silvicultural tools intended to achieve structure types can also be costly to implement, can produce lower volume than traditional, even-age forest management tools, and do not necessarily achieve conservation outcomes within meaningful timeframes.

Achieving a "shifting mosaic" of habitats across the landscape was also prevented by ODF's current approach to ESA compliance: take avoidance. No harvest may occur in areas occupied by federally listed species, thus there is no opportunity for harvesting the associated complex stands. As described in the introduction, implementation of the "take avoidance" strategy is costly and is associated with a high level of uncertainty around annual harvest planning efforts. Take avoidance leads to cancellation of harvest in areas found to be occupied by protected species during pre-harvest surveys, which costs ODF millions of dollars each year.

TERRESTRIAL ANCHORS

Anchor habitat areas are a conservation tool intended to benefit terrestrial species of concern especially those associated with older forest conditions or interior habitat conditions that are sensitive to forest fragmentation, such as those that do not readily disperse across younger forest conditions. Anchor habitats established under the cFMP were selected based on known use by species of concern and habitat conditions. Anchor habitat areas were not intended to be permanent reserves; stands designated today are expected to be released after approximately 30 years. However, they will be maintained until it can be demonstrated through adaptive management that the species concerned is colonizing and persisting in new areas of habitat. Under the cFMP, approximately 10 percent of State forest lands are designated as Terrestrial Anchor Areas (TASs).

RIPARIAN BUFFERS AND AQUATIC ANCHOR REACHES

State Forests currently apply riparian buffers of various widths to protect water quality, habitat for native fish, salamanders, riparian birds, and other sensitive species. These riparian buffers typically require no harvest (no cut). In addition, the cFMP established Aquatic Anchors, which are intended to benefit fish and amphibian species of concern. They are designated in reaches of watersheds where salmon and aquatic amphibian conservation is a priority. Research and monitoring data were used to identify sub-watersheds that provide high quality habitat for salmonid species of concern.

HABITAT RESTORATION

Under the cFMP, ODF does not normally conduct specific habitat restoration actions for specific listed terrestrial species. However, management practices (i.e., structure-based management and creation of anchor habitats) are intended to promote a variety of habitat conditions on the landscape, including those that benefit listed terrestrial species. For aquatic habitat, some specific, targeted stream enhancement activities occur on ODF lands with the goal of improving stream habitat for anadromous fish, including several listed species. Those actions include removing fish barriers and adding large wood structures to the stream in areas identified as lacking large woody debris.

2.3.2 dFMP Differences from the cFMP

At a high-level, the vision for the dFMP is the same as the current plan, state forests are managed to provide economic, environmental, and social benefits and are codified in the Greatest Permanent Value (GPV) mandate. "Specifically, it is designed to produce and maintain an array of forest stand structures across the landscape in a functional arrangement that provides for the social, economic, and environmental benefits called for in the management direction for these lands. These benefits include a high level of sustainable timber and revenue, diverse habitats for indigenous species, a landscape level contribution to properly functioning aquatic systems, and a forest that provides for diverse recreational opportunities." The dFMP would also employ the same take avoidance strategies employed under the cFMP.

The Forest Management Plan will be grounded in the management mandates for Board of Forestry lands as expressed in the Greatest Permanent Value (GPV) and Forest Management Planning OARs, and the mandates for Common School lands.

While much of the foundational aspects of the current plan remain unchanged, there are several fundamental differences between the dFMP and cFMP that are intended to result in improvements in overall financial and conservation performance, while making implementation of the plan more manageable. Changes include a move away from the SBM approach to a focus on outcomes that encompass financial and conservation goals rather than management inputs focused primarily on conservation and forest restoration.

Ecological Forest Management

The SBM approach is replaced by an Ecological Forest Management approach in the dFMP. An ecological approach to forest management views resources and benefits within the context of societal values (e.g. social values, support for rural communities, natural resource-related economies) and the forest ecosystem (e.g. services, function, disturbance, resilience). Both of these are dynamic and hard to predict. This approach acknowledges and anticipates change and uncertainty in forest development and disturbances, in societal values and demands, and in future climate scenarios and effects on forest productivity and biodiversity. It addresses approaches and outcomes that reduce risk to resources and increase future options using an adaptive management framework. Adaptive management is a central tenet of an ecological approach to forest management given uncertainty and risks associated with long-term planning.

dFMP as Outcome Focused

A fundamental difference in the overall dFMP is that it establishes measurable outcomes for each goal, which will provide ODF with a clear adaptive management framework and flexibility to address unique situations or new information as they arise. Standards contained in the cFMP lack measurable outcomes, resulting in a focus on the inputs for management (standards) rather than the outcomes of management (results). The dFMP has been written to establish policy; landscape design will be developed in Implementation Plans (IPs).

Another key difference between the dFMP and cFMP is that the dFMP incorporates additional concepts to improve the financial and conservation outcomes:

1. Active management to produce sustainable harvest and flow of revenue;
2. Active and passive management to protect, maintain, enhance and restore properly functioning aquatic ecosystems; and
3. Active and passive management to address current and potential future effects of climate change on forest health and productivity, and habitat for native fish and wildlife.

The dFMP would provide for more management flexibility and allow foresters to manage for a continuum of habitats with seral stages at a regional-level, rather than setting specific stand structure categories at the District-level. The dFMP includes regional habitat goals that will allow districts to take into account adjacent land ownership and plan for habitat arrangements that complement habitat adjacent to state forest land; this will be particularly helpful for small and/or fragmented districts. Climate change is directly addressed in the dFMP to improve conservation outcomes over the long term and the dFMP provides for adjusting silviculture prescriptions to account for drought, changing fire regimes and forest health (insect and disease pressure). The dFMP also articulates both habitat and harvest goals, which will help to clarify tradeoffs between financial and conservation outcomes. In addition, the proposed plan emphasizes reinvestment in the forest, which would include a balanced approach that improves both conservation and financial outcomes through active management.

Forest Restoration and Conservation Commitments

The concept of a shifting mosaic is removed from the dFMP and is replaced with use of durable conservation areas, goals for a range of seral stages, and strategies to maintain connectivity. In conjunction with designation of durable conservation areas selected and managed to develop older forest conditions, the use of terrestrial and aquatic anchors is retained, as are actions to restore aquatic habitat and improve fish passage. Based on an updated resource assessment completed by ODF as a part of the dFMP and HCP planning effort, these elements have been integrated to develop a planning-level Estimated Landscape Design (ELD). In addition, the proposed plan emphasizes reinvestment in the forest, which would include a balanced approach that improves timber production in some areas and forest restoration and conservation in others through active management. For example, forest harvest prescriptions to restore diseased, poorly stocked stands such as swiss needle cast and acreages of aging red alder would require investment in the short-term but would drive long-term financial and conservation outcomes.

2.4 HCP Overview

ODF has the following vision for the HCP, which defines the future outcome of state forests for GVP with the HCP:

> *The Western Oregon State Forest HCP ensures species protection and conservation as well as increased certainty that working state forestlands will continue to benefit all Oregonians. Multi-objective forest stewardship activities provide revenue to counties, rural communities, the Common School Fund and ODF; create jobs; support resilient forest ecosystems, clean air and water; provide high-quality habitats for native fish and wildlife; and promote educational, recreational, and other partnership opportunities to enhance enjoyment of public forest benefits.*

ODF's overall goal is to increase stability around the costs and revenues from forest stewardship activities and increase certainty that habitat quality will improve over time for covered species.

The HCP outlines expectations for designating areas of focused habitat conservation and management, including implementation of restoration measures that would occur during the permit term in order to mitigate the effects of the taking of covered species, from covered activities. Covered activities generally include forest and recreation management activities in the permit area, as well as the activities needed to carry out the conservation strategy (see sidebar).

The focus of the HCP is on covered species. It does not include measures to inform management of State Forest Lands for other, non-timber resource values (e.g., non-covered species, cultural resources, recreation) unless those activities are analyzed for the effects on covered species or will be influenced by the conservation actions outlined in the HCP. As a result, the HCP would be complemented by a companion FMP for these other resource objectives. The companion FMP would use the dFMP structure because it is based on an updated resources assessment of the same geographic area. In short, the HCP would be the strategy used in the companion dFMP to address conservation outcomes of the covered species and to comply with the Endangered Species Act.

Covered Activities

Projects and activities for which ODF proposes to receive take coverage include:

- Timber Harvest Activities
- Reforestation and Young Stand Management
- Road System Management Activities
- Minor Forest-Product Harvest
- Quarries
- Fire Management
- Recreation Infrastructure and Maintenance
- Conservation Strategy Implementation Activities

2.4.1 Covered Species and Habitat

One of the most important early decisions in preparing an HCP is determining the species for which the applicant will request take authorization. These species, called "covered species" are named on the incidental take permit. In order to issue the permit, the USFWS and NOAA Fisheries must make distinct and independent findings that the HCP has met permit issuance criteria for each of the covered species. Table 2-2 provides a list of covered species included in the HCP.

Table 2-2. List of Covered Species for the HCP

Species Common Name (Scientific Name)	Status [a]		Primary Habitat
	State	Federal	
Fish			
Oregon Coast coho (Oncorhynchus kisutch)	--	FT	Habitat includes the Pacific Ocean and the freshwater and estuarine habitat (rivers, streams and lakes) along the Oregon Coast from the Necanicum River on the north to the Sixes River on the south
Oregon Coast spring chinook (*O. tshawytscha*)	--	--	Habitat includes clean and relatively stable gravel streambeds for spawning and egg incubation, complex channel features, cool temperatures during adult holding and juvenile rearing, access for anadromous migration.
Lower Columbia River coho (O. kisutch)	SE	FT	Includes freshwaters from the Columbia River and its tributaries downstream from the Big White Salmon and Hood Rivers (inclusive) and from the Willamette River and its tributaries below Willamette Falls.
Upper Willamette River spring chinook (O. tshawytscha)	--	FT	Includes freshwaters originating from the Clackamas River and from the Willamette River and its tributaries above Willamette Falls.
Upper Willamette River winter steelhead (O. mykiss)	--	FT	Includes freshwater habitats below natural and manmade impassable barriers from the Willamette River and its tributaries upstream of Willamette Falls to and including the Calapooia River.
Lower Columbia chum (O. keta)	--	FT	Freshwater areas of the Lower Columbia River and tributaries; often limited to the lower 1/3 of the mainstem and tributaries in this area due to the high gradient nature of Lower Columbia River tributaries.
South Oregon/Northern California coho (O. kisutch)	--	FT	Coastal streams and rivers between Cape Blanco, Oregon, and Punta Gorda, California.
Lower Columbia chinook (O. tshawytscha)	--	FT	Freshwaters of the Columbia River and its tributaries downstream of a transitional point east of the Hood and White Salmon Rivers, and any such fish originating from the Willamette River and its tributaries below Willamette Falls.
Eulachon (Thaleichthys Pacificus)	--	FT	The major and most consistent spawning runs return to the mainstem of the Columbia River and the Cowlitz River. Spawning also occurs in other tributaries to the Columbia River, including the Grays, Elochoman, Kalama, Lewis, and Sandy Rivers
Amphibians			
Oregon slender salamander (*Batrachoseps wrighti)*	--	UR	Late-successional and second-growth forests; often associated with large-diameter, decaying Douglas fir logs and bark debris mounds at the base of snags.
Columbia torrent salamander (*Rhyacotriton kezeri)*	--	UR	Coastal coniferous forests in small, cold mountain streams and spring seepages; primarily in older forest sites since the required microclimatic and microhabitat conditions generally exist only in older forests.
Cascade torrent salamander (*R. cascadae)*	--	UR	Coniferous forests in small, cold mountain streams and spring seepages.
Birds			
Northern spotted owl (*Strix occidentalis)*	ST	FT	Forests characterized by dense canopy closure of mature and old-growth trees, abundant logs, standing snags, and live trees with broken tops.

Species Common Name (Scientific Name)	Status [a]		Primary Habitat
	State	Federal	
Marbled murrelet (*Brachyramphus marmoratus)*	ST	FT	Spend the majority life on the ocean, but come inland to nest; generally nest in old-growth forests, characterized by large trees, multiple canopy layers, and moderate to high canopy closure.
Mammals			
Red tree vole (Arborimus longicaudus)	--	--	Found primarily in late-successional (older, structurally complex) forests in western Oregon and northwestern California.
Coastal marten[b] (Martes caurina caurina)	--	PT	Primarily found in near-coast forests with limited or no snow cover; prefer areas with dense shrub cover or areas with closed forest canopy.

Notes: [a] **State Status:** SE= state listed as endangered; ST = state listed as threatened. **Federal Status:** FT = federally listed as threatened; PT = Federal Proposed Threatened; FC = Federal Species of Concern; UR = Under Review

[b] As of the date of this analysis, USFWS has announced that the Coastal Marten will be listed as threatened, but publication of the decision Federal Register has been delayed.

2.4.2 HCP Landscape Management Approach

The HCP specifies biological goals and objectives explicitly for each covered species. As a part of developing the HCP, total acres of occupied and/or suitable habitat will be managed over time. In general the objectives are to maintain a target number of acres of occupied or suitable habitat with the plan area and in some cases increase total number of acres of suitable habitat. By establishing numeric objectives for number of acres, development of the HCP has included a modeling effort to quantify total acres of existing suitable habitat, which will enable ODF to manage and monitor performance over time.

Key elements of the HCPs landscape approach to conservation include:

- Establishing Riparian Conservation Areas (RCAs) for aquatic species.
- Establishing and Managing Habitat Conservation Areas (HCAs) for terrestrial species
- Conservation Actions. Conservation actions are designed to achieve the biological goals and objectives and mitigate for incidental take of covered species.

Riparian Conservation Areas (RCAs)

As with the FMPs, minimum riparian buffer widths would be an important component of the HCP to protect and allow for restoration of habitat for covered fish species. Some streams also provide important habitat for aquatic salamanders that are covered by the HCP. Although these salamanders are not yet listed, they are on the USFWS 7-year workplan for listing considerations, which indicates that listing is possible and even likely within the next 5-10 years. The RCAs would be similar to the riparian buffers and aquatic anchors designated in the FMPs, with some differences in the widths and design as described further in *Chapter 5. Conservation Outcomes*.

Habitat Conservation Areas (HCAs)

The HCAs would replace terrestrial anchors and landscape design designated under the FMPs. These areas were established based on known covered species locations, including northern spotted owl nest sites and response data, marbled murrelet survey results and marbled murrelet management areas, as well as survey results for red tree vole and Oregon slender salamander. Locations that are currently, or are modeled in the future to be suitable or highly suitable habitat for any of the covered terrestrial species were also considered when defining HCAs.

Conservation Actions

Conservation actions developed with the Scoping Team are designed to continually improve species habitat quality and would be implemented in the designated RCAs and HCAs. The conservation actions to be implemented under the HCP fall into three general groups.

Aquatic. Conservation actions that ODF will implement to protect and enhance aquatic systems to primarily benefit covered fish and aquatic amphibians. These actions include establishment of the RCAs and equipment restriction zones, stream enhancement, fish passage barrier removal, and road improvements of vacating.

While ODF currently implements similar practices to restrict equipment usage in riparian areas, reduce sediment delivery from roads into the aquatic system, and conducts stream restoration and enhancement actions voluntarily, these stream restoration and enhancement actions would be required by the HCP. The actions would continue to be targeted for maximum benefit to fish species and would focus on:

1. Increasing species distribution through removal or improvement of passage barriers.
2. Improving spawning and rearing habitat through establishing RCAs to allow for wood recruitment into the aquatic system, coupled with aquatic restoration activities, including strategic placement of large wood structures and side channel reconnection.
3. Establishing RCAs to provide adequate shade to moderate stream temperature and provide nutrient inputs.
4. Establishing ground-based equipment restriction zone within RCAs and on seasonal other streams to reduce sediment delivery into the aquatic system.
5. Managing the existing road network and constructing new roads in a manner that reduces sediment delivery into the aquatic system.

Terrestrial. Management actions (conservation actions) for terrestrial species would include silvicultural activities that result in higher quality habitat over time. Examples of habitat management activities expected to occur in HCAs include:

1. Forest thinning to promote faster tree growth to achieve canopy closure or other advanced structure.
2. Regeneration harvest to remove stands that are not likely to grow into suitable habitat during the permit term and thus would benefit from starting over.

3. Creation of snags or downed wood to create habitat for prey species and covered species such as Oregon slender salamander.

As a part of the HCP, ODF would also begin to contribute to barred owl management to reduce impacts on northern spotted owls. This program would be coordinated with regional partners. The program would likely start as a pilot program and grow over time with the objective of reducing the presence of barred owl on ODF lands to maximize investments in northern spotted owl habitat management.

In addition, the HCP would also include conservation actions that ODF will implement throughout the permit area to minimize effects from timber harvest and road construction and maintenance on covered species. These measures would influence the placement of roads in relation to covered species habitat and operations in or near covered species habitat.

Conservation Fund. The final conservation action would establish a conservation fund that will be used to fund stream enhancement, fish passage barrier removal, active management in the terrestrial HCAs, and barred owl management. The conservation fund will be tied to the timber harvest program revenue and will be designed to generate an average of $1 million per year for conservation activities. For example assuming the average annual expected harvest under the HCP of 225 million board feet, a charge of roughly $5 per thousand board feet would be sufficient.

2.4.3 HCP Management Implications

The HCP will formalize ODFs conservation programs and create a level of control and predictability to revenue-generating operations that have proven impossible with the highly reactive take avoidance approach to ESA compliance. The HCP would address the following aspects of state forests:

- Timber Harvest Activities
- Reforestation and Young Stand Management
- Road System Management Activities
- Minor Forest-Product Harvest
- Quarries
- Fire Management
- Recreation Infrastructure and Maintenance
- Conservation Strategy Implementation Activities

Formalizing this approach through a permit under Section 10a(1)b of the Endangered Species Act will also result in administrative changes, specifically related to monitoring, adaptive management and reporting. An HCP must provide for the establishment of a monitoring program that generates information necessary to assess compliance and verify progress toward achieving the biological goals and objectives, so rather than monitoring to determine presence/absence of species pre-harvest, monitoring would be focused on compliance and effectiveness monitoring. Like the measurable outcomes in the dFMP, the HCP's biological objectives would be used to assess progress and use adaptive management to adjust implementation of the HCP based on monitoring results and new information. However, unlike the dFMP, the HCP identifies triggers for when adaptive management may be needed. There would also be annual reporting to NOAA Fisheries and USFWS for the duration of the permit term.

2.5 Management Activities Included in the Analysis

The FMP in all its forms (e.g., cFMP, dFMP or companion FMP to the HCP) and HCP would collectively affect a wide range of activities that ODF engages in while fulfilling its mission. To focus the analysis, the CA addresses those activities where there is an expected difference, or delta, among the scenarios. The primary activities evaluated in this analysis align with the variables identified for inclusion, namely those involving timber management and conservation outcomes, with additional evaluation of potential implications for recreation, carbon storage, and other culturally-relevant outcomes. The primary activities on ODF-managed lands included in the analysis are:

- Forest management and timber harvest
- Administration of ESA compliance
- Habitat management
- ODF operations and administration (for cost baseline and net revenue calculation)
- Outdoor recreation management

The implications of each scenario are considered for these activities, and used to identify and quantify differences in outcomes for the permit area over the analysis timeframe.

3 Methods and Key Assumptions

Analyses in this study rely upon the most current available data and analyses associated with the HCP and cFMP, including work to-date on the dFMP. Two particularly important components of these analyses are a set of spatially-explicit models:

1. the Policy Level Forest Management Model (Forest Management Model); and
2. four Habitat Suitability models (habitat models), one each for northern spotted owl, marbled murrelet, red tree vole, and Oregon slender salamander.

3.1 Policy Level Forest Management Model

ODF staff in coordination with Dr. Greg Latta of the University of Idaho (previously of Oregon State University) developed the Policy Level Forest Management Model (Forest Management Model) for the purposes of projecting timber harvest activity over the planning timeframe for all three scenarios. It will also support decision-making by ODF moving forward for timber and conservation objectives. Its purpose is to provide sufficient detail to allow for comparison of future strategies and tradeoffs between economic, conservation, and social values. It is not intended to provide exact targets to be implemented.

The Forest Management Model emulates how the forest might be managed and the effects of different approaches over time, at a policy-scale of relevance and applicability. It projects harvest volumes, revenues, costs, forest inventory metrics using data from ODF's Stand Level Inventory (SLI) and a series of model rules and parameters related to yield forecasts, harvest objectives, planning unit scale, landscape design, and acres available for harvest. The Forest Management Model is spatially divided by many of these attributes and constraints, resulting in over 113,000 polygons covering the HCP permit area. In addition to this complexity, the model applies management activities to portions of polygons as well, resulting in some very small harvest acreages. There is uncertainty as to whether or not these small acreages will fit into logical operational units in reality; therefore, all harvest units less than 10 acres have been removed from the financial and harvest results. The Forest Management Model solves for the harvest strategy that provides the maximum achievable net present value (harvest revenue minus harvest costs) while complying with all harvest constraints (including achieving any desired future conditions).

The model maintains harvest objectives and strategies specific to each scenario as well. The three scenarios each involve distinct forest management and harvest approaches. The cFMP pursues Structure-Based Management to achieve specific landscape and forest structure conditions, and harvests are implemented to maintain non-declining even-flow of harvest volume for each State Forests District. The dFMP and HCP are modeled allow for departure from non-declining even-flow to achieve a balance across forest age classes and respect habitat constraints. The HCP is modeled to allow a moderate departure from even flow, with constraints on departure at both for the entire permit area and sub-geographic regions within the permit area. The dFMP allows for unconstrained departure from even flow. A key difference dFMP and HCP both pursue net revenue maximization within a series of landscape scale constraints, while the cFMP pursues non-declining even-flow of harvest volume while coordinating harvests to achieve specific forest characteristics across all acres.

Model results are not meant to be interpreted as specific harvest plans, but are intended to provide representative policy-level information to support consideration of relative differences and expected absolute levels across the key metrics. Full design and implementation of a complete forest management plan including implementation plans would be necessary to identify and calculate results from actual harvest levels and associated outcomes, particularly for the HCP and dFMP. Metrics from the Forest Management Model outputs are used as inputs to the habitat models, to provide policy-level estimates of habitat outcomes, described later.

To develop the analysis, the project team worked closely with ODF staff to identify and interpret relevant data on costs, forest inventory, and management activities; develop assumptions about future conditions; and review model inputs and outputs. The cFMP landscape design reflects current district Implementation Plans for both landscape design and harvest objectives. The HCP landscape design is primarily based on Habitat Conservation Areas (HCAs) that have been designated specifically to incorporate most known covered species locations and current highly suitable habitats, as well as provide for large, functional patches and connectivity in the future. The dFMP was estimated using a mix of current management constraints and conservation commitments. It is critical to note that the dFMP landscape design estimate is the least formalized of the three, and would require significant refinement to truly provide for the species covered in the HCP and operational feasibility.. A variety of spatial analyses of the resulting model outputs were used to interpret the results.

Key assumptions for the CA are:

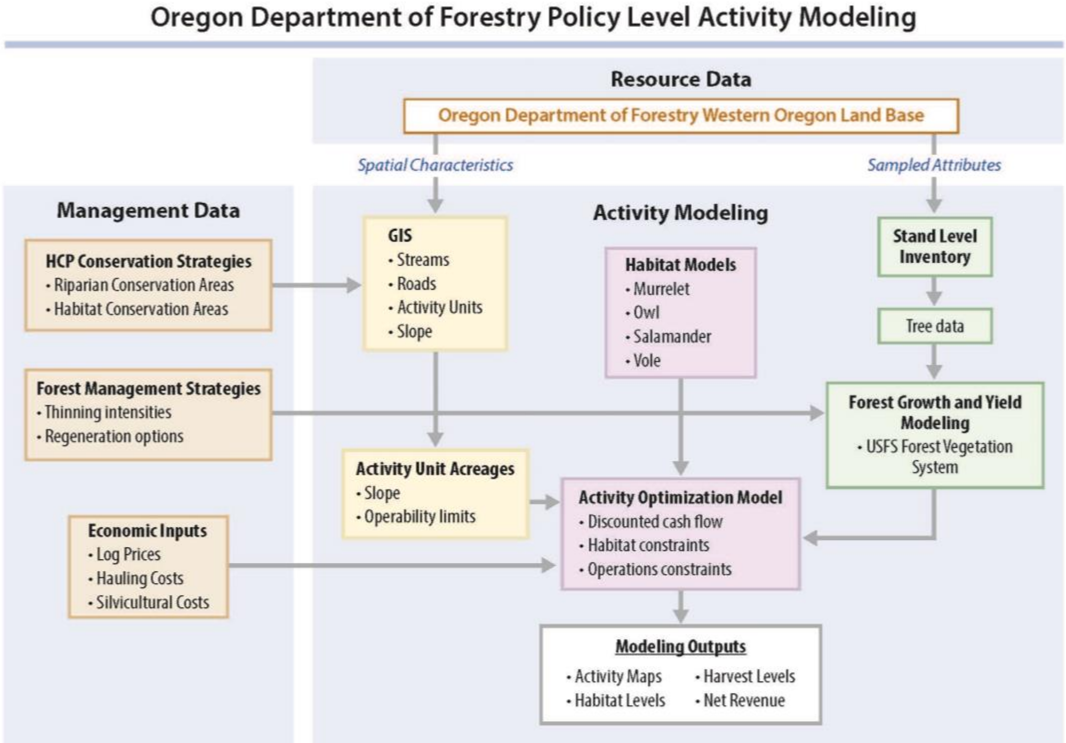
- Agency administration staff costs will increase at a real (inflation adjusted) rate of 1.6 percent annually for the first ten years, and then level off (constant in real terms).
- Under the cFMP and dFMP scenarios, ESA staff administration costs will continue to rise due to increased effort over time at about 2.8 percent annually to maintain the take-avoidance approach to ESA compliance.
- Pre-harvest survey costs under take-avoidance are based on estimates extrapolated from actual costs for Northern spotted owl, marbled murrelet initially, and increase over time to reflect survey costs associated with red tree vole (a species with high potential for listing).
- Initial constraints are based on take-avoidance protections associated with sites currently occupied by listed species, for the cFMP and dFMP. For the HCP initial constraints are based on HCAs.
- Acreage constraints for ESA compliance purposes will increase over time for the cFMP and dFMP, described in more detail in the Constraints section. Acreage constraints do

not increase for the HCP, as HCAs are intended to cover future species occurrence and listings.

- Timber prices are assumed to stay constant in a real sense (inflation adjusted) and reflect the most recent prices available by district (from 2019).
- ODF staff based their estimates of harvest costs on actual average costs per thousand board feet (MBF) by district.
- Future costs and benefits are discounted at a real (inflation-adjusted) discount rate of 3 percent. Data in charts showing changes over time do not include discounting.
- Conservation measures for aquatic and riparian species do not change over the life timeframe of the analysis.

ODF staff in coordination with Greg Latta of the University of Idaho (previously of Oregon State University) developed the Policy Level Timber Harvest Model (Harvest Model) for the purposes of projecting timber harvest activity over the planning timeframe for all three scenarios (Figure 3-1). It will also support decision-making by ODF moving forward for timber and conservation objectives. Its purpose is to provide sufficient detail to allow for comparison of future strategies and tradeoffs between economic, conservation, and social values. The Harvest Model covers all ODF-managed lands in 13,745 spatial units of 10 acres or larger. The model solves for the harvest strategy that provides the maximum achievable net present value (harvest revenue minus harvest costs) while complying with all harvest constraints (achieving desired future conditions). The model maintains non-declining even flow of harvest volumes as well as numerous other model parameter constraints based on ODF policy and state law. More detail on specific model rules is available below.

Figure 3-1. Forest Management Model Structure and Operations



3.1.1 Model Operation and Key Assumptions

The Forest Management Model utilizes a linear programming approach that solves for the highest achievable net present value of harvest operations (subject to constraints) and discounting cash flow over time (3 percent annually). The model covers a 100 year timeframe, from 2023 to 2122, with assumptions that management strategies under each scenario continue consistently for the full timeframe. Linear programming is one of the most widely used techniques for forest planning.[8] The model specification used for the Forest Management Model is the same as has been used for years in linear programming models of this region's timber supply where forest inventory plots were treated as stands.[9]

[8] Belavenutti, Pedro, Romero, Carlos, & Diaz-Balteiro, Luis. 2018. A critical survey of optimization methods in industrial forest plantations management. Scientia Agricola, 75(3), 239-245. The seminal paper for linear programming in forestry is: Johnson, K.N., and Scheurman, H.L. 1977. Techniques for prescribing optimal timber harvest and investment under different objectives. Discussion and synthesis. Forest Science Monograph 18. 30p.

[9] See Adams and Latta (2005) for a description of the method and Adams et al. (2019) for a more recent application of the model. Adams, D.M. and G.S Latta. 2005. Costs and regional impacts of restoration thinning programs on the national forests in eastern Oregon. Canadian Journal of Forest Research 35(6):1319-1430. Adams, D.M., G.S. Latta, M.S. Crandall, and I. Guerrero. 2019. Projecting biomass supplies for liquid biofuel production in western Oregon and western Washington, USA. Forest Policy and Economics 106(2019):101957.

A comparison of Model rules is provided in Table 3-1. Output results are in five year increments. Key inputs include:

- Forest data is stand-level inventory[10]
    - Interpreted as the average tree list for use in growth and yield model
- Growth and yield using the U.S. Forest Service Forest Vegetation System
    - Individual-tree distance-independent growth model
- Silvicultural considerations
    - Thinning entries of varying frequency and intensity
    - Regeneration harvest
    - Pre-commercial thinning assumed in replanted stands
- Geographic and administrative constraints
    - Non-forest areas
    - Unloggable slopes
    - Road rights-of-way, power line easements, administrative sites
    - Deeded harvest restrictions.
- Economic
    - Log prices (11 species, 5 log sorts or grades)
    - Logging costs
        - Depend on average diameter, volume removed, slope, yarding distance, and logging system
    - Hauling costs
    - Road maintenance costs associated with harvest
- Ecological
    - HCP - HCAs covered terrestrial species
    - cFMP, dFMP
        - Protected habitat for 3 listed species (northern spotted owl, marbled murrelet, red tree vole)
        - Landscape design/Estimated landscape design (cFMP, dFMP), including terrestrial anchors
    - Riparian and steep slope protections

Model outputs are in 5-year averages and include:

- Timber harvest volume
- Timber harvest revenue
- Timber harvest costs
- Timber inventory
- Carbon storage
- Forest inventory

[10] A forest stand for the purposes of this model is contiguous community of trees sufficiently uniform in composition, structure, age, size, class, distribution, spatial arrangement, site quality, condition, or location to distinguish it from adjacent communities. A forest is a "collection of stands."

- Covered species habitat quality

Design and implementation of the Forest Management Model was an iterative process. It balanced constraints on harvest with economic needs as well as conservation commitments against regulatory requirements to obtain permits. This involved model calibration including review by ODF field staff. Results should be interpreted primarily at the policy level. That is, much more detailed development of a Forest Management Plan and associated implementation plans would be necessary to have temporal and geographic specificity of harvest activity for the dFMP and HCP scenarios. Some assumptions and constraints were necessary for the model to generate results. Actual constraints for harvest activity are likely to differ based on a variety of local and regional conditions.

Table 3-1. Comparison of Forest Management Modeling Rules for the cFMP, dFMP and HCP

Category	cFMP	dFMP	HCP	Significance for outputs
Policy Model Rules				
Harvest Objectives: Volume departure	Non-Declining Even Flow: NDEV relative to current IP, by district	5% harvest volume departure per time period per sub-geographic region	5% harvest volume departure per time period per sub-geographic region & No more than +/-10% departure from 100-year average Volume harvest	High; revised 2 times
Harvest Objectives: Age Class Distribution outside Landscape Design	No equivalent	Same as HCP	Target Age Class +/- 2% 0-30: 30%; 30-60: 30%; All Age Classes above 60, total 40%	High; revised 1 time
Scale of Planning Unit	Planning area is at district-level	Same as HCP	Across Subgeographic areas North coast 75% ≤+ 5% TL/AT/FG Valley 15% +/-3% NC/WO South 10% +/- 3% WL/Coos/SW	Medium; revised 1 time
Model Scenario				
Aquatic/Riparian	No equivalent	No equivalent	No harvest allowed in Temperature Protection Zones	Low
DFC Free-Up: Landscape design is freed once complex structure goal is attained	DFC is released by district: Astoria, Forest Grove, West Oregon & Tillamook : After year 70 N. Cascade & W. Lane: After Year 35 Coos: N/A - no LD has been designated Southwest: After year 20	No equivalent	No equivalent	High
Complex Structure Goal: minimize time to achieve desired amount of complex structure	Total Complex Structure must meet or exceed levels present when mapped DFC is released. Once a stand becomes complex, LYR or OFS, it may not be harvested for 20 years	No equivalent	No equivalent	High
Estimated Landscape Design	No equivalent	Current take avoidance acres Current Terrestrial Anchors Current OFS in FMP landscape design then add inventory to get to 34% across planning area.	No equivalent	High
NSO Conservation: T&E projected encumbrance	Adding potential encumbrance based on habitat suitability models (After year 10)	Same as cFMP	No equivalent	Medium-High (but not indicated)
NSO Take Avoidance or Conservation	Take Avoidance: Use NSO 50% and 40% habitat model "floating" circles for inner/outer circles	Same as cFMP	Conservation: *Non-Declining acres for Habitat Model values ≥0.6 *SNC and Alder Habitat Model = 0 for first 30 years *Stands with Habitat Model ≥0.6 are removed from management	Medium-High (depending on district)

Category	cFMP	dFMP	HCP	Significance for outputs
Marbled Murrelet Conservation: T&E projected encumbrance	Adding potential encumbrance based on habitat suitability models (After year 10)	Same as cFMP	No Harvest in designated occupied stands, *No regen harvest in identified buffer	HCP: Medium cFMP: Medium-High
Marbled Murrelet Take Avoidance or Conservation	Take Avoidance: No action in MMMA's or additional incumbered acres	Same as cFMP	Conservation: No Harvest in designated occupied stands, suitable nor highly suitable habitat. *No regen harvest in identified buffer nor within 100 meters of unbuffered designated occupied, suitable or highly suitable habitat	HCP: Medium cFMP: Medium-High (depending on district)
Red tree vole	Adding potential encumbrance based on habitat suitability models (After year 10)	Same as cFMP	None	Medium-High (depending on district)
Species of Concern (SOC)	Terrestrial Anchors: No clearcuts nor partials cuts that results in less than 80ft2/ac BA nor residual SDI less than 35% of the max	Same as cFMP	No equivalent; replaced by HCAs See below)	High
Species of Concern (SOC)	Aquatic Anchors: Increased buffers within aquatic anchors	Same as cFMP	No equivalent; Covered by RCAs	Medium
HCP HCA Strategies: Partial Cut Constraints	No equivalent	No equivalent	Maximum of 2 light/ moderate thinnings through age 90 removing up to 40% of canopy cover	Medium
Forest Health Strategies	No equivalent	Swiss Needle Cast: same as HCP except for 475 acres (+/-10%) Regen Harvest per year for Tillamook, Astoria, (North Fork and Sweethome)[11]	Swiss Needle Cast: 500 acres (+/-10%) regen harvest per year for Douglas-fir in severe and moderate SNC zones through age 90 for the first 6 periods or until severe and moderate zones are treated, whichever comes first for Tillamook, Astoria (North Fork, Sweethome and Astoria basins)[12]	Medium; revised 1 time
HCP HCA Strategies	No equivalent	Hardwood Conversion: same as HCP except for 100 acres (+/- 10%) regen harvest per year.	Hardwood Conversion: 200 acres (+/- 10%) regen harvest per year in hardwood dominated stands within Tillamook for the first 6 periods	Medium; revised 1 time

[11] dFMP Scenario: SNC w/in ELD target: 14,250 acres over 30 years (475/yr) out of 46,528 acres in SNC stands; ~31% HWD w/in ELD target: 3,000 acres over 30 years (100/yr) out of 11,753 acres in HWD stands; ~26%

[12] HCP Scenario: SNC w/in HCA target: 15,000 acres over 30 years (500/yr) out of 49,839 acres in SNC stands; ~30%, HWD w/in HCA target: 6,000 acres over 30 years (200/yr) out of 22,227 acres in HWD stands; ~27%

3.2 Habitat Suitability Index Modeling

Habitat suitability models were developed for northern spotted owl, marbled murrelet, red tree vole, and Oregon slender salamander. The four species for which habitat is modeled are all strongly associated with late-seral conifer forests (where they reach their highest densities) and younger stands with legacy components. As such, the models include parameters that quantify these characteristics, particularly those that provide key habitat features, such as larger, older trees used by marbled murrelet, northern spotted owls and red tree voles for nesting, or large downed wood used by Oregon slender salamanders. The habitat suitability models are based on known habitat requirements for each species and were developed using SLI data so that each forest stand could be assigned a habitat suitability category based on key attributes accounted for in the inventory data that were used in the Forest Management Model. Published species habitat models were utilized as background and important parameters identified in those published models were represented, as feasible, using the same or correlative attributes in the SLI data. These habitat models generally included parameters for tree height, tree size, number of trees per acre, stand age, and for the Oregon slender salamander, amount and type of downed wood. Because of the similarities in model parameters all of the terrestrial habitat models behave similarly over time. As forests get older they generally become higher quality habitat for all four species.

Species presence is dynamic and always changing, whereas habitat changes typically follow a predictable trajectory, unless there is a disturbance event such as a fire, or insect or disease infestation. The habitat models use best available information on the habitat requirements of each species and existing species monitoring data was used to validate and refine the model to map current habitat. The resulting model is then used to predict future habitat suitability.

Species often rely on particular attributes of the forest that are either not known, or difficult to represent in growth model, but often are correlated with stand age (e.g., downed wood, standing dead trees). Because of this, stand age was also used to help evaluate conservation outcomes on the landscape.

Each forest stand was assigned a habitat suitability category based on the characteristics of the stand. As those characteristics change over time the habitat suitability category may change as well. For example, if a stand is not harvested and grows older it will very likely become higher quality habitat for covered species. Similarly, if a stand is harvested, habitat suitability would be reduced initially, and then increase over time as the stand regrows. The underlying stand characteristics that equate to each suitability category varies by species, but the habitat suitability categories can generally be described as:

- **Highly suitable:** high probability that the habitat characteristics required by the species are present and that habitat provides core natural history functions such as nesting, foraging, and resting habitat. Habitat is likely associated with more frequent observed occurrences.

- **Suitable:** probable that all or most of the habitat characteristics required by the species are present and that habitat provides some but not all natural history functions such as nesting, foraging, and resting habitat. Habitat associated with some observed occurrences.
- **Marginal:** probable that many of the key habitat attributes required by the species are either missing/not present or are sporadic on the landscape. Few or no observation of this species would be expected in stands with these characteristics. The one caveat would be that marginal habitat could provide habitat for infrequent or short-term uses, such as movement between higher quality habitat patches.
- **Not suitable**: forest stand does not provide for key habitat attributes required by the species and observation of this species in these stands would be uncommon.

By linking the habitat suitability models to the SLI and the forest management model, habitat suitability can be assessed at any point during the HCP permit term. Suitable habitat growth and harvest are both accounted for in the forest management model, allowing ODF to estimate the overall potential gain in quality and quantity of habitat. This ensures that habitat commitments in the HCP can be achieved. In the CA, the habitat suitability models have been used to compare changes in habitat quality and quantity over time for the HCP, cFMP, and dFMP.

3.3 Spatial Analyses

The outputs from the forest management model and habitat suitability models are all spatially explicit, meaning that they can be linked back to the model polygons and analyzed spatially. The model outputs were segmented geographically by subregion (north coast, Willamette Valley, and southern Oregon) and for the harvest/financial analysis by district and county.

3.3.1 Terrestrial Habitat Quantity and Quality

Covered Species

For covered species, the habitat suitability model outputs for each species at years 0 (current conditions), 25, 50 and 75 for each scenario were quantified to compare the relative amount of highly suitable, suitable, marginal, and unsuitable habitat predicted over time. The data was further segmented to compare habitat suitability within HCAs or terrestrial anchors relative to the rest of the permit area.

Non-Covered Species

The forest stand age distribution outputs from the Forest Management Model were used as a proxy to assess for the presence and quantity of a diverse range of habitats, represented by forest stands at different ages within the permit area over time. For example, ungulate species favor a forest mix that includes a significant younger seral component. The model results are evaluated for the permit area as a whole, for each scenario at years 0, 25, 50, and 75.

3.3.2 Aquatic Habitat Quantity and Quality

The FMP and HCP riparian buffers were used to calculate the potential increase in no harvest areas with an HCP as compared to the cFMP and dFMP. Quantifying aquatic habitat involved the following steps:

1. A modeled stream network was developed as a consistent basis across scenarios.
2. The modeled stream network was then reclassified to include stream size, seasonality and fish bearing characteristics, based on field verified data. Total stream miles were then summed by subregion inside the Permit area.
3. For both the FMP and HCP buffers, the total acreage within each were summed based on each planning subbasin in the permit area to calculate the total quantity of riparian habitat protected with each scenario.
4. Riparian habitat for each covered aquatic species with the FMP and HCP buffers was calculated using the total acreage within each scenario and summing it within each planning subbasin in the permit area. This information was then overlain with each separate ESU for each salmonid species.

In addition to acreage calculations, quality of riparian habitat was evaluated by looking at the stand age distribution model results for each scenario within riparian areas.

3.3.3 Terrestrial Habitat Fragmentation

The habitat fragmentation analysis examines the configuration of conservation areas for each scenario. The analysis of continuity and fragmentation evaluated the areas designated for conservation (LD, ELD and HCAs) for the cFMP, dFMP and HCP, respectively, to assess how the configuration of these areas can be expected to influence change in habitat continuity and fragmentation over time, given the general outcome that these areas will become more suitable for covered species over time. The analysis includes calculating patch size, distance between patches, and number of patches. One of the ways that habitat configuration manifests is through edge effects. Edge effects are the direct and indirect effects of the adjacent open area (e.g., clear cuts, open areas, roads, etc.) on the forested section in contact with that open area. To evaluate potential changes in edge effects, the analysis calculated the ratio between edge and interior area for each scenario.

3.4 Summary of Metrics and Analyses

Table 1-1 summarizes of the model inputs used to derive each variable included in the CA. As illustrated in the table, the forest management model, habitat model models and various spatial analyses of the model outputs over time were used in a variety of ways to develop the CA.

4 Projected Land Management and Acreage Constraints

Land management categories and acreage constraints are how ODF translates forest management laws and policies spatially. Across all ODF lands, there are areas where timber harvest does not occur because those areas are either not forested or they are forested but classified in ways that prohibit harvest. All other areas are then technically available for harvest, when it is economically feasible. This section defines land management categories and identifies the categories that are expected to change in each scenario. We then present the assumptions governing acres available for harvest and conservation developed and applied to the analysis of each scenario.

The acres reported in this Comparative Analysis vary slightly from actual acres for certain components (e.g. HCAs) that are reported in the HCP. This variation is entirely due to differences between actual designations and spatial data used for forest management modeling purposes. Existing modeling polygons were selected that best represent HCAs, current listed species habitat, and other attributes. In addition, acreage numbers are rounded to the nearest thousand, or the nearest hundred for areas less than one thousand acres. This results in a close, but not exact match with actual designations.

4.1 Land Management Categories

A summary of each land management category is provided here with an assessment of whether the designation or availability of these acres for timber harvest would change with each scenario.

4.1.1 Inoperable

Inoperable acres includes lands that are not available for the harvest of trees, including roads, non-forest stands, and deed restrictions. This category includes non-forest land cover types are not being harvested now and will not be harvested in the future under any of the scenarios. Non-forest land cover types include wetlands, lakes, meadows, and developed areas. These constraints are not expected to change regardless of whether ODF moved forward with an HCP, the cFMP, or dFMP.

4.1.2 Regulatory and Policy Constrained

Constrained

Some forests are constrained for policy-related, technical, or environmental reasons. The BOF in 1998 adopted a Forestland Management Classification System[13] that includes high value

[13] Oregon Administrative Record (OAR) 629-350-005.

conservation areas and special use areas that are typically off-limits to timber harvest. In some districts there are areas considered administratively removed (“AdminRem”) for stewardship reasons such as utility rights-of-way, rock quarries, cultural or heritage sites, or other protections. Some areas classified as off-limits to harvest because they are inaccessible by road or helicopter; these are lands that have physical constraints such as steep cliffs are classified as “logging systems” (“Logsys”). Lands classified as “Inner Gorge” are riparian areas and “LSPSHighrisk” are areas of risk to roads, other infrastructure, and public safety due to very steep slopes or landslide potential. These constraints would not change based on scenario.

Some constraints on harvest are due to designations mandated by the Forest Practices Act (FPA) or Northwest Oregon Forest Management Plan (FMP). For example, some areas have been designated to provide wildlife connectivity (“FPAWild”). Core habitat for northern spotted owl is not harvested and is classified as “NSO Core” areas. These NSO Core areas are generally 70-acre polygons centered on a northern spotted owl occurrence (in the North Coast Districts, Core Areas are 250 acres). In order to avoid take of northern spotted owl, ODF does not harvest the highest-quality 40 percent of northern spotted owl habitat (“NSO40pct”) within a 1.2 - 1.5 mile buffer (depending on district) around nest sites, which includes the NSO Core area. Finally, ODF does not harvest timber in marbled murrelet management areas (“MMMA”), which are designated to protect habitat that has been determined to be “occupied” by murrelets. These land designations (FPAWild, NSOCore, NSO40pct, MMMA) will not change under any of the scenarios and would continue to be unavailable for harvest. Areas constrained for take-avoidance would be subject to change to protect new areas occupied by northern spotted owl and marbled murrelet and to encompass areas occupied by newly listed species.

The FMP also designates areas that are to be maintained as Old Growth (“Old Growth”). Those areas represent a small percentage of total acreage across ODF lands, they are not available for harvest and would continue to be unavailable for harvest under all scenarios. Those areas are not harvested now, nor are they assumed to be harvested in the future. Similarly, stream buffers designated in the Forest Management Plan (“FMPStreams”) are not available for commercial harvest.

Limited Constraints

Some areas in each scenario are designated to address strategies driven by conservation goals. The cFMP has a designated landscape design (LD) that includes stands that have a desired future condition of complex structure intended to provide for species associated with late-seral forests (i.e. Layered and Older Forest Structure stand types), and areas designated as terrestrial anchors (TAS) for species of concern.

No specific landscape design has been designated for the dFMP. An estimated landscape design (ELD) was determined for this analysis based on a combination of current conditions (e.g. current protections for listed species and older stands on inoperable ground) and certain existing LD components (e.g. Older Forest Structure, TAS). Riparian buffers were assumed to be the same for both FMPs.

For the HCP, this category is comprised of RCAs and HCAs. These areas are designated to achieve conservation objectives for covered species under the HCP. The management objective for these areas is to increase the quantity and quality of suitable habitat over time.

The ability to harvest timber in these areas designated for conservation is expected to change over time. Over the last 20 years of implementation of the cFMP under take avoidance, the design of these areas has changed significantly, commensurate with changes to the locations of listed species sites and other policy updates. HCAs are more certain to remain unchanged over time, due to the assurances afforded by an HCP. LD and ELD would likely be subject to further shifts over time, but are modeled as a fixed area.

4.1.3 Available (Unconstrained)

All of the areas not constrained by the land categories described above are considered available for harvest at any time and categorized as "unconstrained." Timing of harvest is dependent on economic feasibility and ODF harvest management plans. ODF manages its forests for GPV so that the forests can provide benefits over the long run. Relatedly, ODF schedules harvests over time to maintain the availability of consistent and sustainable harvests . There is potential for the amount of unconstrained land to change in the future depending on whether an HCP is completed or not.

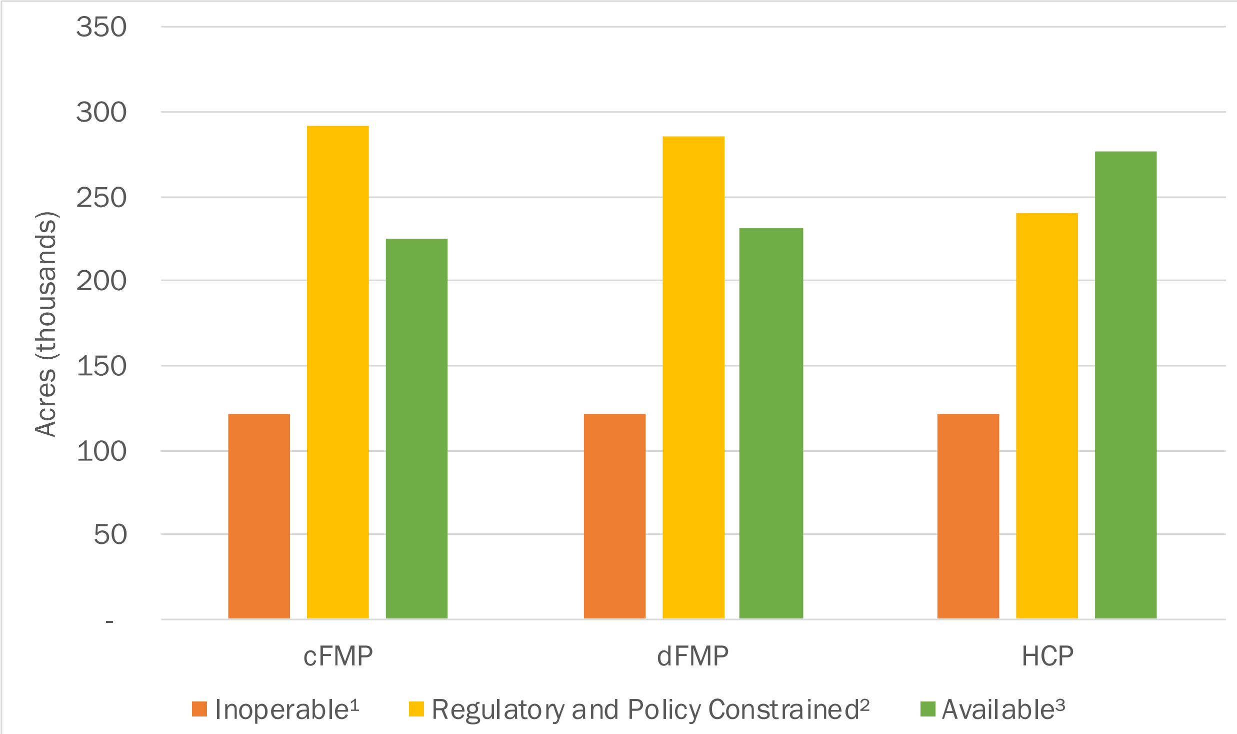
4.2 Projected Land Management and Acreage Constraints

Under all scenarios, the area of land available for harvest is expected to decrease relative to existing conditions (Table 4-1 and Figure 4-1). However, more acres are expected to be available for harvest with an HCP than without by the end of the 70-year implementation timeframe.

The largest change is associated with constraints within terrestrial areas related to implementation of additional take avoidance strategies. Under the cFMP and dFMP, continued implementation of the take avoidance strategy is projected to reduce the future area available for harvest by approximately 140,000 acres. Specifically, as forest stand age increases, the overall areas affected by northern spotted owl (NSO) and marbled murrelet (MAMU) are expected to increase, both from new occurrences and development of habitat at existing sites. Protections for future listed species in areas where previous protections were not needed are also included, based on modeled estimates of red tree vole habitat. The acres available for harvest change directly proportional to future constraints posed by protected species. A large proportion of these acres are already subject to other constrains or are included within the LD and ELD, so the net effect is 82,000 and 95,000 for the cFMP and dFMP, respectively.

The expansions of listed species and newly listed species are still expected to occur, but initial constraints under the HCP (the HCAs) would not increase as a result. With an HCP in place, ODF will retain some operational flexibility to harvest in areas that would otherwise be constrained. It is important to recognize that an HCP may require harvest practices that minimize environmental impacts in these areas. Nonetheless, it is expected that more acres will be available for harvest over the long-term with an HCP than without.

Figure 4-1. Projected Acreage Designations by Scenario



[1] Inoperable acres either do not hold forest or would be impractical to harvest.
[2] Policy constrained acres are either unavailable for harvest or severely limited for harvest by policy and regulatory constraints (e.g., Oregon Forest Practices Act, federal Endangered Species Act and FMP stream buffers).
[3] Available acres would be available for harvest according to appropriate policy requirements.

Table 4-1. Net Acreage Constrains by Category for Each Scenario

Group		Constraint Type	cFMP	dFMP	HCP
Inoperable		**Roads**	16,000	16,000	16,000
		Non-Forest	5,000	5,000	5,000
		Admin	7,000	7,000	7,000
		Inoperable	94,000	94,000	94,000
	Subtotal		**122,000**	**122,000**	**122,000**
Regulatory and Policy Constrained	**FPA**	**FPA Wild**	200	200	200
		NSO Core	1,000	1,000	1,000
		LSPS *	5,000	5,000	5,000
	FMP/HCP	**Riparian ****	53,000	53,000	56,000
		Inner Gorge	10,000	10,000	10,000
		TA/HCP MMMA	14,000	14,000	13,000
		HCP MAMU			50,000
		TA/HCP NSO Best 40	20,000	20,000	21,000
	Policy	**Old Growth**	<10	<10	<10
		Land. Des./HCAs	106,000		-
		TAS	400	88,000	83,000
	New FMP TA	**Add. TA**	82,000	95,000	0
	Subtotal		**292,000**	**286,000**	**240,000**

Group	Constraint Type	cFMP	dFMP	HCP
Available	**None**	225,000	231,000	277,000
Percent		35%	36%	43%
Total Area		639,000	639,000	639,000

Net Acres. Constraints have a hierarchy, according to the order listed. Net Acre are calculated by subtracting overlapping acres from the preceding constraint types (e.g. net non-forest types subtracts the roads acreage). Areas reported are based on the model polygon layer.

Although much more is known about the HCP conservation actions now than reported in the original BCA, projecting all three management scenarios into the future still required the application of assumptions regarding future conditions. Key information regarding acreage constraints is as follows:

- Under the cFMP and dFMP scenarios, constrained acreage due to habitat requirements for the northern spotted owl, marbled murrelet, and red tree vole[14] would increase after the first 10 years, resulting in a decrease in available acres by 82,000 and 95,000 acres for the cFMP and dFMP, respectively (Add. TA in Table 4-1). These acres would be removed from the acres available for harvest.
- Riparian buffers are utilized in all three scenarios. While the size, and thus overall acreage in riparian buffers differs between the HCP and the FMP scenarios, modeled management prescriptions (no riparian management) in riparian areas are the same across all three[15].
- Under the HCP Scenario, increased riparian buffers would decrease acres available for harvest by about 3,000 acres immediately.
- Terrestrial strategies in the three scenarios are as follows:
    - HCP uses Habitat Conservation Areas (HCAs)
    - cFMP uses Terrestrial Anchor Sites (TAS) and landscape design, plus existing and projected species sites
    - dFMP uses Estimated Landscape Design (ELD), plus existing and projected species sites
- Under the HCP Scenario, areas currently managed with limited harvest as a part of landscape design and conservation (Terrestrial Anchor Sites) would be replaced by HCAs. In total, approximately 275,000 acres[16] (43 percent of the permit area) would be within HCAs, these acres are primarily drawn from areas currently occupied, or projected to be occupied over the permit period.

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[14] Red tree vole is identified as the species most likely to be listed within the next 15-years. Other species that could potentially be listed during the HCP permit term include Oregon slender salamander, Columbia torrent salamander, Cascade torrent salamander, and Coastal Martin. The HCP would include take protections for these species as well.

[15] Policy in the cFMP allows harvest within riparian buffers in some circumstances, but operationally this is rarely done.

[16] Gross Acres based on the model polygon layer.

- Under the HCP Scenario, conservation acreage designated in HCAs would include existing NSO and MAMU suitable and highly suitable habitat, where forest management activities would focused on habitat creation. Just under half the forests within HCAs will be actively managed to maintain and develop late-seral structure stands as they relate to specific habitat needs for individual covered species. Forest management implemented to improve habitat over time would include thinning and harvest in marginal or low-quality habitat. Activities would include harvest and reforestation of Swiss needle cast stands and targeted alder stands (conifer restoration).
- Under the dFMP, a new ELD encompassing just over 217,000[17] acres (34 percent of the permit area) was developed. The dFMP includes 6,000 more acres available for harvest than the cFMP.

The largest change is associated with constraints within terrestrial areas related to implementation of additional take avoidance strategies. Under the cFMP and dFMP, continued implementation of the take avoidance strategy is projected to reduce the future area available for harvest by approximately 140,000 acres. Specifically, as forest stand age increases, the overall areas affected by northern spotted owl (NSO) and marbled murrelet (MAMU) are expected to increase, both from new occurrences and development of habitat at existing sites. Protections for future listed species in areas where previous protections were not needed are also included, based on modeled estimates of red tree vole habitat. The acres available for harvest change directly proportional to future constraints posed by protected species. A large proportion of these acres are already subject to other constrains or are included within the LD and ELD, so the net effect is 82,000 and 95,000 for the cFMP and dFMP, respectively.

The expansions of listed species and newly listed species are still expected to occur, but initial constraints under the HCP (the HCAs) would not increase as a result. With an HCP in place, ODF will retain some operational flexibility to harvest in areas that would otherwise be constrained. It is important to recognize that an HCP may require harvest practices that minimize environmental impacts in these areas. Nonetheless, it is expected that more acres will be available for harvest over the long-term with an HCP than without.

Figure 4-1 shows that acres available for harvest are greater under the HCP scenario than the No HCP scenarios by 2034. These resulting acreage ranges are based primarily upon estimated acreage requirements for northern spotted owl, marbled murrelet, and red tree vole. These ranges correspond to available acres in the permit area (BOFL and CSFL) at 35 and 36 percent (about 225,000 and 231,000 acres), for the cFMP and dFMP scenarios, respectively, and 43 percent (about 277,000 acres) for the HCP scenario.

The largest change is associated with constraints within terrestrial areas related to implementation of additional take avoidance strategies. Under the cFMP and dFMP, continued implementation of the take avoidance strategy is projected to reduce the future area available for harvest by approximately 140,000 acres. Specifically, as forest stand age increases, the

[17] Gross Acres based on the model polygon layer.

overall areas affected by northern spotted owl (NSO) and marbled murrelet (MAMU) are expected to increase, both from new occurrences and development of habitat at existing sites. Protections for future listed species in areas where previous protections were not needed are also included, based on modeled estimates of red tree vole habitat. The acres available for harvest change directly proportional to future constraints posed by protected species. A large proportion of these acres are already subject to other constrains or are included within the LD and ELD, so the net effect is 82,000 and 95,000 for the cFMP and dFMP, respectively.

The expansions of listed species and newly listed species are still expected to occur, but initial constraints under the HCP (the HCAs) would not increase as a result. With an HCP in place, ODF will retain some operational flexibility to harvest in areas that would otherwise be constrained. It is important to recognize that an HCP may require harvest practices that minimize environmental impacts in these areas. Nonetheless, it is expected that more acres will be available for harvest over the long-term with an HCP than without.

The acreage constraints presented in this section represent the current best estimate of conditions over the next 75-years. For the HCP scenario, the HCAs have been designed to "stand the test of time" to provide sufficient habitat and mitigation to offset the estimate taking of covered species during the conduct of covered activities. They, and by extension the acres available for harvest, would be set for the 70-year permit term. This is not the case for either of the FMP scenarios which would experience variation in the acres available for harvest. The cFMP has been subject to incremental policy changes that has resulted in changes to the LD on an annual basis. The policy uncertainty and never-ending policy and planning cycle between ODF, the BOF, and stakeholders would continue to occur with the continued implementation of the take avoidance strategy associated with either FMP scenario. Constraints by sub-geographic regions and for the CSFL are provided in Appendix A.

5 Conservation Outcomes

5.1 Factors Influencing Analysis

5.1.1 Constraints on Harvest in Terrestrial Areas

Logistical and Legal Constraints

Many logistical and legal constraints affect the ability to produce environmental, social and economic outcomes across the draft HCP permit area. As presented in *Chapter 4. Projected Land Management and Acreage Constraints*, inaccessible areas that cannot be logged, non-forest areas, road rights-of-way, and compliance with underlying Oregon Forest Practices Act rules are examples of these constraints. While those areas are included in the overall modeling and analysis, they are not explained in detail here because they are the same across all scenarios.

FMPs

Current constraints on harvest are based on take avoidance protections associated with sites that are occupied by listed species, specifically Marbled Murrelet Management Areas (MMMAs) and northern spotted owl (NSO) nest sites. Each year ODF conducts surveys in areas that are planned for harvest (pre-harvest surveys) in order to confirm avoidance of potential impacts to listed species. Harvest is not permitted in areas occupied by listed species. Presently, approximately 34,000 acres of forest are not available for harvest to avoid take of listed species for both the cFMP and dFMP scenarios. Growth of habitat over time is assumed to result in an increase in acres made unavailable for harvest due to take avoidance measures. By the year 2034, it is estimated that 140,000 additional acres will be affected, due the expansion of both MMMAs and NSO sites, as well as new potential listings for other species, such as red tree vole. This sum total of 178,000 acres of take avoidance constraints is partially offset by existing conservation commitments included in the landscape design for both FMPs, detailed below.

The cFMP and dFMP have different landscape design policies that have implications for harvest. Providing protections to sites occupied by the listed species is a common goal of both; however, the cFMP is more focused on future forest composition, while the dFMP is more responsive to current conditions.

The cFMP complex structure types (Layered and Older Forest Structure) are intended to form a "shifting mosaic" over time, so that harvest and habitat occur on all portions of the landscape over time. As a result, it is necessary to manage additional stands towards complex structure, so that they can eventually replace currently complex stands. The cFMP also includes certain anchor habitat areas with management constraints to protect other species of concern. The total area of complex structure targets and anchor habitat areas in the cFMP landscape design is 214,000 acres. It is estimated that 58,000 acres of the 140,000 acre increase stated above will occur within this existing landscape design, resulting in 82,000 additional acres constrained by take avoidance. This results in a total of 296,000 acres constrained for conservation under the cFMP.

The dFMP replaces the structure targets and shifting mosaic concept with an estimated landscape design (ELD) that remains static over time and is focused more on existing NSO sites and MMMAs, existing stands of old forest, and inoperable areas with more mature stands. It also includes the same anchor habitats for species of concern. Within the ELD there will be goals for a range of seral stages, which is expected to provide more flexibility for harvest while also improving habitat quality. It is important to note that the ELD is an estimate, and that any actual landscape design for the dFMP scenario would not be created unless the dFMP were to be implemented. The total area of the dFMP landscape design is 217,000 acres. It is estimated that 45,000 acres of the 140,000 acre increase stated above will occur within this existing landscape design, resulting in 95,000 additional acres constrained by take avoidance. This results in a total of 312,000 acres constrained for conservation under the dFMP.

HCP

The primary conservation action intended to conserve, maintain, and enhance habitat for the terrestrial covered species is the designation, preservation, and long-term enhancement of Habitat Conservation Areas (HCA) throughout the permit area. The HCP would designate HCAs totaling 275,000 acres, or 43 percent of the permit area. Operable lands outside of the HCAs and RCAs would remain available for timber harvest (forest matrix lands).

The primary design criteria for HCAs is to conserve, maintain, and enhance habitat within and adjacent to existing occupied habitat, as well as to increase overall habitat values for covered species at the landscape level. Forests within HCAs will be managed to maintain and develop late-seral structure stands as they relate to specific habitat needs for individual covered species.

Under the HCP scenario, ODF will manage the forest matrix to achieve environmental, social, cultural, and economic values. In the most productive forest lands, the majority of stands will still be managed for timber production, focused on the generation of a diversity of sawlog sizes at final harvest. Depending on the site productivity and stand characteristics, many stands in the matrix will have one or more thinning entries prior to final harvest. Management would also include retention of live trees, with priority given to the oldest and largest trees, retention of largest available snags and retention of downed wood. These management actions are designed to promote the continuation of legacy structure in the matrix landscape between conservation areas.

5.1.2 Pace and Scale of Upland Habitat Restoration

FMPs

Under the cFMP, ODF does not normally conduct habitat restoration actions for specific listed terrestrial species. However, ODF does implement management practices intended to promote a variety of habitat conditions on the landscape, including those that benefit listed terrestrial species. The dFMP would take a similar approach, and includes goals for forest restoration and long-term investments to improve forest health and improve wildlife habitat.

Implementation of both the cFMP and dFMP is almost entirely funded through ODF's share of timber harvest revenues, which vary with cyclical economic trends; full implementation of all strategies of the FMPs (including monitoring and adaptive management) is contingent on funding available at any given time. Under the cFMP and dFMP, funding available for reinvestment in the forest, including silviculture prescriptions for forest structure development and forest restoration activities, is subject to revenue fluctuations and the operating fund balance being at or above a prudent balance.

Under the dFMP funding would only be available for reinvestment: implementation of management actions to create a range of stand ages, increase pre-commercial and commercial thinning, and a modest amount of forest restoration activities subject to funding. Full implementation of these actions would only occur when ODF's operating fund balance is above the prudent balance and there is a projection for increasing revenues.

Over the long term, it is likely that revenues will support the management activities necessary to meet the Greatest Permanent Value mandate and FMP goals. However, there is uncertainty around the ability of ODF to fully implement the FMPs. After 18 years of implementing the cFMP, some aspects have been challenging to implement (e.g. SBM, monitoring, and adaptive management), and it has been difficult to consistently achieve desired economic outcomes.

HCP

The HCP would outline expectations for habitat management to occur during the permit term in order to mitigate the effects of the taking of the covered species from covered activities. Impacts from covered activities include harvest of stands (and related management activities) that have some degree of suitability for the covered species.

Within HCAs, activities will utilize silvicultural prescriptions designed to accelerate development of late-seral habitat characteristics required by the covered species. Management of existing late-seral habitat within HCAs will be limited to treatments clearly needed to reduce risk of habitat loss due to insects, disease (e.g., Swiss needle cast), or fire. Treatments will also be used to increase specific habitat components such as snags and small (0.5 to 2 acre) stand gaps to increase stand heterogeneity. These actions are significant improvements to the to the FMP scenarios because they are designed to improve the quality of habitat over time, increase the resilience of the forests, and decrease the risk of catastrophic loss due to fire, insects, and disease.

Management outside of HCAs will be primarily focused on wood production to support social and economic values, such as jobs in the timber sector and revenue to counties. Management activities will also be implemented to address forest health and enhance specific legacy components to promote habitat values on the landscape, as described above.

While funding for HCP activities will also primarily come from timber harvest, implementation of conservation actions would be buffered from cyclical economic trends. The elimination of timelines associated with species surveys for take avoidance will allow the auction of timber to be better timed with market conditions, and the dedicated conservation fund will ensure there is funding available to finance prioritized habitat enhancement projects, even when markets are down. The HCP will include a funding plan to cover all HCP implementation costs over the entire, 70-year permit term. Moreover, ODF will be required to monitor and track implementation of conservation actions in the HCP and report them annually to the USFWS and NOAA Fisheries to ensure compliance with the HCP and permits.

5.2 Constraints on Harvest in Riparian Areas

As described in *Chapter 2.3.1. Current FMP Goals and Management Highlights*, the FMPs apply riparian buffers and identify Aquatic Anchors to protect water quality, habitat for native fish, salamanders, riparian birds, and other sensitive species. Riparian buffer widths are defined in terms of three stream categories:

1. Fish bearing: yes or no
2. Stream size: large, medium, or small (defined in terms of streamflow in cubic feet per second)
3. Stream flow duration: perennial or seasonal flows

These three categories produce eight distinct types of streams in state forests[18]. The majority of stream miles in state forests are in the last category of small, seasonal, and non-fish bearing (Table 5-1). ODF further distinguishes these small, seasonal, non-fish bearing streams into three categories with distinct riparian buffers: High debris flow potential, high energy, and other (i.e. seasonal streams without the potential to deliver material to fish-bearing waters).

Table 5-1. Stream Types by Subregion (Miles)

Subregion	Fish Bearing				Non-Fish Bearing			
	Large, Perennial	Medium, Perennial	Small, Perennial	Seasonal[1]	Large, Perennial	Medium, Perennial	Small, Perennial	Seasonal[1]
North Coast	417	340	242	6	5	121	785	2,696
Willamette Valley	46	39	54	14	2	17	88	197
South Coast	15	19	22	124	0	4.0	60	206
Total	**478**	**397**	**318**	**33**	**7**	**142**	**933**	**3,099**
Percent of All Streams	9%	7%	6%	1%	<1%	3%	17%	57%

[1] Includes small, medium, and large seasonal streams

ODF has established a riparian buffering strategy under the cFMP (2010) to maintain, enhance and restore properly functioning aquatic habitat, and to comply with the Oregon Forest

[18] Four combinations of these variables do not exist in state forests because there are no large or medium seasonal streams.

Practices Act and other water quality regulations (Table 5-2). In some cases, a wider buffer applies to sites designated as aquatic anchors. Buffer widths reflect an average distance as applied in the field, recognizing the stream bank zone (0-25 ft.), inner RMA zone (25-100 ft.) and some contribution from the outer RMA zone (variable from 100-170 ft.), where necessary. The cFMP expressly recognizes the ability to manage in these areas. Under the dFMP (2020), ODF anticipates implementing a riparian strategy similar to the cFMP to achieve these goals, using slightly different buffer widths, with less potential management therein. While there would be differences between the two, they are small enough that the two strategies were modeled the same, using the buffer widths in Table 5-2, and assuming no management within them.

Table 5-2. 2010/2020 FMP Minimum Riparian Buffer Widths in Feet[1,2]

	Fish Bearing				Non-Fish Bearing			
	Large, Perennial	Medium, Perennial	Small, Perennial	Small, Seasonal	Large, Perennial	Medium, Perennial	Small, Perennial	Small, Seasonal
cFMP (2010)[2]	115	115	115	115	115	115	30	0-30[3]
dFMP (2020)[2]	115	115	115	115	115	115	30	0-30[3]
Aquatic Anchor Reaches	115	115	115	N/A	115	115	50	0-50[4]

[1] Riparian buffer widths are applied as a horizontal measurement from each edge of the stream bank.
[2] Assumed buffer widths of 115 feet for fish bearing streams of all sizes, or non-fish medium and large streams, recognizing the stream bank zone (0-25 ft.), inner RMA zone (25-100 ft.) and some contribution from the outer RMA zone (variable from 100-170 ft.), where necessary.
[3]High debris flow potential streams and high energy streams = 30-foot buffer; all others = zero no-cut buffer (but other harvest and access limitations may apply).
[4] High debris flow potential streams and high energy streams with aquatic anchor = 50-foot buffer; all others = zero no-cut buffer (but other harvest and access limitations may apply).

Under the HCP Scenario, the buffer widths are slightly different and have been established through discussions with NOAA Fisheries, USFWS, and ODFW (Table 5-3). The RCAs have been designed to address key limiting factors for covered fish species in the plan area; wood recruitment, stream temperature, and sediment delivery. Collectively the ability of the RCAs to address these factors will result in improved habitat over time for covered fish species, which is the biological goal outlined for all covered fish species in the HCP.

There are two key differences between the RCAs in the HCP and the riparian buffers in the cFMP and dFMP: buffer width, and buffer design. In most stream types, the difference in buffer width between the HCP assumption and cFMP is 5 feet on either side of the stream (Table 5-1). Small perennial non-fish bearing streams and small seasonal non-fish bearing streams that are high energy or potential debris flows, would have up to a 90-foot increase in riparian buffer along a small portion of their reach (Table 5-4).

The reason RCAs under the HCP have the potential to be wider than riparian buffers described in the cFMP and dFMP is because the RCAs were designed to target the key stream processes described above: temperature, sediment, and wood recruitment. Targeted buffering will occur in RCAs in non-fish bearing streams to create opportunities for wood recruitment into fish-bearing streams, specifically in non-fish bearing streams that have a high debris flow potential or are high energy. The portion of the stream network immediately upstream of fish-bearing streams receives an increased buffer to increase wood recruitment potential into the fish-bearing stream. In addition, in order to reduce the potential for water temperature increases in small non-fish bearing perennial streams to influence temperatures in fish-bearing streams, the stream buffer width is expanded to 120 feet wide for the first 500 feet above the end of the fish-bearing stream (Temperature Protection Zone). This increase in buffer width will allow water to cool before it reaches the fish-bearing stream. Collectively these targeted wood recruitment and temperature protection strategies are referred to as process protection buffers in the HCP. The differences shown in Table 5-3 are largely driven by these more targeted process protection buffers.

Table 5-3. Minimum Riparian Buffer Widths Comparing 2010/2020 FMP with the HCP Riparian Conservation Areas (Feet)[1]

	Fish Bearing				Non-Fish Bearing			
	Large, Perennial	Medium, Perennial	Small, Perennial	Seasonal	Large, Perennial	Medium, Perennial	Small, Perennial	Seasonal
cFMP (2010)[2]	115	115	115	115	115	115	30	0-30[3]
dFMP (2020)[2]	115	115	115	115	115	115	30	0-30[3]
Aquatic Anchor Reaches	115	115	115	N/A	115	115	50	0-50[4]
2020 HCP	120	120	120	120	120	120	35-120[5]	0-50[6]
Difference (effect of HCP)	5	5	5	5	5	5	5-90	0-20

[1] Riparian buffer widths are applied as a horizontal measurement from the outer edge of aquatic feature.
[2] Assumed buffer widths of 115 feet for fish bearing streams of all sizes, or non-fish medium and large streams, recognizing the stream bank zone (0-25 ft.), inner RMA zone (25-100 ft.) and some contribution from the outer RMA zone (variable from 100-170 ft.), where necessary.
[3] High debris flow potential streams and high energy streams = 30-foot buffer; all others = zero no-cut buffer (but other harvest and HCP_FMP_Comparison_combined_table16_17access limitations may apply).
[4] High debris flow potential streams and high energy streams = 50-foot buffer; all others = 0-foot equipment restriction zone
[5] Within process protection zone= 120-foot buffer; above process protection zone = 35-foot buffer
[6] High debris flow potential streams and high energy streams within process protection zone = 50-foot buffer; above process protection zone = 35-foot buffer; all others = 0-foot buffer with a 35-foot equipment restriction zone

Table 5-4. Minimum Buffers Widths for Small Perennial and Seasonal Non-Fish Bearing Streams

Stream Type	Within Process Protection Zone	Above Process Protection Zone
Perennial Small Type N	120	35
Potential debris flow track (Seasonal Type N)	50	35
High energy (Seasonal Type N)	50	35
Seasonal other (Type N)	0[1]	0[1]

1 35’ Ground Based Equipment Restriction; Group Leave Trees (TBD)

The increased stream buffer widths would decrease acres available for harvest by about 3,000 acres. Similar to the FMPs, no harvest (no cut) would be permitted in the riparian buffers.

5.2.1 Pace and Scale of Aquatic Habitat Restoration

Some specific, targeted stream enhancement activities occur and would continue to occur on ODF lands under all scenarios with the goal of improving stream habitat for anadromous fish, including several listed species. Those actions include removing fish barriers, adding large wood structures to the stream in areas identified as lacking large woody debris, and improving or vacating roads. These projects are informed by the Oregon Department of Fish and Wildlife Statewide Fish Passage Priority List[19].

Passage Barriers Modification or Removal

From 1995 to 2018 ODF replaced an average of 12 culverts a year to meet Oregon Department of Fish and Wildlife fish passage standards. These replacements focused on the most cost-effective projects that allowed access to the most stream miles with potential habitat. The projects that remain are more complex and costly, with less potential habitat upstream, and the average replacements per year have decreased to 5 to 6 per year). Under the cFMP and dFMP, work would continue on fish passage barrier removal efforts, based on availability of funding. Historically, these stream enhancement projects have been completed with the support of other partners and funded through grants.

Under the HCP, ODF would commit to repairing or replacing at least 167 culverts that do not currently meet NOAA Fisheries fish passage requirements to provide passage over the course of the 70-year permit term. The current average of 5-6 projects per year is expected to continue, and will increase in years as opportunities are available. Selection of fish passage barrier removal projects will be informed by a 2019 fish passage barrier prioritization analysis completed by ODFW in 2019 (ODFW 2019), as well as prioritization criteria in the HCP.

Stream Enhancement

Stream enhancement projects focus on restoring natural processes to create habitat that improve overall conditions for the covered species and other aquatic organisms in the permit area. These projects allow for immediate improvements to instream complexity. This is especially important in young riparian forests that may have a shortage of large wood inputs to streams due to historic large fires and logging practices.

Over the course of 23 years (1995–2018) ODF has implemented 195 instream wood placement habitat projects in the permit area and has donated over 7,200 logs to local watershed councils for use in similar stream enhancement projects. Projects are designed and often implemented in collaboration with local ODFW biologists and accomplished in collaboration with watershed councils, local nonprofit organizations, and the Oregon Watershed Enhancement Board. Under

[19] Oregon Department of Fish and Wildlife. 2019. *Fish Screening and Passage Program*. 2019 Statewide Fish Passage Priority List. April, 19. 43pp.

the cFMP and dFMP, ODF stream enhancement work would continue along a similar trajectory, subject to resources and grant funding.

Under the HCP, ODF will support restoration projects through the development of a Conservation Fund which can be used by ODF and partners to execute restoration projects. Every timber contract will contribute to the conservation fund either though instream project work, in-kind work (provide trees, equipment, etc.), or a portion of gross sales (i.e., after revenue disbursements to Conservation Fund. Stream enhancement projects would focus on improvements that address limiting factors of the fish species covered by the HCP, which could range from simple projects like installation of large wood debris (LWD) to more complex floodplain reconnections or channel restoration projects.

Road Improvement and Vacating

Best management practices associated with road improvement and road vacating and are designed and implemented to disconnect the road system hydrologically from the stream channels. ODF has existing policies and guidance[20] in place that govern road improvements and vacating practices. Over the past 23 years (1995–2018) ODF has closed or vacated 155.4 miles of road and improved 2,287 Type N stream crossings in the permit area, primarily to reduce sediment transport to the aquatic system. The majority of this activity occurred in the Astoria District (See HCP Section 4.7.5).

ODF would also continue to implement these practices with project prioritization informed by the Forest Road Hazard Inventory (ODF 2000), or suitable surrogate. With the cFMP and dFMP, specific plans regarding road system improvements and vacating are included in district Implementation Plans. Similarly, under the HCP, ODF would review the current conditions of the road system in the permit area during each Implementation Planning (IP) cycle to determine what road segments pose a risk to the covered species and identify potential erosion and landslide hazards in proposed harvest areas.

Under all scenarios, improvements to aquatic habitat associated with implementation of these practices are expected to provide strong conservation outcomes. The HCP is expected to perform somewhat better than the cFMP and dFMP, and also includes a strong regulatory requirement to track instances where road construction or other activities intersect RCAs, and report those instances on an annual basis. If monitoring indicates these activities are taking place outside the anticipated scope of the HCP, adaptive management would be used to examine alternative strategies, and if necessary, adjust future management actions.

5.3 Habitat Quality and Quantity for HCP-Covered Species

This CA groups the 16 species that are covered by the HCP into terrestrial and aquatic. Aquatic species (fish and torrent salamanders) are addressed though an evaluation of the riparian conditions over time. Terrestrial species are addressed through an evaluation of general forest

[20] Department of Forestry's Forest Roads Manual 2000

conditions and specific habitat suitability for four species (northern spotted owl, marbled murrelet, red tree vole, and Oregon slender salamander). Native species that are not directly covered by the HCP will benefit from the habitat protections designed for covered species, and will be more directly addressed in a companion Forest Management Plan that will be developed to go with the HCP. In order to allow for a comparison between scenarios with respect to habitat quality and quantity over time, consistent data upon which to base the comparison was necessary. As such, species habitat models were developed for four terrestrial species to evaluate how each scenario influences changes in habitat. For aquatic species an evaluation of acres within riparian buffers, and the age of forest inside those buffers over time, is used as a surrogate for changes in aquatic habitat quality over time.

In the section that follows, the results of habitat modeling for northern spotted owl, marbled murrelet, red tree vole, and Oregon slender salamander for each scenario from the beginning and end of the period of analysis (2023 through 2097) are described and presented.

5.3.1 Terrestrial Species

The HCP intentionally delineates a larger proportion of the landscape for the conservation of terrestrial species' habitat within HCAs. The design of the HCAs includes areas known to be currently occupied by covered species, have current highly suitable habitat for covered species, and that have a high probability of developing into suitable habitat over time as estimated by the forest management model.

The habitat models were used to identify areas with high conservation value for each covered species. They were also used to assess forest management model projections of habitat development over time, through growth. However, there are limitations to the habitat and forest management models. The habitat models characterize habitat using only a few key stand level attributes, and do not directly include spatial attributes at the landscape level for each species. As a result, they do not describe the full potential habitat quality for a species. Specifically, as long as there is not a regeneration harvest in a stand, it is predicted to develop into suitable habitat over time. As a result, the predicted development of suitable and highly suitable habitat for the HCP scenario is likely an underestimate, as it does not fully account for both site-specific and landscape level factors that will be targeted for enhancement. Note that while landscape patch attributes were not modeled for each species, patch statistics are presented for conservation areas generally in Chapter 5.4. *Habitat Configuration and Fragmentation*.

Similarly, the forest management model was designed to produce policy level outputs to compare scenarios generally and has a limited set of silvicultural prescriptions from which to draw. This generalized prescription set results in a potential overestimate of the development of suitable habitat outside areas designated for conservation (LD, ELD, HCAs), and a potential underestimate of habitat developed within HCAs, due to its lack of more nuanced silviculture aimed specifically at habitat enhancement. Also, for the cFMP and dFMP, the forest management model does not add acres back into the inventory of available acres once they are initially removed for implementation of take-avoidance. In reality, some of these acres might become available for harvest again over time, due to species' sites becoming vacant. This results in potential inflation of the habitat predicted to develop over time for both the cFMP and dFMP.

The analysis also assumes that the LD and ELD would remain the same over the 75-year period of the analysis. As already discussed in *Chapter 5. Conservation Outcomes*, the reality is that the areas designated for conservation would change overtime, driven by policy changes and the need to rebalance these policy-related constraints with harvest objectives.

These dynamics are illustrated in the predicted area weighted habitat suitability over time for northern spotted owl, marbled murrelet, red tree vole, and Oregon slender salamander across the permit area overall for the three scenarios (Figure 5-1). Figure 5-1 shows overall habitat suitability increasing over time for all four species as the relative age of forests in the permit area increase (see Figure 5-11 for more information).

The cFMP outperforms the HCP for all but Oregon slender salamander, which is directly related to the amount of harvest, less harvest under the cFMP results in older stands and higher habitat suitability score. The gap between the cFMP and the HCP narrows overtime for northern spotted owl, marbled murrelet, red tree vole as younger stands protected within HCAs at the beginning of the permit term mature into suitable habitat for these species. The HCP outperforms the FMPs for Oregon slender salamander because future take avoidance acres were determined based on the habitat for red tree vole. There is no overlap in the range of the North Coast Distinct Population Segment (DPS) of the red tree vole (the potential population to be listed) and Oregon slender salamander.

Figure 5-1. Weighted Habitat Suitability Index (HSI) for the Permit Area Over Time

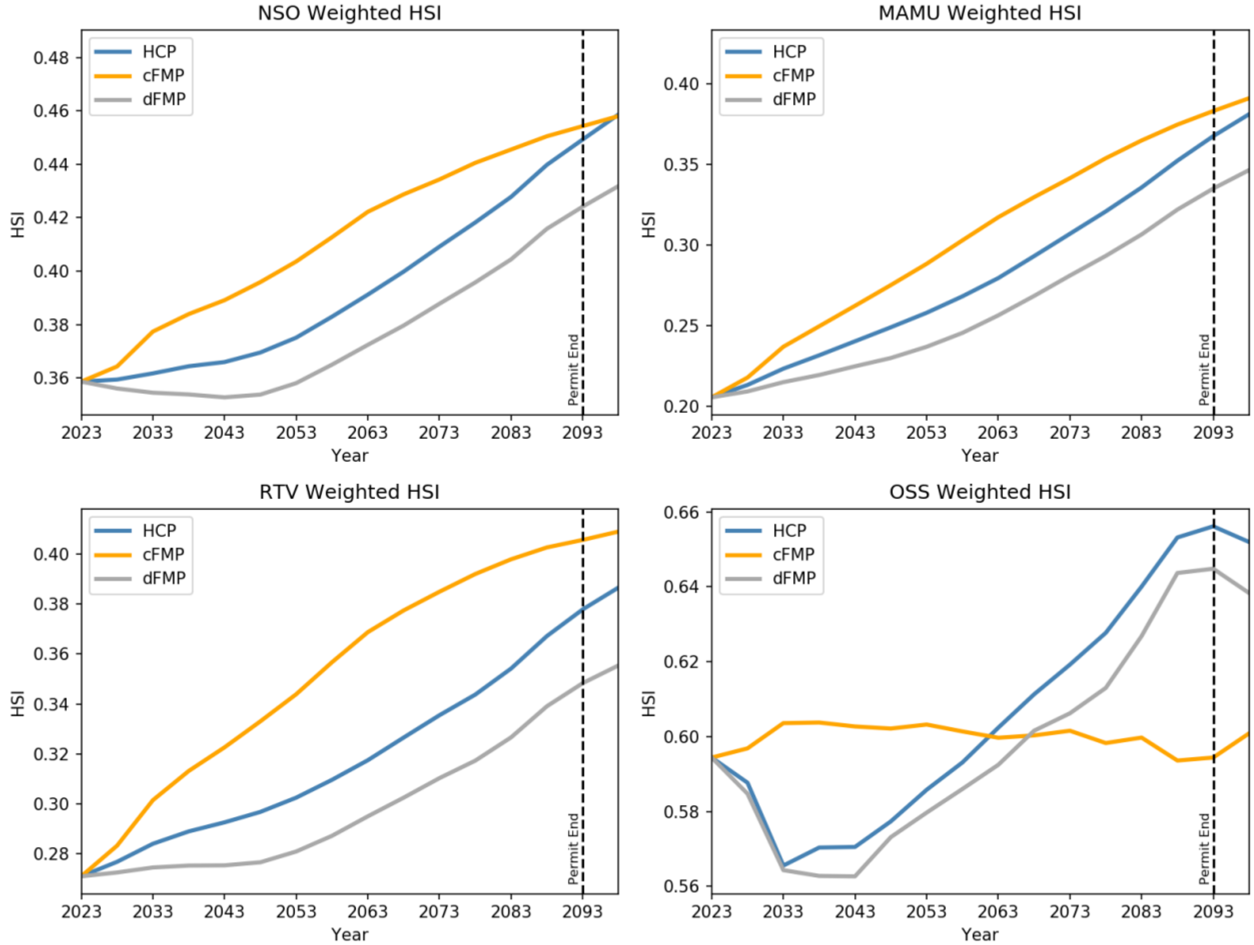


Figure 5-2, Figure 5-4, Figure 5-6, and Figure 5-8 show acres of highly suitable and suitable habitat inside areas designated for conservation for northern spotted owl, marbled murrelet, red tree vole, and Oregon slender salamander, respectively. These figures show more suitable and highly suitable habitat developing within the HCAs than the LD and ELD, but the difference shown by the models is not a large as might be expected given that the HCAs are larger than the LD and ELD. The difference can be expected to be larger with implementation of conservation measures intended to improve and restore forest habitat and increase the resilience of the forest within HCAs over time.

Figure 5-3, Figure 5-5, Figure 5-7, and Figure 5-9 show the predicted habitat suitability over time in the permit area overall for each of the four species. They show the cFMP and dFMP could potentially result in more suitable and highly suitable habitat over time for all but Oregon slender salamander. As described above, future take avoidance assumptions were based on potential listing of the North Coast DPS of the red tree vole, which does not overlap the range of the Oregon slender salamander. An important difference between the HCP and FMPs in the permit area as a whole that is not shown by these figures is the relative level of certainty around the quality and quantity of habitat associated with these scenarios.

Specifically, the modeling analysis assumes that once acres are constrained for take-avoidance they never become available for harvest during the remainder of the 75-year period of this analysis. The reality might be much different, and would have implications for other variables included in the CA. For example, costs for pre-harvest surveys would increase to include more species and more areas may need be surveyed for to ensure enough acres can be harvested each year to meet harvest objectives. It is also unknown which species would have a "vacancy" standard in their survey protocol to establish when an unoccupied site could be harvested without incurring take. For instance, there is some general agreement that northern spotted owl sites can be considered abandoned at some point (although this does not completely remove the risk of take). In contrast, habitat determined to be occupied by marbled murrelets is considered occupied forever.

There is more certainty around the future quality and quantity of habitat with the HCP given the commitments in the HCP versus either of the FMPs. While the habitat suitability modeling provides an estimate of the quantity and quality of terrestrial habitat, it only provides a partial picture of the how the cFMP, dFMP, and HCP compare relative to conservation outcomes. The regulatory environment of take avoidance is centered on specific species' sites, which may become vacant or move, making long-term investments in habitat enhancement riskier and more difficult to align with other resource constraints, and therefore less likely. Commitments to habitat protection and enhancement on specific areas of the landscape, coupled with the assurances of an HCP, make these investments less risky and more likely, both for ODF and the covered species.

Figure 5-2. Comparison of Quantity and Quality of Northern Spotted Owl Habitat Inside Areas Designated for Conservation 2023 – 2097 (acres)

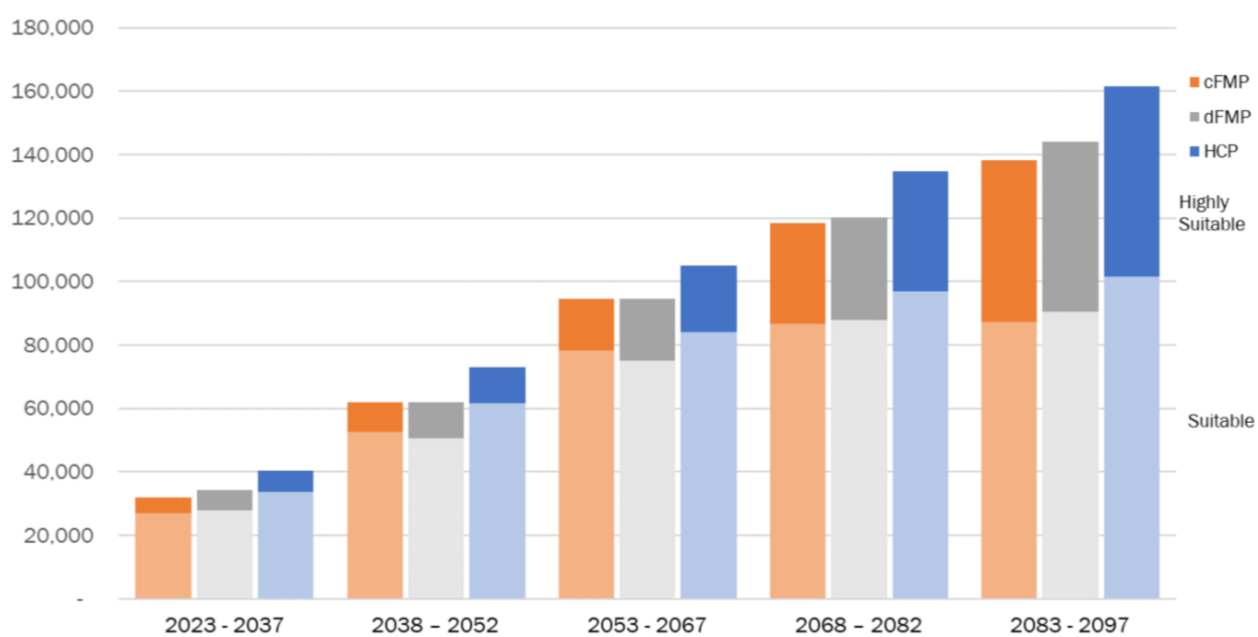


Figure 5-3. Comparison of Quantity and Quality of Northern Spotted Owl Habitat in Permit Area 2023 – 2097 (acres)

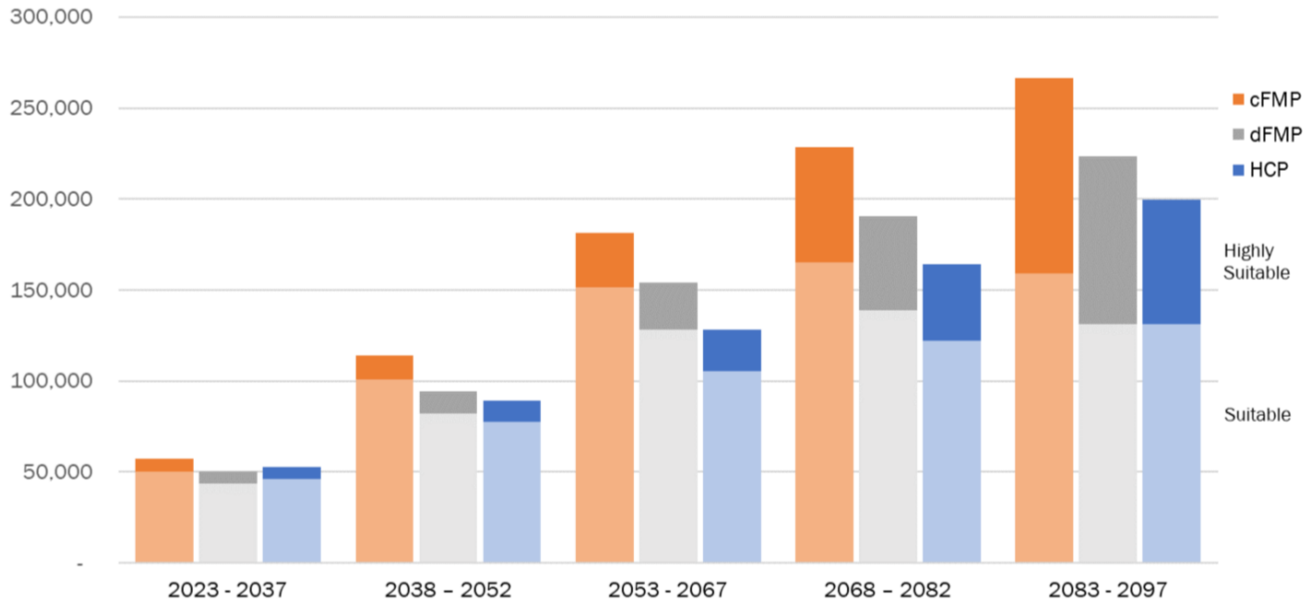


Figure 5-4. Comparison of Quantity and Quality of Marbled Murrelet Habitat Inside Areas Designated for Conservation 2023 – 2097 (acres)

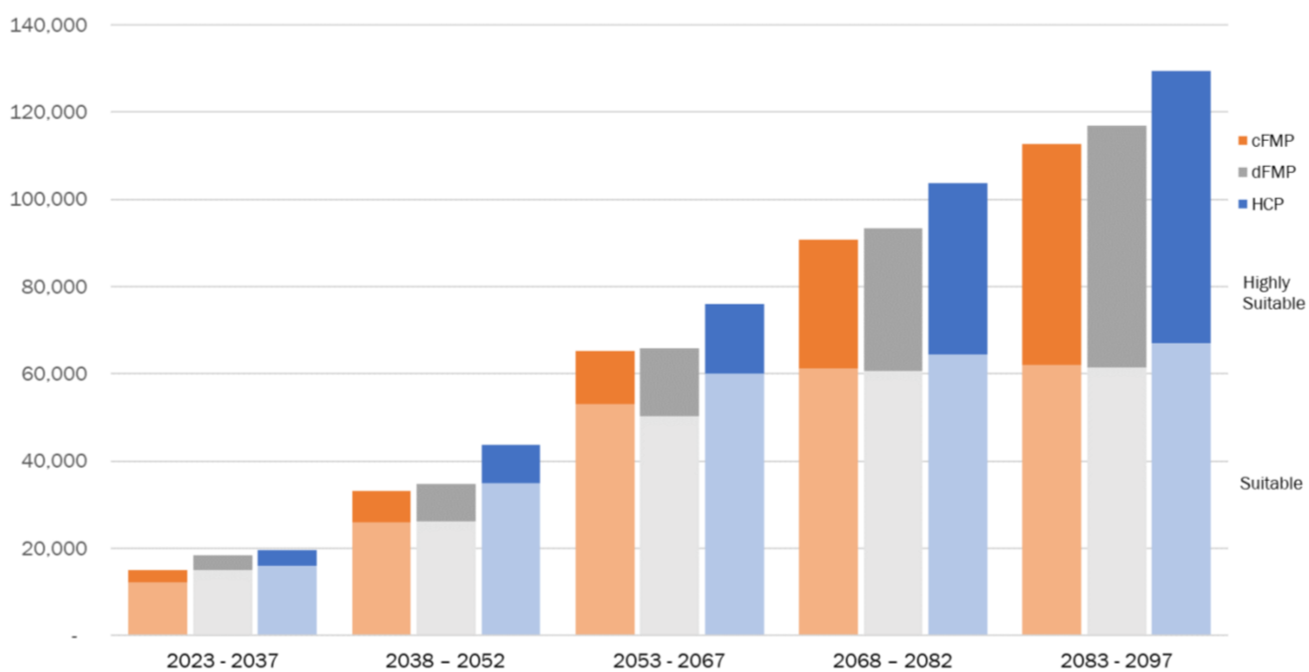


Figure 5-5. Comparison of Quantity and Quality of Marbled Murrelet Habitat in Permit Area 2023 – 2097 (acres)

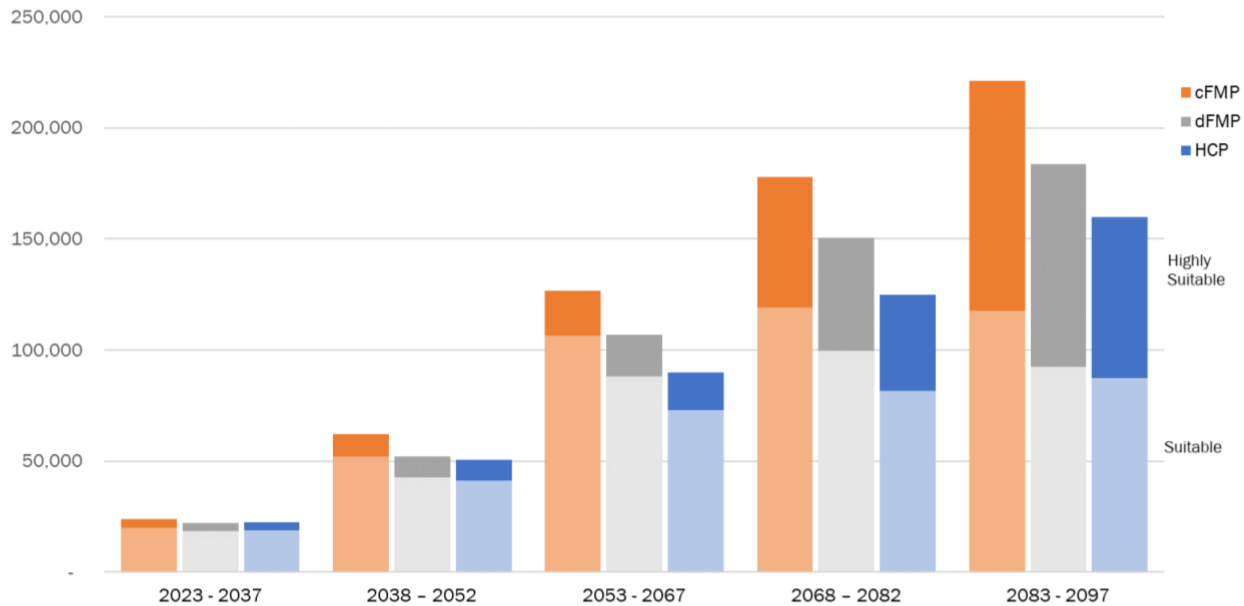


Figure 5-6. Comparison of Quantity and Quality of Red Tree Vole Habitat Inside Areas Designated for Conservation 2023 – 2097 (acres)

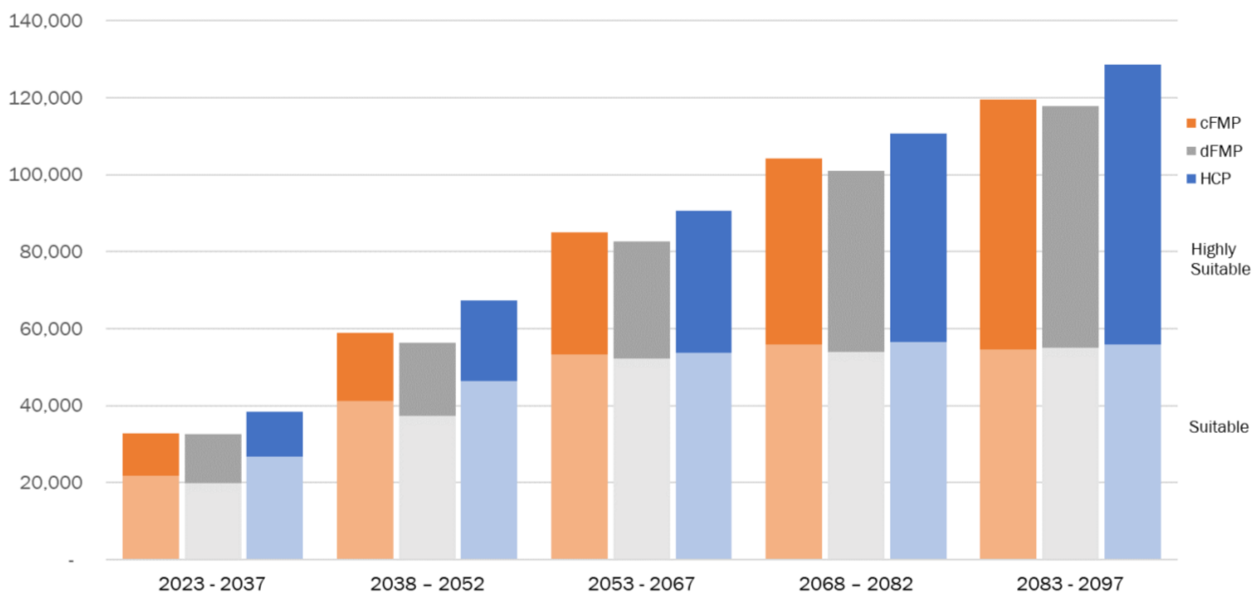


Figure 5-7. Comparison of Quantity and Quality of Red Tree Vole Habitat in Permit Area 2023 – 2097 (acres)

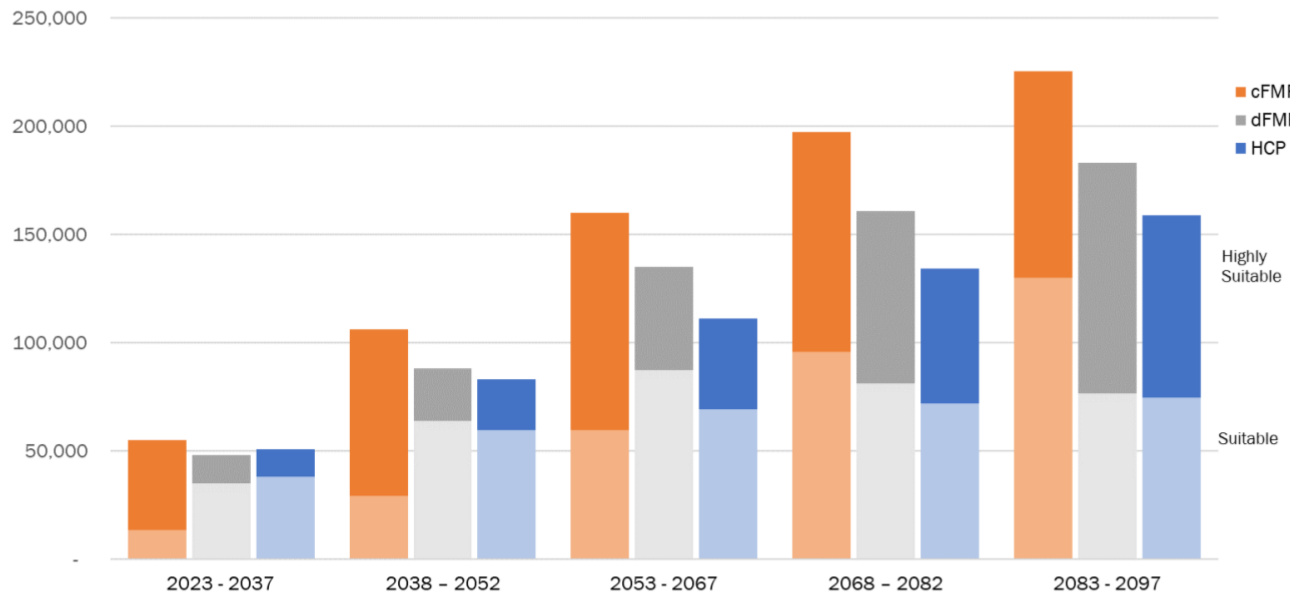


Figure 5-8. Comparison of Quantity and Quality of Oregon Slender Salamander Habitat Inside Areas Designated for Conservation 2023 – 2097 (acres)

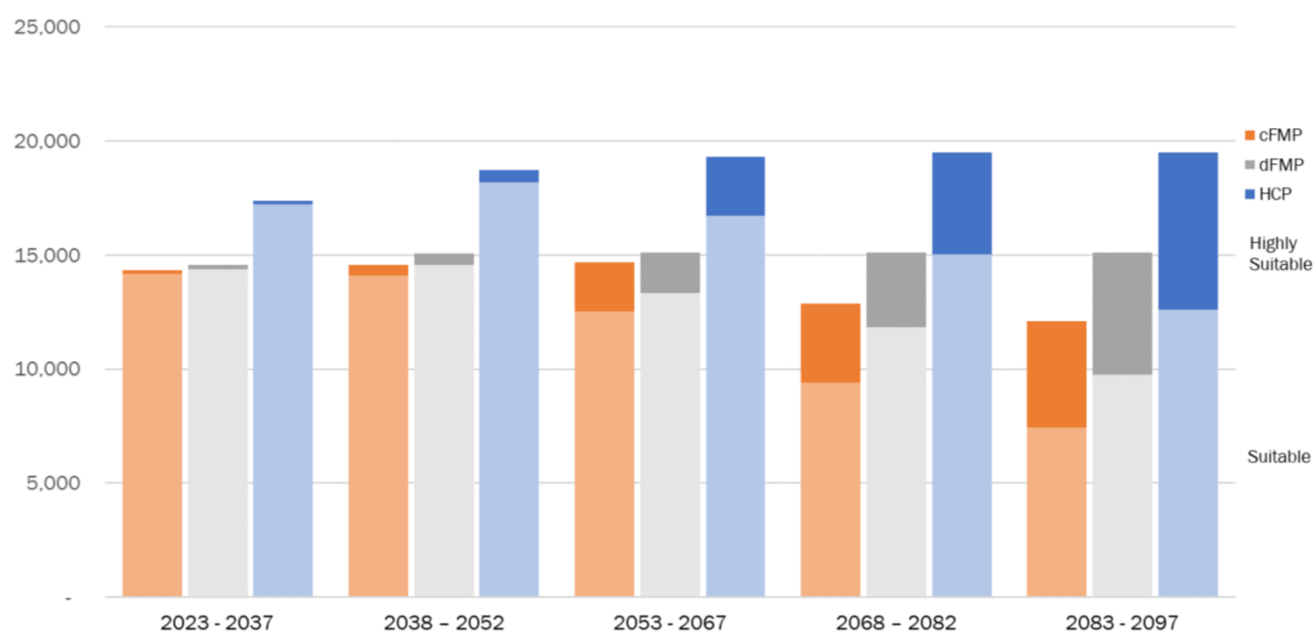
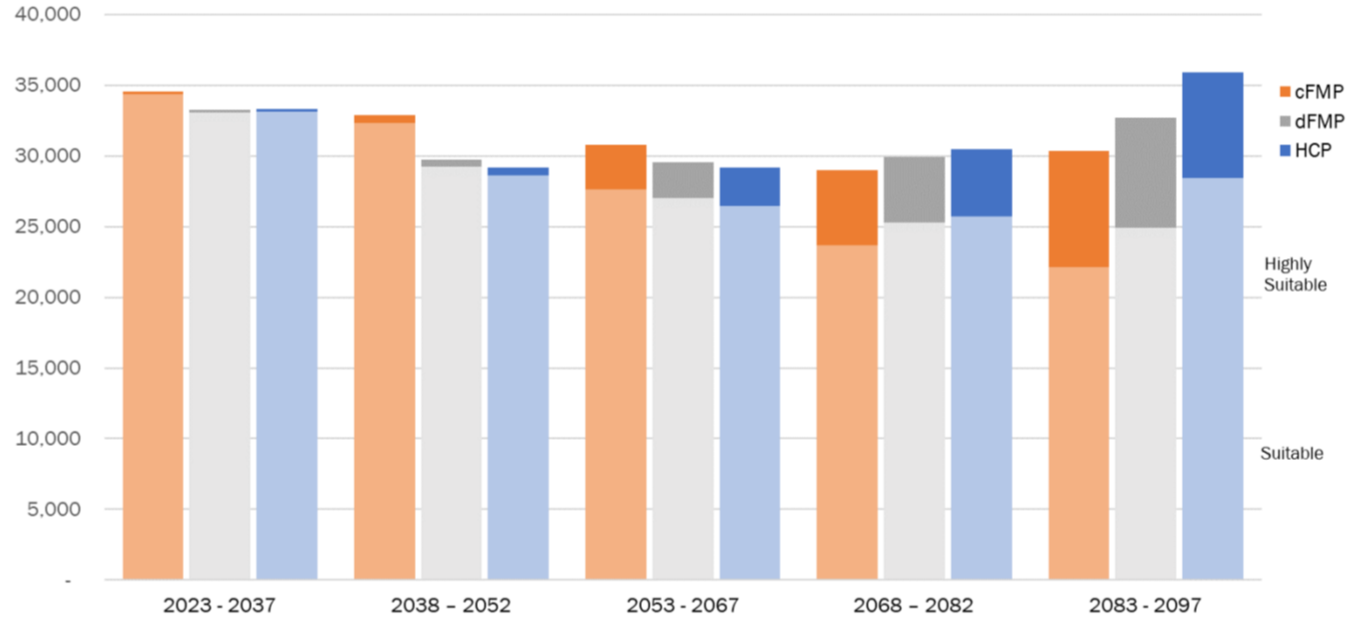


Figure 5-9. Comparison of Quantity and Quality of Oregon Slender Salamander Habitat in Permit Area 2023 – 2097 (acres)



5.3.2 Aquatic Species

Habitat Quantity

The RCAs are designed to support and protect the ecological process that address the limiting factors and the Biological Goals and Objectives for covered aquatic species. They were built using the best available data, including fish distribution, SLI, LiDAR, and designated critical habitat.

The HCP would result in a 5 percent (3,400 acres) increase in the number of acres included in permanent, no harvest riparian areas (Riparian Conservation Areas). Buffers would generally be increased over current standards (cFMP). Buffers along fish-bearing streams would increase by 5 feet, and small, perennial non-fish streams and seasonal streams would receive various additional protections, depending on their relationship to fish-bearing waters. Table 5-5 shows the results in acres of the expected increase in no harvest areas as a result of the assumed HCP riparian buffers. Table 5-6 shows the estimated increase in permanent no harvest areas for covered salmon and steelhead by subregion as a result of the HCP riparian conservation areas. The greatest increases work be for Oregon Coast Coho, Columbia River Chum, Lower Columbia River Chinook, and Lower Columbia River Coho.

Table 5-5. Estimated Increase in Permanent No Harvest Areas by Subregion as a Result of the HCP Riparian Conservation Areas (Acres)

	North Coast	South Coast	Willamette Valley	Total
2010/2020 FMP	62,443	4,003	7,413	73,589
2020 HCP	65,280	4,384	7,632	77,296
Acreage Increase	2,837	381	218	3,437
Percent Increase	4.5%	9.5%	2.9%	4.7%
Percent of Total Acres	83%	11%	6%	100%

Note: Acres reported are gross acres, not accounting for other, overlapping constraints.

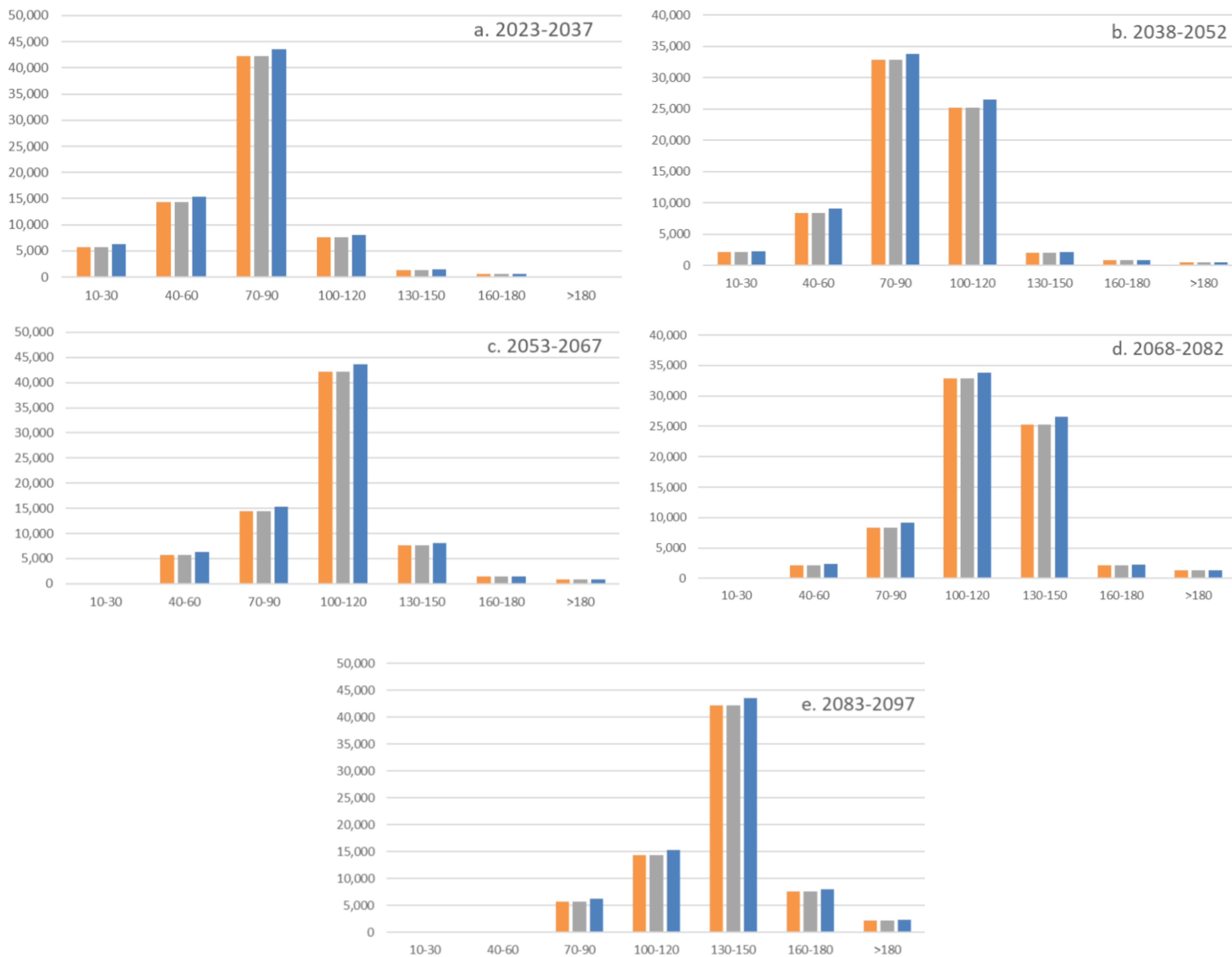
Table 5-6. Estimated Increase in Permanent No Harvest Areas for Covered Salmon and Steelhead by Subregion as a Result of the HCP Riparian Conservation Areas (Acres)

	North Coast			South Coast			Willamette Valley		
	2010/2020 FMP	2020 HCP	Increase under HCP	2010/2020 FMP	2020 HCP	Increase under HCP	2010/2020 FMP	2020 HCP	Increase under HCP
Oregon Coast Coho	56,212	57,948	1,736	3,459	3,748	289	2,745	2,790	45
Columbia River Chum	3,823	4,527	704	NA	NA	NA	10	12	2
Lower Columbia River Chinook	3,823	4,527	704	NA	NA	NA	10	12	2
Lower Columbia River Coho	3,823	4,527	704	NA	NA	NA	10	12	2
Upper Willamette River Chinook	NA	NA	NA	30	38	8	3,999	4,067	68
Upper Willamette River Steelhead	3,284	2,277	393	NA	NA	NA	4,624	4,798	174
SONCC Coho	NA	NA	NA	458	531	73	NA	NA	NA

Habitat Quality

Figure 5-10 shows predicted stand age distribution in 15-year increments from in 2023 and 2097. As shown in these figures, stands within riparian areas become older in all three scenarios and the stand age outcomes show very little difference in forest stand age distribution across the three scenarios. The only difference between the HCP and the FMPs is the number of acres in the RCAs. The forest harvest modeling assumes there would be no harvest or active forest management activities within riparian buffers under all three scenarios. This is a simplification, as the cFMP allows for harvest in order to increase mature forest conditions; however, this is generally not cost-effective and rarely implemented. Forest stand age would result in other improvements to riparian habitat quality generally. The increase in HCP buffers is designed to protect against direct stream warming and allow for cooling of heated water from upstream prior to reaching fish bearing streams, and to improve large wood recruitment. In addition, the level of certainty regarding the pace and scale of aquatic habitat restoration is higher with the HCP because the HCP includes funding assurances for habitat restoration. In comparison, restoration activities undertaken with the cFMP and dFMP would be contingent on grant funding, financial performance (both current and projected) and operating fund balance. As a result, habitat quality may vary more between among scenarios, with the HCP being more certain to generate more, higher quality habitat.

Figure 5-10. Riparian Age Class Distribution (acres)



5.3.3 Monitoring and Adaptive Management

Monitoring and adaptive management is important for assessing impacts and benefits to protected species habitat quality and quantity, providing a way to verify the effectiveness of, and support informed adjustments to, forest management and conservation actions. It can also provide valuable information on habitat occupancy and species populations. Assurances for, and components of, monitoring and adaptive management would vary widely between the HCP and FMP scenarios. Table 5-7 shows how the quality and quantity of monitoring compares under each scenario.

The HCP monitoring program will include compliance monitoring and effectiveness monitoring and will apply to the entire area included within the HCAs and RCAs as well as targeted monitoring outside of HCAs and RCAs (Table 5-7). It includes a process to determine whether the habitat parameters required for covered species are present in areas identified as suitable habitat by the habitat models. The monitoring program will also assess how habitat parameters change over time and will allow for adaptive management. Monitoring would be coupled with active management in HCAs designed to restore late-seral forest habitat characteristics.

Table 5-7. Comparison of Quantity and Quality of Monitoring and Management

Parameter	cFMP	dFMP	HCP
Quantity Covered species management and assurances	No program targeted to species. Subject to resource availability	No program targeted to species. Subject to resource availability	Terrestrial (HCAs): 260,000 acres Aquatic (RCAs): 77,000 acres plus targeted monitoring outside HCAs
Quantity of Covered Species Monitoring	Terrestrial: subject to operational planning; less than dFMP Aquatic: None	Terrestrial: subject to operational planning; more than cFMP Aquatic: None	Terrestrial: 260,000 acres Aquatic: 77,000 acres
Quality of Monitoring	No formal commitment to monitor habitat quality or test effectiveness of management activities; focused on take-avoidance before timber sales/harvest		Systematic monitoring coupled with measurable performance metrics and adaptive management strategy

Note: Acres reported are gross acres, not accounting for other, overlapping constraints.

Under the FMPs, annual and operational species-specific surveys would continue to focus on detecting the occupancy of listed species. If a listed species is present, timber sales are modified or abandoned to support implementation of the take avoidance. Although species surveys are valuable for ensuring compliance with the ESA, they fall short of providing a net benefit to the species. This is because the take avoidance approach restricts ODFs ability to manage these lands for habitat or harvest, and is one of the primary drivers of uncertainty for both conservation and forest management over time. The cFMP includes active management specifically designed to improve habitat for all native wildlife species (including the listed species), through the concepts of Structure Based Management. The dFMP also includes active management concepts designed to provide these benefits through concepts of ecological forestry. While both FMPs have a monitoring and adaptive management component, they are more general and would not include a formal commitment to monitor habitat quality for the covered species within specific conservation areas over time, or test the effectiveness of management activities related to habitat enhancement. This is largely due to a lack of funding to be able to conduct both the required surveys for take avoidance and effectiveness monitoring. The savings incurred from not having to conduct take avoidance surveys under the HCP allows for more meaningful investments in monitoring and adaptive management.

5.4 Habitat Quality and Quantity – Non-covered Species

5.4.1 Terrestrial Species Results

Meeting the habitat requirements of non-covered species requires that ODF forest lands are managed for a variety of seral stages, stand structures, and stand sizes across the landscape. Whereas the covered species predominantly require old forest characteristics, non-covered species require a variety of habitats, from early successional forests through to late seral-stage forests and encompassing riparian areas, springs, wetlands, rock outcrops, and talus slopes. At a landscape level, this is most readily characterized with the forest stand age distribution and species mix. Forest lands that include representation of all age classes signifies that the forest is providing a diversity of habitats that will support biodiversity.

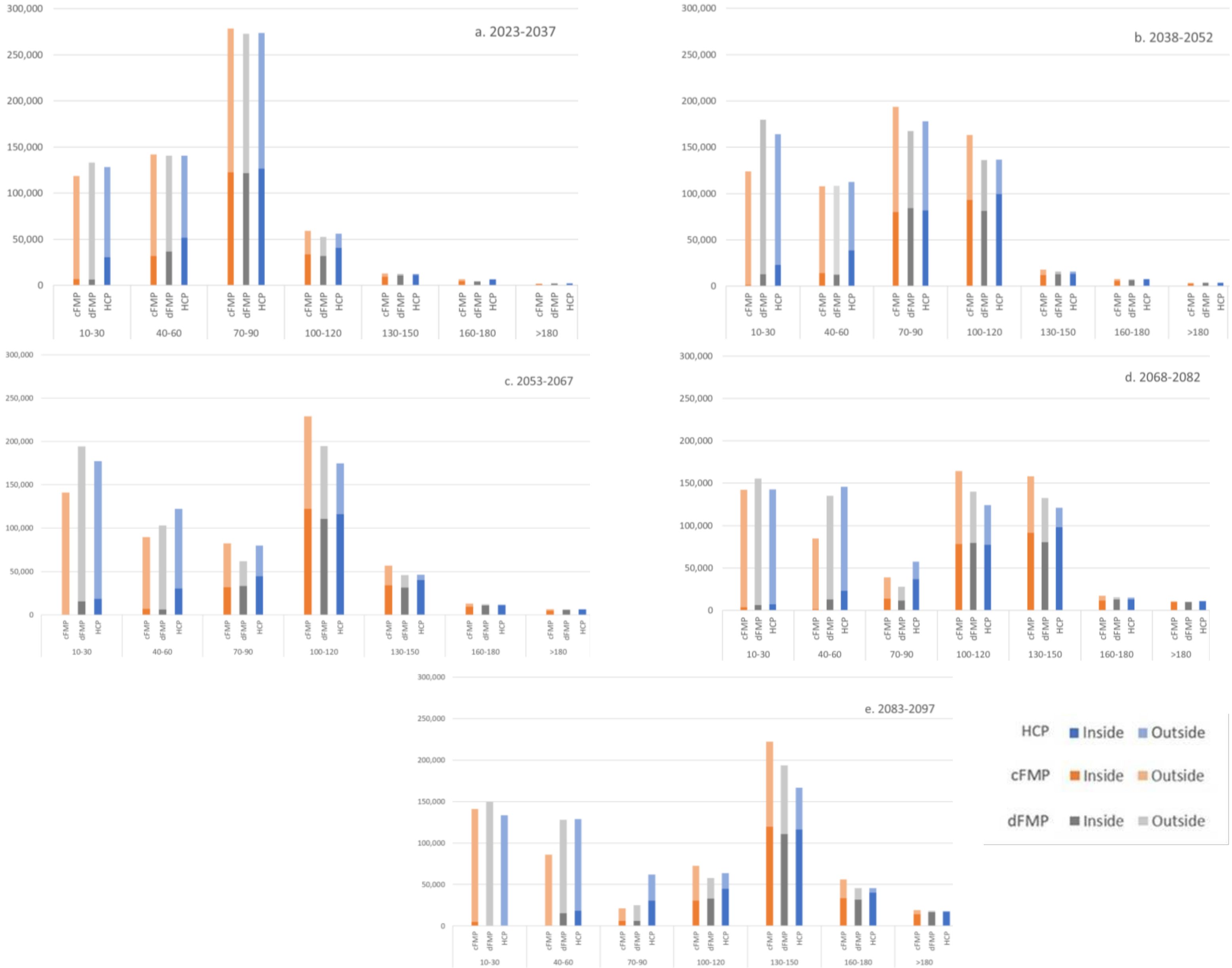
The forest stand age distribution outputs are used as a proxy to assess the presence and quantity of a diverse range of habitats within the permit area, represented by area of forest stands at different ages over time. For example, species that favor an open canopy for grazing and forage such as ungulate species would favor young forest conditions. The diversity of tree species, or the mix of hardwood versus conifer, would be relatively similar for each scenario, so our analysis focused on stand age.

Figure 5-11 provides a snapshot of average forest stand ages at fifteen-year increments from the beginning through the end of the analysis period (2023 - 2097), inside and outside areas designated for conservation (LD, ELD and HCAs). As shown in Figure 5-11a, most forests in the plan area are less than 100 years old and all three scenarios are very similar. However, the HCP includes more acres of younger stands, up to 60-years in age, in the HCAs. By design, the FMPs primarily include older forested inside the LD and ELD to preserve habitat that currently exists.

The HCAs are designed to preserve current habitat and recruit future habitat into larger patches by including younger stands adjacent to suitable habitat and between existing species sites that will grow into suitable habitat over time. Figure 5-11b through Figure 5-11e, show that over time, the distribution of stand ages is predicted to balance the amount of forest over and under 100 years in age, becoming approximately equal by 2097. Old forests are primarily located within areas designated for conservation and young stands are almost exclusively located outside areas designated for conservation. The results for the HCP and dFMP are similar, but the result for the cFMP show fewer stands in the 40-90-year age classes.

The HCAs were designed so that they would be distributed evenly across the landscape, and it is expected that there would be a diverse set of stand ages present at any point in time, such that all non-covered species groups could persist. Overall, the dFMP and HCP would result in an even age distribution of stands under and over 100-years in age than the cFMP (approximately a 50:50 split for both scenarios). A large proportion of forests would be under 100-years in year 2097 (40% and 60%, respectively) with the cFMP scenario.

Figure 5-11. Average Forest Stand Age Class Distribution in the Permit Area Inside and Outside Areas Designated for Conservation



5.4.2 Aquatic Species Results

Without harvest in riparian conservation areas the stand age distribution trends older over time, with the majority of stands older than 100 years by the 2097. As shown in Figure 5-10 the diversity of stand ages will be reduced over time and no stands less than 80-years old would be present within riparian areas across all scenarios. This is projected to be the predominant condition except in areas where natural disturbance (e.g., landslides, wildfires) removes older forests allowing younger forests to establish. This is expected to be beneficial to both covered and non-covered aquatic species and water quality parameters such as temperature are expected to improve.

5.5 Habitat Configuration and Fragmentation

The configuration of the habitat is important because it provides information about the degree of habitat continuity, or the inverse, habitat fragmentation. Fragmented habitats present challenges for some species due to the increased resistance to the movement of individuals between patches. Decreased movement can result in genetic decay (inbreeding) or demographic decay and increases the likelihood of patch-level extirpation. Within a fragmented landscape, the distance between, patches can be an important measure of the degree of fragmentation and can influence the degree and pace of genetic and demographic decay. In addition, for many species, like the northern spotted owl and marbled murrelet, habitat patch size is important, with larger patches of forested habitat likely to provide more functional interior habitat than the same amount of habitat configured into smaller patches. Reducing the "edge effect" (i.e., providing a lower perimeter to area ratio) on suitable habitat through the establishment of larger habitat patches affords covered species protection against threats like nest predators, windthrow and changes in microclimate. Small, isolated patches of suitable habitat can act as sinks, attracting dispersing individuals that then experience poor reproductive success and do not contribute to the broader population.

5.5.1 Landscape Level Configuration of Lands Designated for Conservation

Over the 75-year period of analysis, the configuration of areas designated for conservation will have a significant influence on how the continuity of suitable habitat for protected species changes over time. Lands outside these designated areas are available for harvest, unless there are other constraints such as operability, access or regulatory limitations. Harvest of these areas would reduce overall patch size of habitat, and create edge effects. In contrast, active management and implementation of other conservation measures in the HCAs are designed to increase the rate at which habitat suitable for covered species develops, increasing patch size and reducing the relative amount of edge. Figure 5-12 shows a comparison of the cFMP landscape design, including terrestrial anchors (LD), dFMP estimated landscape design (ELD), and HCP HCAs relative to modeled suitable habitat in 2023 for northern spotted owl and marbled murrelet in the Tillamook District. The HCAs cover larger, more even-edged and contiguous areas than the LD and ELD. The ELD is the most complex[21] (i.e. fragmented), comprised of a larger number of small, disconnected areas across the area show in Figure 5-12.

HCP delineates a larger proportion of the landscape for terrestrial species conservation within HCAs that the cFMP LD and the dFMP ELD. As shown in Table 5-8 and Figure 5-12, the HCAs are substantially larger than the terrestrial anchors. They would also be managed significantly differently as described in the next section. Whereas no management activities are permitted in the terrestrial anchors, there would be active management in the HCAs through implementation of the conservation actions.

Table 5-8. Lands Designated for Conservation under Each Scenario

Scenario	Description	Acres (gross)	Percent of the Permit Area
cFMP	LD (with Terrestrial Anchors)	214,000	34%
dFMP	ELD	217,000	34%
HCP	HCAs	275,000	43%

5.5.2 Fragmentation of Lands Designated for Conservation

An analysis of the number, size and distance between areas included in the LD, ELD and HCAs further illustrates the difference between the configuration of areas designated for conservation in the cFMP, dFMP and HCP. The design of these areas has implications for the relative development and fragmentation of future potentially suitable habitat. As shown in Table 5-9, the HCAs are much larger and the ratio between perimeter and area is lower than the cFMP LD and the dFMP ELD (lower ratio signifies less fragmentation). Patches included in the ELD are smallest and more numerous, with over 1,100 patches averaging only 150 acres each. The cFMP and HCP perform much better in this respect, with the cFMP having 231 patches averaging 770 acres, and the HCP having 255 patches averaging 1,100 acres.

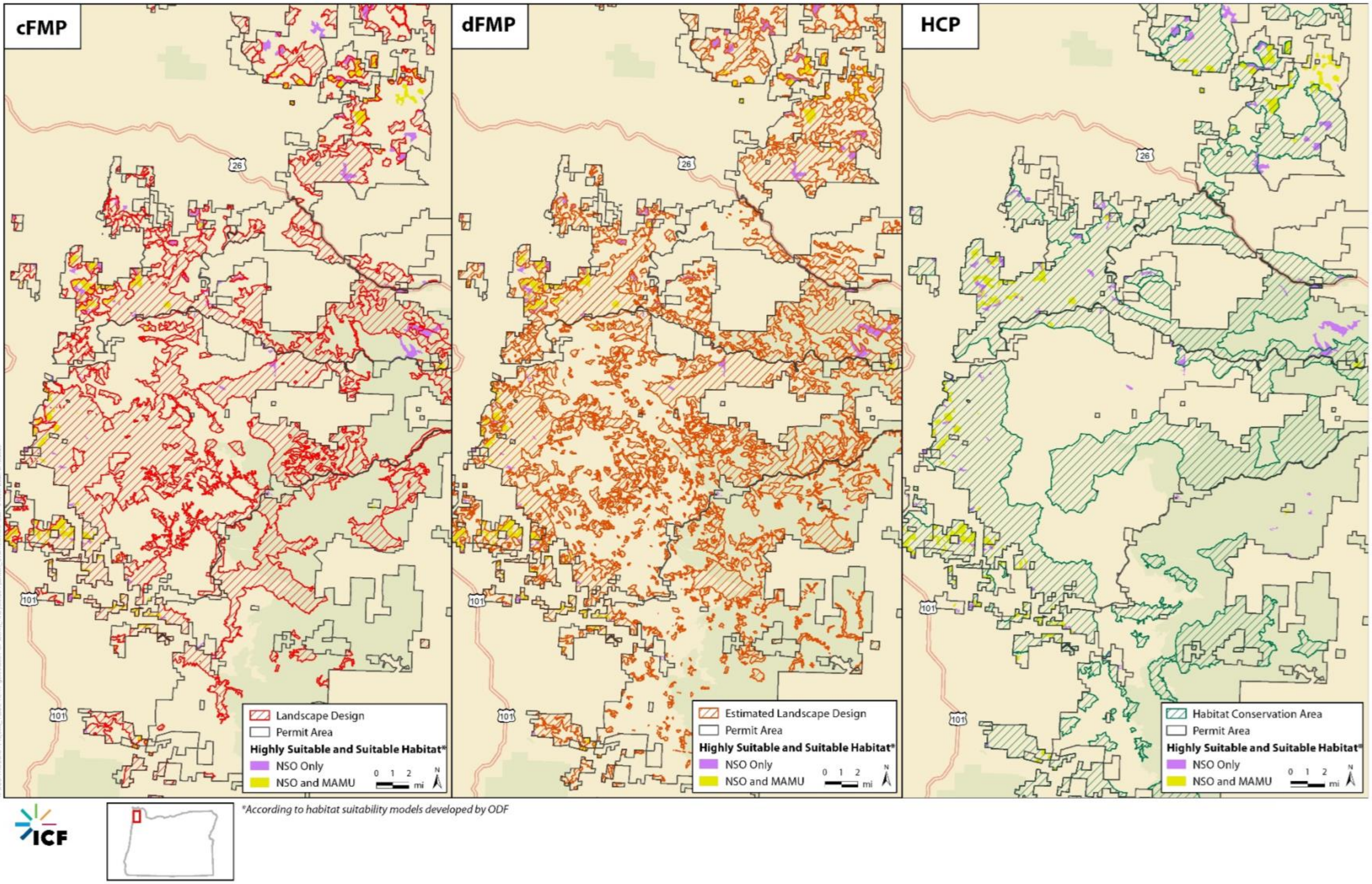
The ratio between perimeter to interior area is also the highest for the ELD, indicating a less interior habitat and greater susceptibility to edge effects, as opposed to the HCP which performs the best of the three scenarios (Figure 5-12). From a conservation perspective, the ELD could potentially result in a less functional landscape that would present both logistical management complexities and poor habitat configuration for species with large home ranges or poor dispersal abilities.

[21] The ELD is "estimated" based on constraints and inoperable areas at this point in the dFMP planning process and does not currently include landscape considerations in the design. It would be subject to change if the BOF directs ODF to continue development of the dFMP.

Table 5-9. Comparison of the Size and Configuration of Areas Designated for Conservation under the FMPs and HCP

Scenario	Number of Patches	Mean Distance between Patches (meters)	Mean Patch Size (acres)	Maximum Patch Size (acres)	Ratio of Perimeter to Area
cFMP	231	500 (± 1,300)	770 (± 3,200)	41,300	6.2
dFMP	1146	180 (± 620)	150 (± 1,200)	28,800	9.2
HCP	255	2,400 (± 6,200)	1,100 (± 4,300)	47,700	2.9

Figure 5-12. Comparison Between the Landscape Design (cFMP), Estimated Landscape Design (dFMP) and Habitat Conservation Areas (HCP) Using Northern Spotted Owl and Marbled Murrelet Modeled Habitat



5.5.3 Alignment with Existing Habitat and Species Occurrence

Figure 5-12 and Table 5-10 shows the level of alignment between areas designated for conservation and current suitable habitat across the permit area. Across the entire permit area, the ELD is best aligned with currently modeled habitat, encompassing all of the marbled murrelet habitat and 99 percent of the northern spotted owl habitat. In comparison, the HCP does not protect all of the existing habitat, but provides for targeted development of larger patches of interior habitat during the permit term.

Table 5-10. Alignment of Areas Designated for Conservation (LD, ELD and HCAs) Relative to Modeled Suitable Habitat for Northern Spotted Owl and Marbled Murrelet 2023 within the Permit Area

	Northern Spotted Owl			Marbled Murrelet		
	Highly Suitable	Suitable	Total	Highly Suitable	Suitable	Total
Acres	3,400	21,900	**25,200**	1,600	11,000	**12,700**
Amount protected by cFMP LD	3,100 (92%)	16,500 (75%)	**19,600 (78%)**	1,500 (91%)	9,200 (83%)	**10,600 (84%)**
Amount protected by dFMP ELD	3,400 (100%)	21,500 (99%)	**24,900 (99%)**	1,600 (100%)	11,000 (100%)	**12,700 (100%)**
Amount protected by HCP HCAs	3,300 (98%)	16,900 (77%)	**20,200 (80%)**	1,600 (100%)	10,000 (90%)	**11,600 (91%)**

The HCAs were also designed to include as many areas occupied by northern spotted owl and marbled murrelet as practical. Table 5-11 shows the level of alignment in the design of the LD, ELD and HCAs with occurrence data. The HCAs include a larger proportion of both the northern spotted owl survey response locations (31percent) and the locations with Significant and Presence marbled murrelet observations (40 percent). This will help to ensure protection of existing populations. Figure 5-13 and Figure 5-14 and illustrate the alignment of the LD, ELD, and HCAs with the northern spotted owl and marbled murrelet occurrence data. The large contiguous areas delineated by HCAs protect more of the occupied habitat

Table 5-11. Alignment of Areas Designated for Conservation (LD, ELD and HCAs) Relative to Species Occurrence Data for within the Permit Area

	Northern Spotted Owl	Marbled Murrelet
Total Response Locations	5,362	3,069
Proportion of locations protected by cFMP in LD	24%	29%
Proportion of locations protected by dFMP in ELD	23%	35%
Proportion of locations protected by HCP in HCAs	31%	40%

Note: Analysis limited to northern spotted owl and marbled murrelet habitat range, northern spotted owl call response locations, and Significant and Presence marbled murrelet occurrence status

Figure 5-13. Comparison of the Landscape Design (cFMP), Estimated Landscape Design (dFMP) and Habitat Conservation Areas (HCP) Using Northern Spotted Owl Occurrence Kernel Density

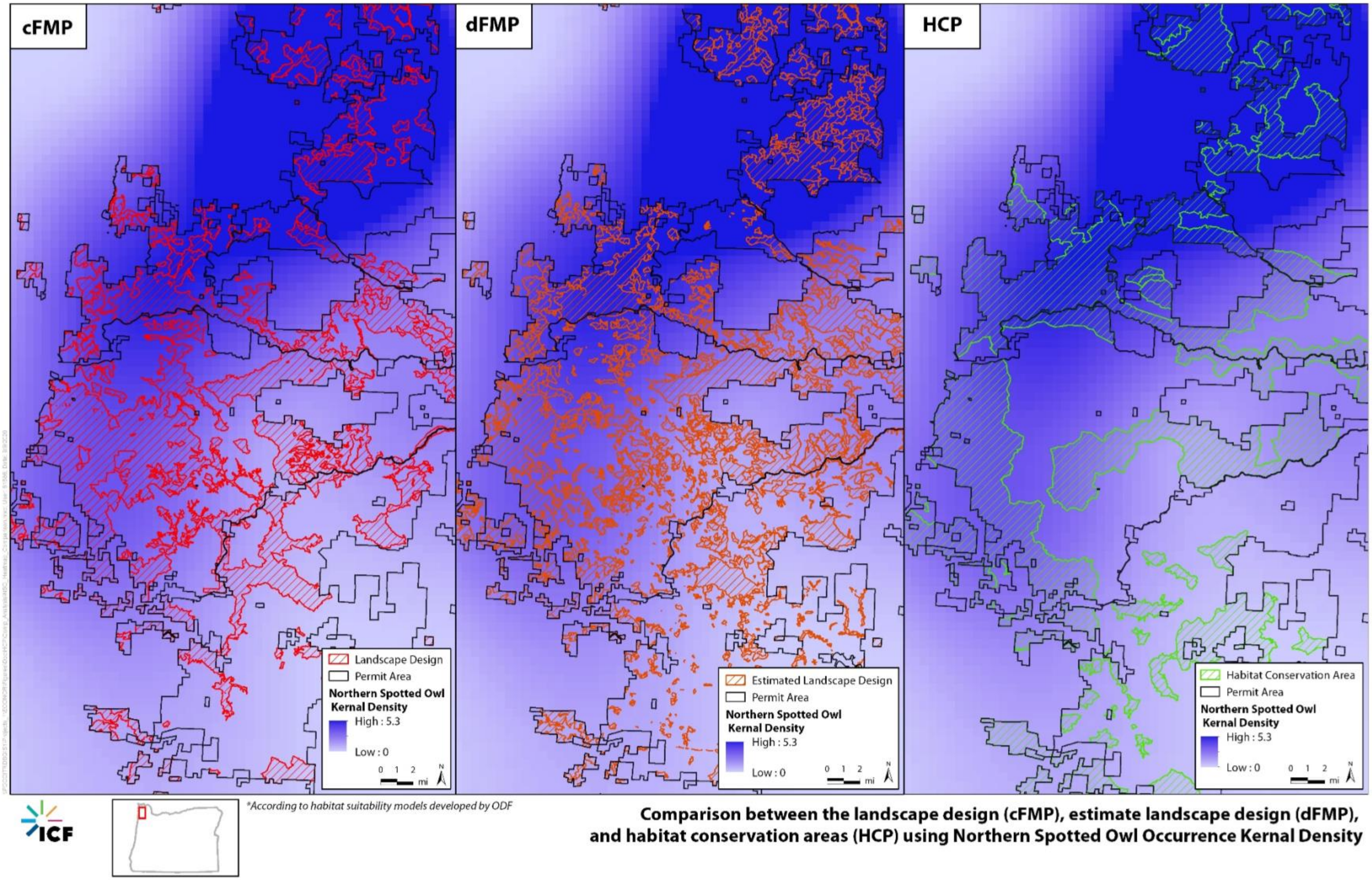
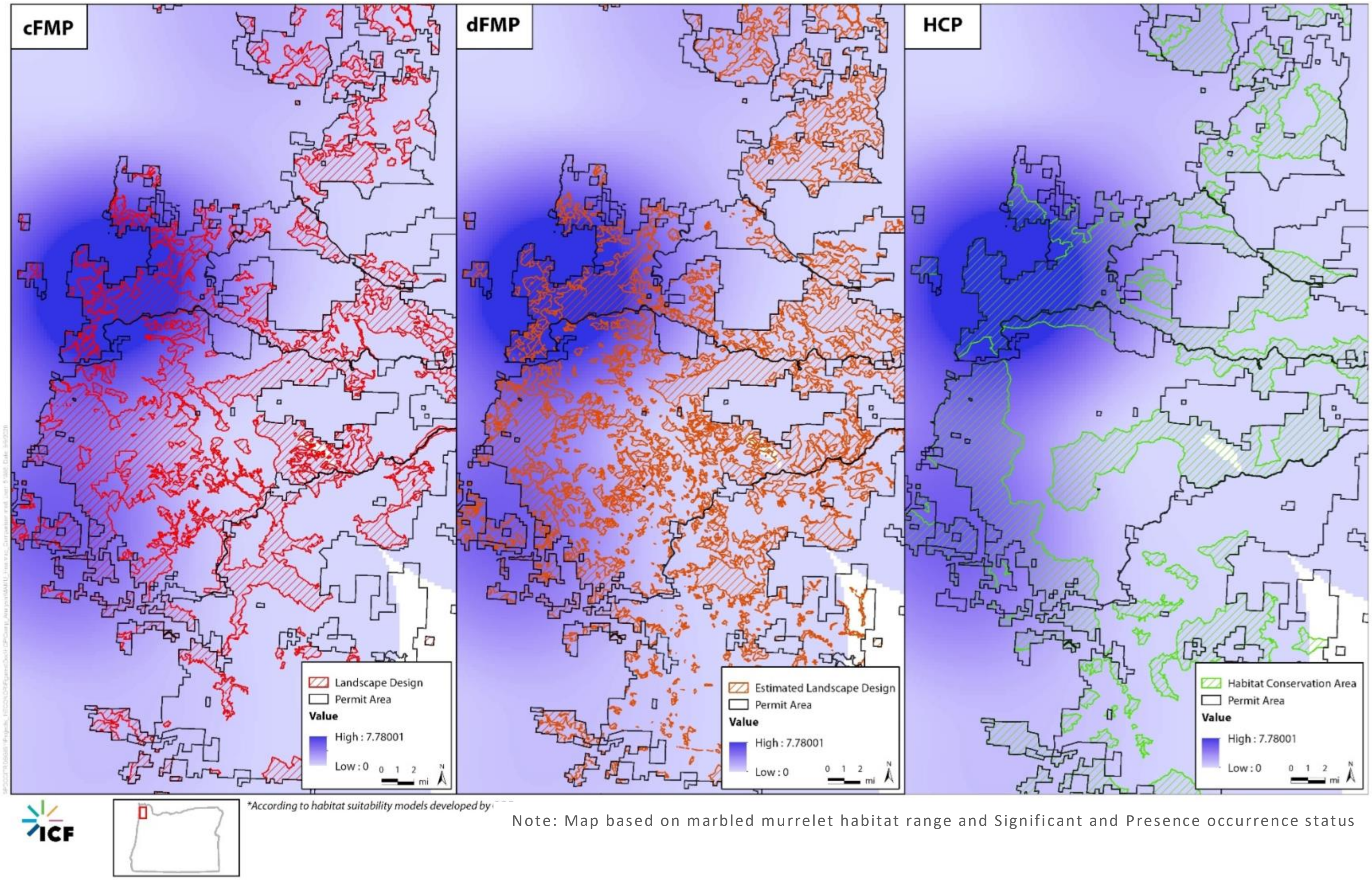


Figure 5-14. Comparison of the Landscape Design (cFMP), Estimated Landscape Design (dFMP) and Habitat Conservation Areas (HCP) Using Marbled Murrelet Occurrence Kernel Density



Note: Map based on marbled murrelet habitat range and Significant and Presence occurrence status

5.6 Conservation Outcomes Conclusion

The analysis and comparison of conservation outcomes associated with the cFMP, dFMP, and HCP has covered multiple attributes used describe the quantity and quality of habitat for covered and non-covered species within the permit area, projected over the next 75-years. The measure used to describe conservation outcomes include:

- Terrestrial Species - Quantity and Quality of Suitable Habitat
- Aquatic Species - Quantity and Quality of Habitat
- Monitoring and Adaptive Management
- Non-covered species habitat
- Habitat Configuration and Fragmentation

For measures associated with stand-level habitat suitability in the permit area as a whole, the cFMP is projected to produce better results than the HCP. When rolled-up together as shown in Table 5-12, the HCP would result in better conservation outcomes overall, with the cFMP ranked second. Moreover, and what is not shown in Table 5-12, is the level of certainty associated with projected outcomes. There is a high degree of uncertainty regarding the stability and overall conservation outcomes of the cFMP and dFMP. The uncertainty is higher for the dFMP, because the ELD would require refinement and would likely change if the decision is made to proceed with this scenario. The level of certainty associated with the conservation outcomes of the HCP is higher due to the following factors:

1. Once established, the HCAs would remain fixed for the 70-year permit term. The LD and ELD would be subject to change with planning cycles and policy changes.
2. HCAs are designed to include large contiguous areas that include current and future suitable habitat and areas known to be occupied by northern spotted owl and marbled murrelet. This design will reduce edge effect, wind-throw damage, and better protect existing populations.
3. Existing covered species populations will be further protected by implementation of actions such as barred owl management restriction on certain activities during nesting periods.
4. Improvements in habitat quality within HCAs would be accelerated with active management and the HCP contains specific commitments related to implementation of conservation measures developed to ensure biological goals and objectives are achieved. In addition, implementation of certain measures, such as thinning younger stands would increase the overall resilience of these areas to effects of changing climate and insect and disease pressure.
5. Covered and non-covered aquatic species would benefit from the increased protections offered by wider riparian buffers and implementation of restoration and enhancement actions.

6. The HCP will include a funding plan to cover all HCP implementation costs over the entire, 70-year permit term.
7. ODF will be required to monitor and track implementation and effectiveness of conservation actions in the HCP and report them annually to the USFWS and NOAA Fisheries to ensure compliance with the HCP and permits.

Table 5-12. Summary of the Relative Ranking of Conservation Outcomes for Each Metric Evaluated

Conservation Measure	Conservation Ranking		
	cFMP	dFMP	HCP
Terrestrial Species - Quantity and Quality of Suitable Habitat	3	1	2
Aquatic Species - Quantity and Quality of Habitat	1.5	1.5	3
Monitoring and Adaptive Management	1.5	1.5	3
Non-covered species habitat	1	2	3
Habitat Configuration and Fragmentation	2	1	3
Total Score	**9**	**7**	**14**

Highest Score = Best Relative Conservation Outcome

6 Timber Harvest and Net Revenue Outcomes

6.1 Harvest Volume, Prices and Costs

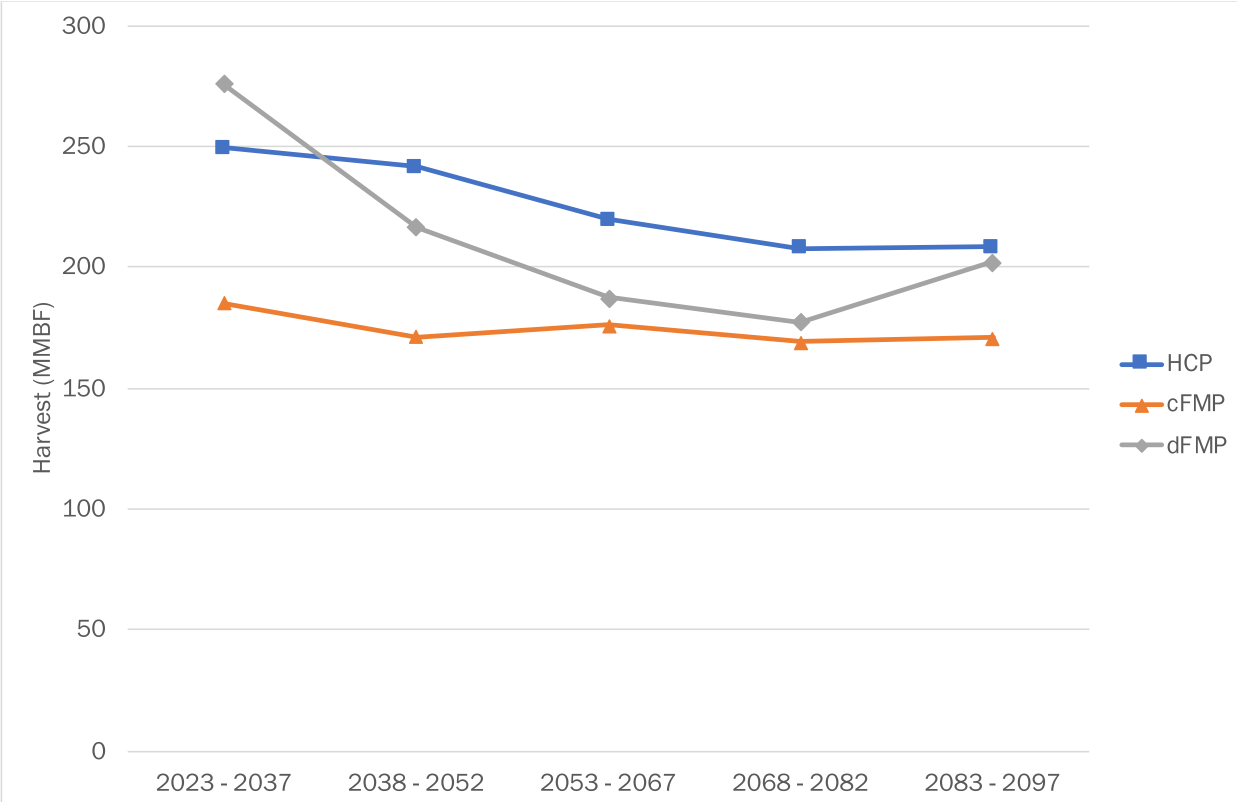
The three scenarios each involve distinct timber management and harvest approaches. The cFMP pursues Structure-Based Management to achieve specific landscape and forest structure conditions, and harvests are implemented to maintain non-declining even-flow of harvest volume. The dFMP and HCP are modeled for this analysis to involve departure from non-declining even-flow under the cFMP to achieve a balance across forest age classes and respect habitat constraints while pursuing the highest net value timber product harvest. The key difference is that the dFMP and HCP pursue net revenue maximization within a series of landscape scale constraints, while the cFMP pursues non-declining even-flow of harvest volume while coordinating harvests to achieve specific forest characteristics across all acres.

All three scenarios are modeled to maintain a certain degree of stability in harvests year-over-year. For this analysis, no time period harvest can be more than 10 percent greater than or less than the average for the overall modeling timeframe.[22] Furthermore within each of the three geographic regions, five-year model time periods cannot vary more than 5 percent more or less than the previous time period.

Harvest activity under the cFMP follows a schedule and trajectory consistent with the current FMP and associated Implementation Plans. These pursue specific landscape-scale characteristics for the forest. The HCP and dFMP are relaxed in this analysis in terms of departing from this long-term objective and associated flow constraints to pursue the most valuable harvests. Furthermore the HCA constraints limit the HCP harvests from the beginning of the timeframe, while the full set of regulatory constraints on harvest under the cFMP and dFMP do not take effect until after the first ten years of harvest. Consequently harvests during the first fifteen-year time period are the least constrained under the dFMP scenario. These consistency of constraints under the HCP versus increasing constraints under the dFMP are the primary driver for the relatively more stable year-over-year harvests under the HCP than under the dFMP.

[22] Note that the harvest modeling was conducted for a full 100 years, but only the first 75 years are used for this analysis.

Figure 6-1. Annual Harvest Volume by Scenario, 2023 to 2097



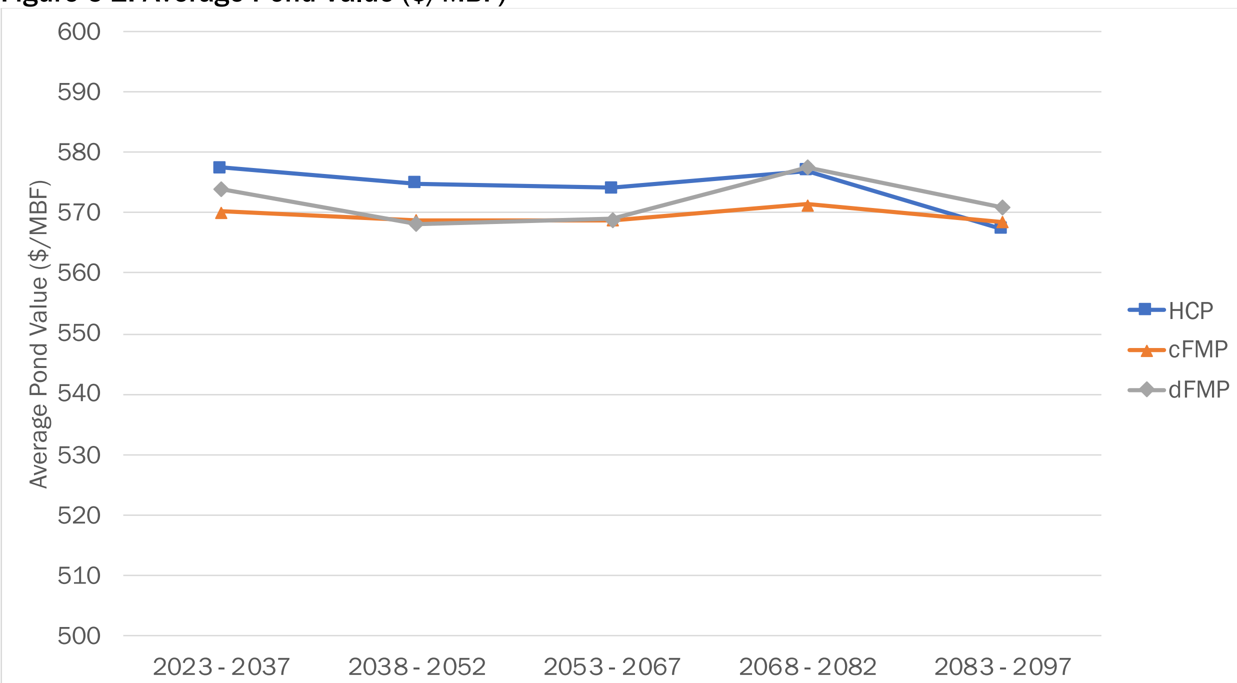
Note: Points represent 15-year averages.

Following from these methods and assumptions (further described earlier in *Chapter 3. Methods and Key Assumptions*), annual harvest volume is expected to be greatest under the HCP, with an average over the 75-year timeframe of 225 MMBF annually, compared to 175 MMBF for the cFMP and 212 for the dFMP. Under all scenarios, harvests are expected to initially decline at a gradual rate for several years and then level off over time (Figure 6-1). This decline is primarily due to increases in constraints on available acres (for harvest) due to HCAs under the HCP and expected expansion of areas constrained by currently and yet-to-be listed species. This derives directly from the various scenario-level constraints described earlier in *Chapter 5. Conservation Outcomes* of this report. Note that annual variability will cause actual harvest trends to vary more than the chart suggests, although the harvests are expected to be more consistent under an HCP than otherwise. In general, these volumes are expected to be highly uncertain over time under the cFMP and dFMP, and more predictable and manageable under an HCP. Note that harvest volume results are provided disaggregated to the regional and county scale in Appendix B. Harvest inventory data by scenario can also be found in Appendix B.

The forecast planning-level modeling of timber harvests under each scenario pursues the greatest net present value for harvest net revenue. Towards this end within the constraints imposed on each scenario (e.g., available acres, annual harvest volume, annual changes, in harvest, etc.) the model identifies the harvest strategy with the most efficient harvest schedule, which is pursuing high value harvest at low harvest cost. Variation in harvest value, driven by variation in the value of logs harvests, is minimal. However zooming in on the average value of harvest by scenario for each of the 15-year time periods, the HCP scenario reveals the highest value harvests of the three scenarios particularly during the initial time period, followed by the dFMP (Figure 6-2). This reflects the departure strategy to pursue the highest value logs, as opposed to the structure-based objectives pursued under the cFMP.

These price estimates reflect pond value, which is prior to any inclusion of harvest costs. These average pond values range across all three scenarios from a high of $578/MBF under the dFMP to a low of $567/MBF during the last time period under the HCP. Overall the average values are $574/MBF for the HCP, $572/MBF for the dFMP, and $570/MBFfor the cFMP.

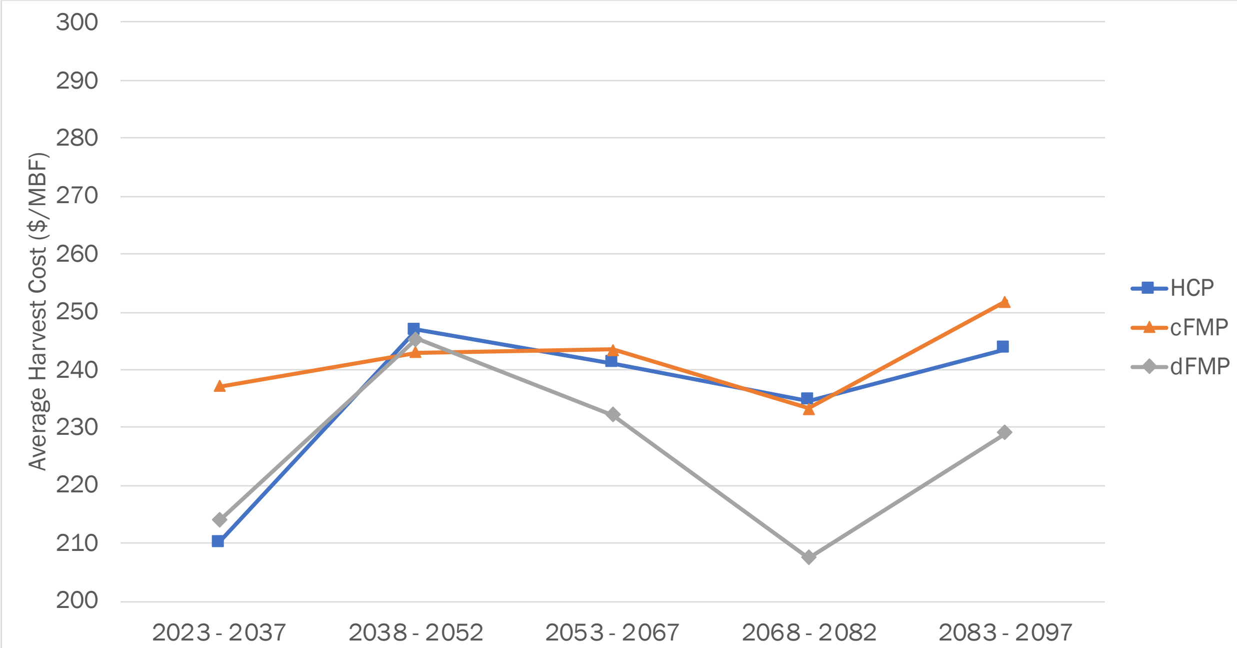
Figure 6-2. Average Pond Value ($/MBF)



Note: Vertical axis scale does not extend to zero and is zoomed in to reveal differences between scenarios. Actual fluctuations in prices are not as extreme as the chart might suggest without noting the vertical axis scale.

Similar to this price result of the distinction in harvest strategies for the HCP and dFMP relative to the cFMP, harvest costs per-unit are lower for the dFMP and HCP than the cFMP (Figure 6-3). Again the chart zooms in on the lines in order to show the relative variation, and it should be noted that the vertical axis does not go to zero, thus suggesting greater year-over-year variability than the data actually reflect. The highest unit harvest cost average for any 15-year time period in the analysis is $252/MBF under the cFMP, while the lowest is $210/MBF under the HCP. The averages over the full 75-year timeframe are $226/MBF for the dFMP, $235/MBF for the HCP, and $242/MBF for the cFMP.

Figure 6-3. Average Harvest Cost ($/MBF)

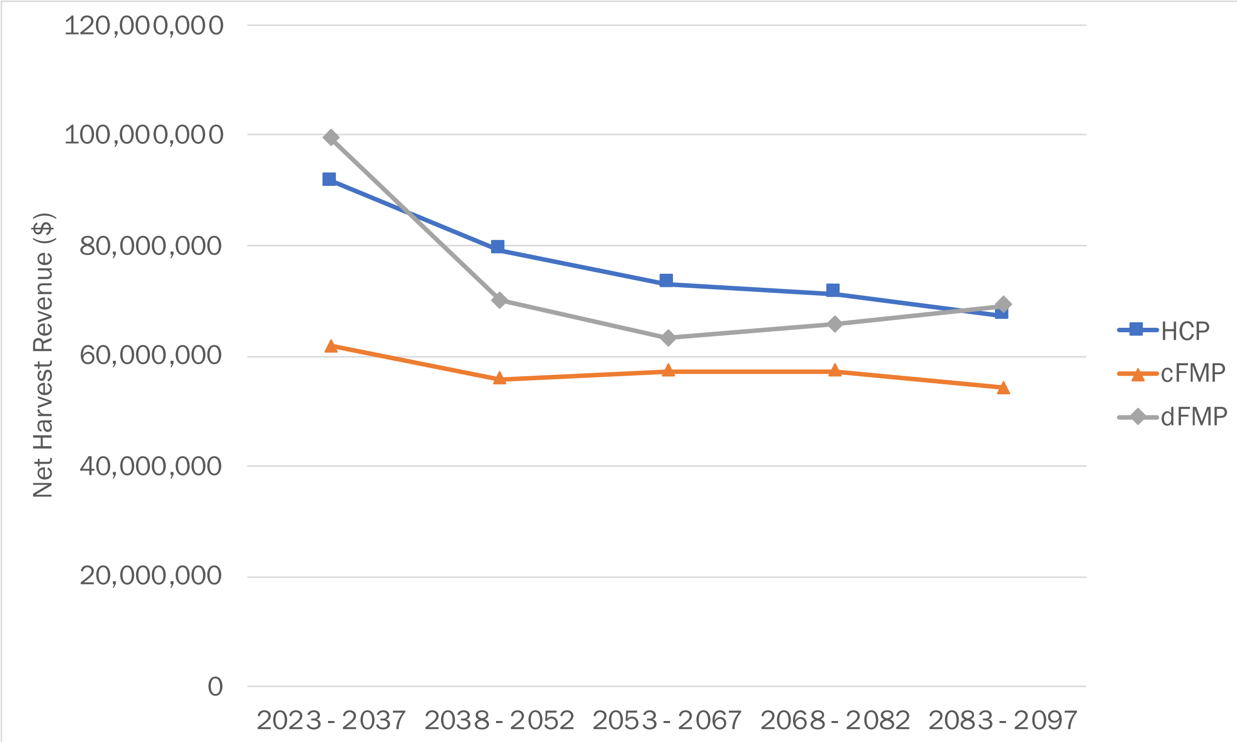


Note: Vertical axis scale does not extend to zero and is zoomed in to reveal differences between scenarios. Actual fluctuations in prices are not as extreme as the chart might suggest without noting the vertical axis scale.

6.2 Harvest Revenue

Taking the gross harvest revenue for each scenario and subtracting only the harvest costs provides the average annual estimates of harvest revenue. The volume, price, and harvest cost results above directly lead to similar ranking of net harvest revenue where the HCP and dFMP scenarios have higher revenue than the cFMP (Figure 6-4). Note that the values in the chart are 15-year averages. Total undiscounted harvest revenue over the 75-year timeframe is greatest for the HCP at $5.7 billion, $5.5 billion under the dFMP, and $4.3 billion under the cFMP. Note that disaggregated harvest revenue results are provided at the regional scale in Appendix B.

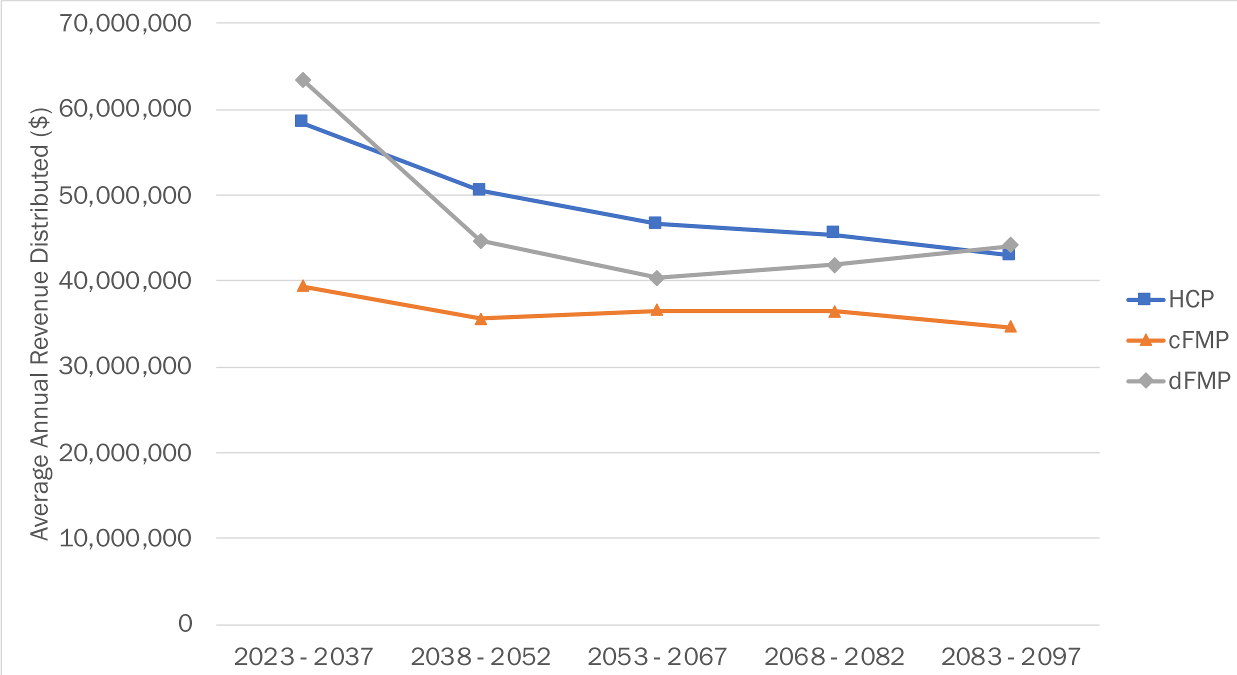
Figure 6-4. Harvest Revenue



Note: Points represent 15-year averages.

Each year 63.75 percent of annual harvest revenue is distributed to the counties. These distributions are greatest under the HCP, although during the initial period, they are greatest under the dFMP (Figure 6-5). This temporal difference is due to the fact that the full set of acreage constraints do not take effect in the analysis until the third 5-year modeling increment. So two-thirds of the initial time period involves greater available acreage for the dFMP than the HCP. Total undiscounted harvest revenue distributed over the 75 years is $3.7 billion under the HCP, $3.5 billion under the dFMP, and $2.7 billion under the cFMP. Again it is important to note that actual harvest revenue is highly sensitive to available acres for harvest. Consequently the substantially greater uncertainty regarding available acres in the future under the cFMP and dFMP means that there is less confidence in the specific values for these scenarios than under the HCP. Note that disaggregated revenue distribution estimates are provided at the county scale in Appendix B.

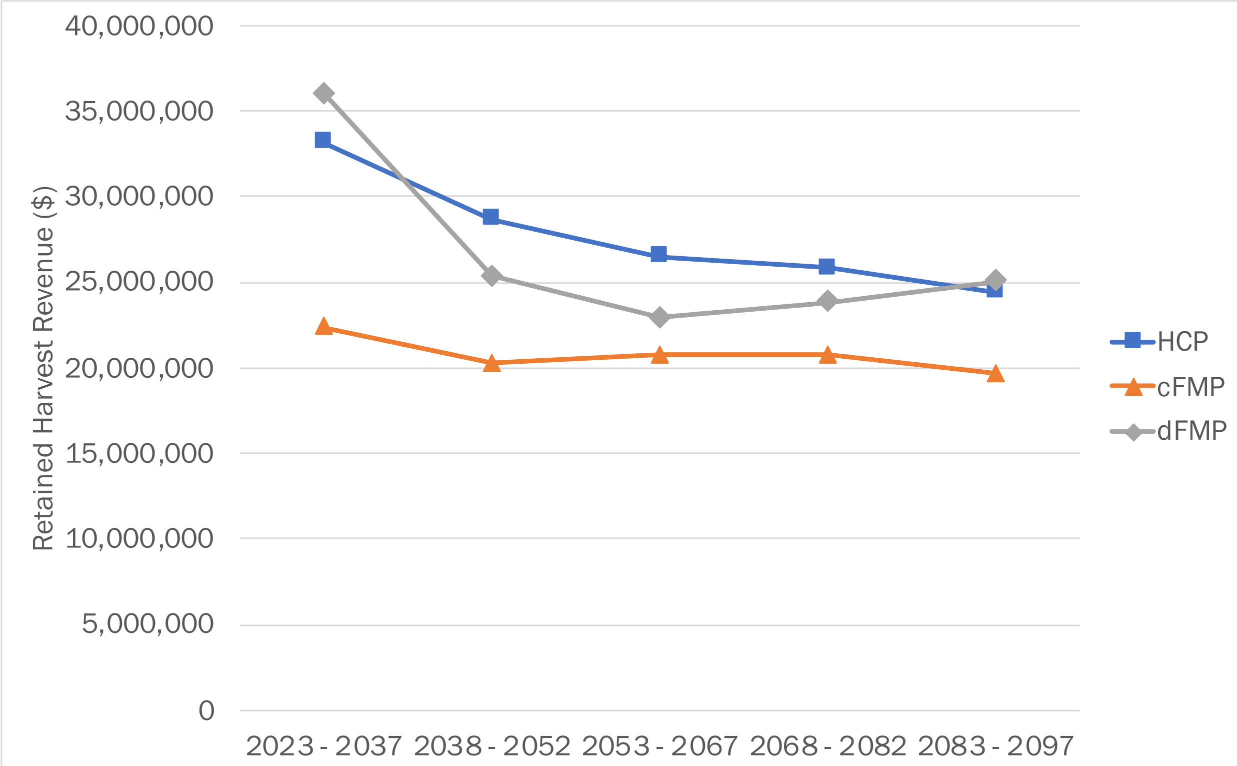
Figure 6-5. Annual Distributed Harvest Revenue



Note: Points represent 15-year averages.

After distributions, ODF retains 36.25 percent of harvest revenue, which reflects similar patterns over time to overall harvest revenue as well (Figure 6-6). Note that distributed revenue and retained harvest revenue (by ODF) sum to overall harvest revenue.

Figure 6-6. ODF Retained Harvest Revenue

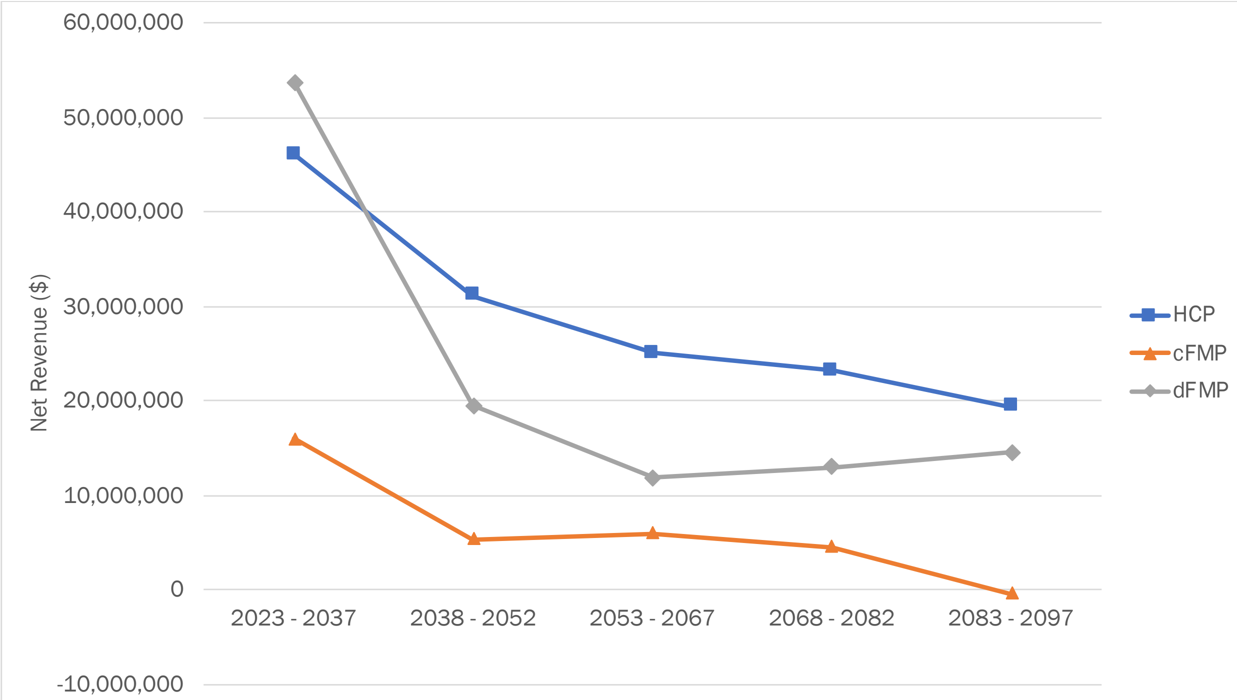


Note: Points represent 15-year averages.

Similar to harvest revenue and after accounting for all costs (lowest for the HCP scenario), net revenue is greatest under the HCP, followed by the dFMP and then the cFMP. Costs are described in more detail later in the Cost chapter. Net revenue in this case is gross timber revenue minus ODF costs, but does not include revenue distributions (county payments). Net revenue is a useful figure to consider the overall solvency of ODF's activities in terms of managing the forests with greater revenue than the costs required. Average annual net revenue (before revenue distributions) is expected to be $29 million under the HCP, $23 million under the dFMP, and $6 million under the cFMP. Over time, net revenue is expected to decline across all scenarios (Figure 6-7). These trends are due to the declining harvest volumes across all scenarios combined with increasing costs under the cFMP and dFMP. Average annual costs over the 75-year timeframe are lowest for the cFMP and highest for the dFMP, largely due to the corresponding levels of harvest (lowest for cFMP and highest for dFMP).

Summed over the 75-year timeframe of 2023 to 2097 and discounted at 3 percent, the net revenue before county payments based on these calculations is expected to be $1.1 billion for the HCP, $1.0 billion for the dFMP, and $297 million for the cFMP.

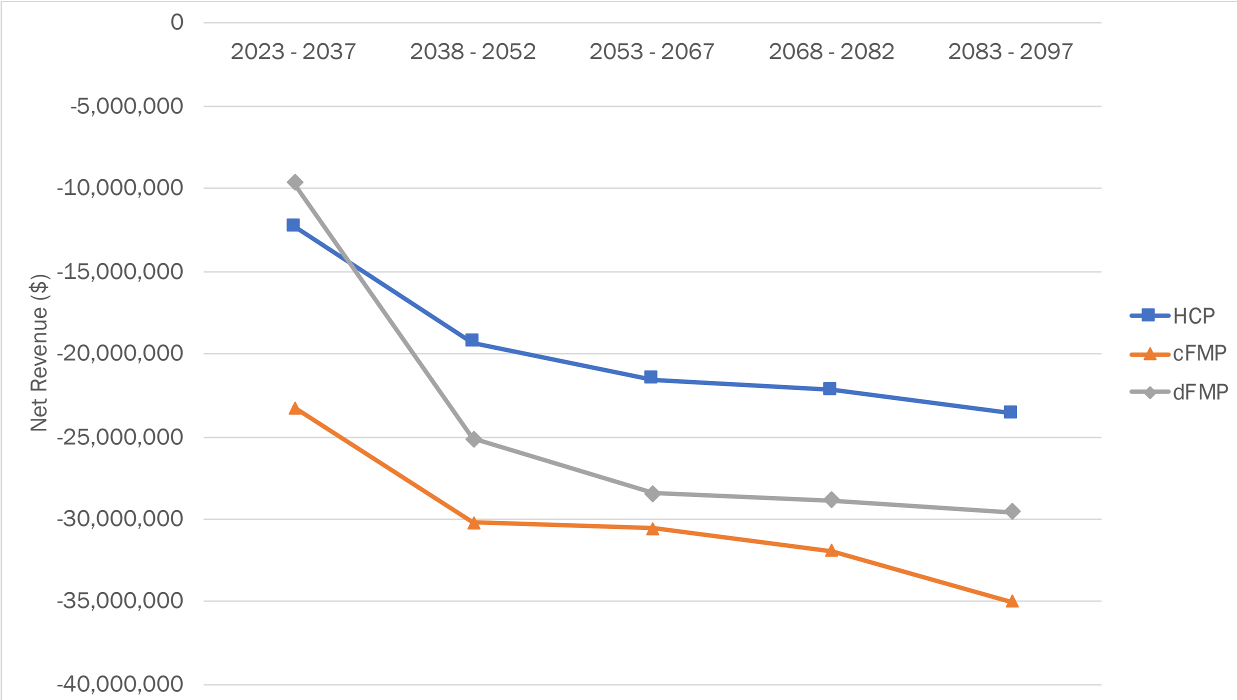
Figure 6-7. Annual Net Revenue (Harvest Revenue Minus ODF Costs) Across All Scenarios



Note: Points represent 15-year averages.

When including the harvest revenue distributions, net operating income to ODF after county payments is expected to be negative across all three scenarios (Figure 6-8). After revenue distributions, annual revenue retained by ODF is expected to be greatest under the HCP scenario, followed by the dFMP scenario. It is expected to be negative and declining across all three scenarios. In general, these net revenues are expected to be highly uncertain over time under the cFMP and dFMP, and much more predictable under an HCP.

Figure 6-8. Annual Net Operating Income for ODF after Revenue Distributions



Note: Points represent 15-year averages.

6.3 Summary Harvest and Revenue Totals

For the total values over the full 75-year timeframe of the analysis, financial results are most favorable for the HCP Scenario, followed by the dFMP with the cFMP least favorable (Table 6-1). Under all three scenarios, harvest revenue after all costs of ODF operations but before county payments are positive. After county payments however, net operating income to ODF is negative across all scenarios.

Table 6-1. Summary Harvest and Revenue Results by Scenario, 2023-2097 Totals

Scenario	Harvest Revenue	Non-Timber Costs	Net Revenue (without County Payments)	Net Operating Income (with County Payments)
Undiscounted				
HCP	$5,737,000,000	$3,565,000,000	$2,172,000,000	-$1,485,000,000
cFMP	$4,293,000,000	$3,821,000,000	$473,000,000	-$2,265,000,000
dFMP	$5,509,000,000	$3,821,000,000	$1,688,000,000	-$1,824,000,000
Discounted				
HCP	$2,505,000,000	$1,435,000,000	$1,070,000,000	-$527,000,000
cFMP	$1,798,000,000	$1,501,000,000	$297,000,000	-$849,000,000
dFMP	$2,475,000,000	$1,501,000,000	$974,000,000	-$604,000,000

7 Social Outcomes

7.1 Carbon Storage

7.1.1 Background

Since 2003, the Oregon Board of Forestry (BOF) has officially recognized climate change based on rising levels of carbon dioxide and other greenhouse gases in their strategic plan and recognized the important role that forests play in the carbon cycle by sequestering and storing carbon. The BOF identified enhancing carbon storage in forests among other strategic objectives to address this threat.

Oregon's *Roadmap to 2020* was developed by the Oregon Global Warming Commission (OGWC) to meet the state's emission reduction targets established in 2007. Key actions included establishing a carbon storage inventory and increasing the carbon storage within forest ecosystems. The BOF acknowledged that "sustainable forest management included stable or increasing rates of carbon sequestration and storage in Oregon forests and forest products as well as promoting the use of biomass to offset emissions from fossil fuels."[23]

The OGWC established a Forest Carbon Task Force subcommittee and a quantitative forest monitoring framework was developed in the *Oregon Forest Ecosystem Carbon Inventory: 2001-2016* report. This report provides calculations of the carbon storage and flux (the amount of carbon exchanged between carbon pools) in Oregon based on measurements from the Forest Inventory and Analysis Program (FIA) of the U.S. Forest Service within 9,483 forested plots in Oregon and compares the results with other major methods of carbon accounting.[24]

As shown in Table 7-1 the net average annual flux for forest land remaining forest land during the study time period is calculated directly from the *Oregon Forest Ecosystem Carbon Inventory* as 30.9 million metric tons carbon dioxide equivalent (MMT CO_2e) annually. This value is based on the pools of live vegetation accumulating carbon at a rate of 37.9 MMT CO_2e, pools of dead vegetation losing MMT CO_2e at a rate of about 7.3 MMT CO_2e annually, and the forest floor/soils gaining 0.4 MMT CO_2e annually. Using a Growth, Removals, and Mortality (GRM) approach, live carbon pools include trees, foliage, live roots and understory vegetation while dead vegetation includes standing dead trees, dead roots and down wood. Oregon's high annual tree growth rate results in the net accumulation of carbon in live trees specifically at approximately 30.1 MMT CO_2e annually. Aside from changes in forests that remain forests, land conversion from forest to non-forest (-2.5 MMT CO_2e) and from non-forest to forest (3.4 MMT CO_2e) on average annually combined to add a net of 0.9 MMT CO_2e, though this result was not

[23] Yost, A., Christensen, G., Gray, A., Kuegler, O., (2019). Oregon Forest Ecosystem Carbon Inventory: 2001-2016. Portland, OR: US Department of Agriculture, Forest Service, Pacific Northwest Research Station

[24] Yost, A., Christensen, G., Gray, A., Kuegler, O., (2019). Oregon Forest Ecosystem Carbon Inventory: 2001-2016. Portland, OR: US Department of Agriculture, Forest Service, Pacific Northwest Research Station

statistically significant. State and local government managed forests account for approximately 3.4 percent of total carbon flux on Oregon forested lands.

Overall, forested land in Oregon is calculated to be a pool of 3.2 billion metric tons of carbon including carbon in the forest floor and forest soils. State and locally owned forested land accounts for approximately 4.5 percent of the total forest carbon pool. Live trees account for approximately 32 percent of carbon sequestered overall and 34 percent of carbon sequestered on state and locally owned land. The Harvested Wood Product (HWP) carbon pools are not included in this report.

Table 7-1. Forest Land Carbon Stock and Flux by Ownership in Oregon, 2001–2016

	Carbon Stock (MMT CO_2e)		Carbon Flux (MMT CO_2e/year)			
Ownership	Aboveground Live Tree	Total	Gross Tree Growth	Harvest	Net Flux (Standing Live Tree)	Net Flux (All Categories)
State + Local	183	538	4,970	-3,105	876	1,063
All Ownerships	3,811	11,880	90,197	-34,782	30,074	30,914

Notes: Carbon Stock calculated for 2007-2016. Flux represents average annual carbon flux form 2001-2006 sampling period to 2011-2016 sampling period. Flux estimates exclude emissions from land-use changes and non-CO2 greenhouse gases.
Source: Table 4.13a and Table 4.3 from Yost, A., Christensen, G., Gray, A., Kuegler, O., (2019). Oregon Forest Ecosystem Carbon Inventory: 2001-2016. Portland, OR: US Department of Agriculture, Forest Service, Pacific Northwest Research Station

On a per acre basis, state and local government managed land had the highest rate of gross tree growth compared to other ownership types during the study time period as well as a relatively high rate of harvest removal as shown in Table 7-2.

Table 7-2. Annual Net Change Per Acre in Aboveground Live Tree Carbon Stocks on Forested Land in Oregon in Metric Tons CO_2e/acre/year (2007-2016)

	State and Local Gov.	All Ownerships
Gross tree growth	4.5	3.1
Removals - harvest	-2.8	-1.2
Mortality - fire killed	0.0	-0.2
Mortality - cut and fire	--	0.0
Mortality - insects and disease	0.0	-0.2
Mortality - natural/other	-0.8	-0.5
Net change (± 95% Confidence Interval)	**0.79 (1.52)**	**1.04 (0.20)**

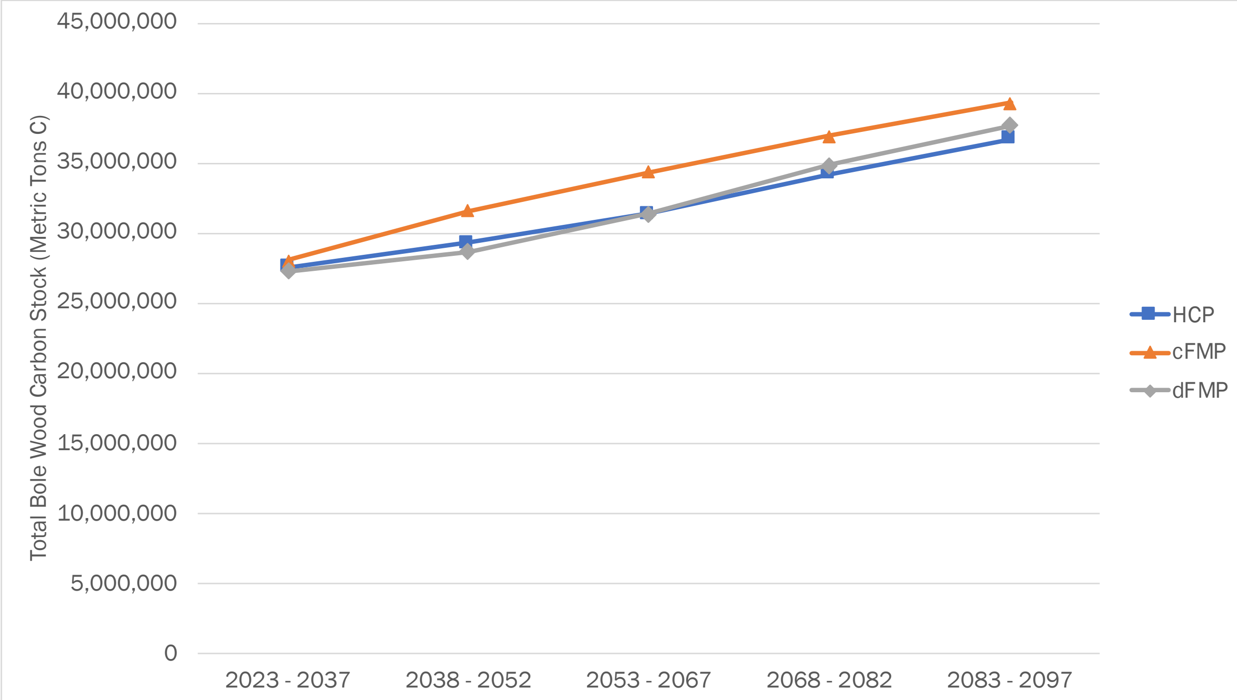
Source: Table 4.4 from Yost, A., Christensen, G., Gray, A., Kuegler, O., (2019). Oregon Forest Ecosystem Carbon Inventory: 2001-2016. Portland, OR: US Department of Agriculture, Forest Service, Pacific Northwest Research Station

7.1.2 Carbon Storage Estimation Methods for Comparative Analysis

For this analysis, the harvest model calculates the total carbon storage relevant to the comparative analysis based on bole wood (main trunk) over the projected time period and excludes other above ground and below ground carbon. Over time, the inventory will change based on growth and timber harvest as well as natural disturbance such as insect damage and wildfire. While carbon is not explicitly mentioned or addressed in the HCP, it would be addressed in a companion FMP.

7.2 Results by Scenario

Figure 7-1. Carbon Storage in Tree Bole Wood by Scenario, 2023-2097



For this analysis, the Harvest Model calculated the total volume of carbon in metric tons (1,000 kg or 1.1 US tons) in tree bole wood (main trunk) in the permit area for each time period by scenario. All 3 scenarios show increasing carbon storage volume over time, with slightly more net storage at the end of the timeframe under the cFMP (39.3 MMT CO_2e), and nearly identical storage under the dFMP and HCP (37.7 and 36.7 MMT CO_2e). This calculation does not include other above ground and below ground carbon volumes in the permit area, but can be considered net of harvest and other factors affecting total inventory (e.g. mortality).

7.3 Recreation

7.3.1 Recreational Use of ODF Lands

State forests in western Oregon have historically and continue to support a wide array of outdoor recreation activities. These recreational activities contribute to quality of life and public health for local communities, which in turn can attract residents and businesses. Some of the primary activities offered include:

- Hiking (trails)
- Biking (trails)
- Off-highway vehicle (OHV) trail use

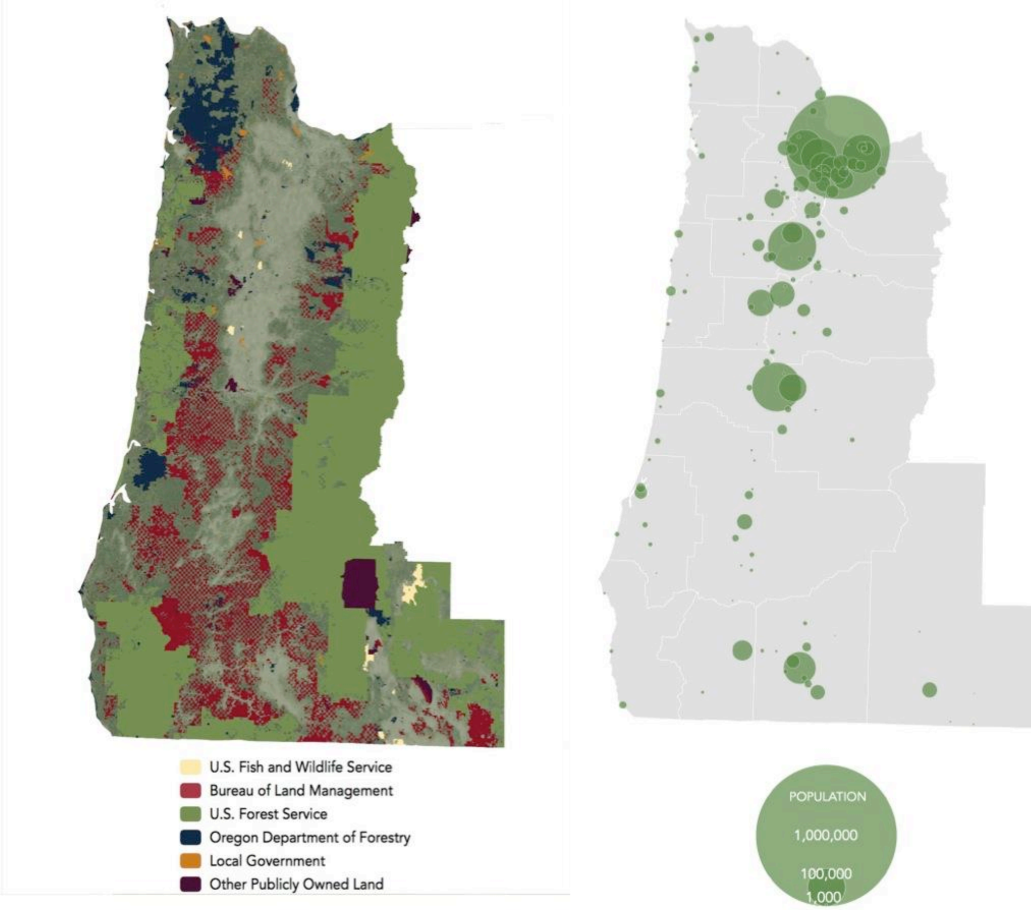
- Camping
- Hunting
- Fishing
- Target shooting
- Wildlife and bird watching

The state forests also support educational opportunities. In part educational opportunities are directly supported through the Tillamook Forest Center, a facility within the Tillamook State Forest that provides a forest-based learning center, outdoor classroom facilities, and educational exhibits on forest history, wildfire, sustainable forestry science, and forest-related art. Recreation contributes to the local economy through visitor spending and providing amenities that improve incentives for businesses and employees to move to or stay in the area. Outdoor recreation provides additional benefits in improved physical and mental health outcomes.

ODF manages outdoor recreation opportunities within a context of other local, state, and federal outdoor recreation facilities and accessible public lands and waters. Neighboring opportunities are offered by local government, Oregon State Parks, the U.S. Forest Service, and the Bureau of Land Management. State forests generally fill a niche of non-motorized and motorized trail use opportunities near population centers, as well as the range of other activities, particularly those relying upon little development required (e.g. hunting and fishing). Figure 7-2 shows that ODF has the highest concentration of public lands in the northwest corner of Oregon, which also corresponds to the highest concentration of people, generally associated with the greater Portland metropolitan area. Consequently, the demand on ODF-managed lands is generally highest in this region.

ODF is transitioning to management of outdoor recreation opportunities collectively across all state forests rather than the district level. This has led to establishment of the Recreation, Education and Interpretation (REI) Program with specific dedicated staff. The mission of the REI Program is "to create lasting and diverse outdoor recreational, interpretive and educational experiences that inspire visitors to enjoy, respect and connect with Oregon's state forests." REI capture the educational, historical aspects of the state forests, as communicated by the Tillamook Forest Center. The intention of REI is to improve the overall quality and value of recreational and educational opportunities provided by ODF-managed lands.

Figure 7-2. Land Ownership and Population Centers in Western Oregon



Sources: PSU Population Center 2012, U.S Census 2014
Note: The 'Other Publicly Owned Land' includes lands owned by the Army Corps of Engineers, Bureau of Reclamation, and National Oceanic and Atmospheric Administration, which tend to focus on water resources.

Regional Trends in Outdoor Recreation Demand

These outdoor recreation opportunities supported by BOF and CSFL lands in western Oregon are particularly valuable considering the increasing scarcity in this region with increasing population and population density. At the same time demand for such outdoor recreation activity is increasing as well. The U.S. Forest Service tracks demand nationally and regionally for outdoor recreation.[25] Some of the key national trends in demand relevant to BOF and CSFL lands are:

- **Overall outdoor recreation participation is growing**, generally faster than background population growth.
- **Nature-based activities termed "viewing and photographing nature" are growing faster than traditional forest activities.** Growth has occurred in both participation and

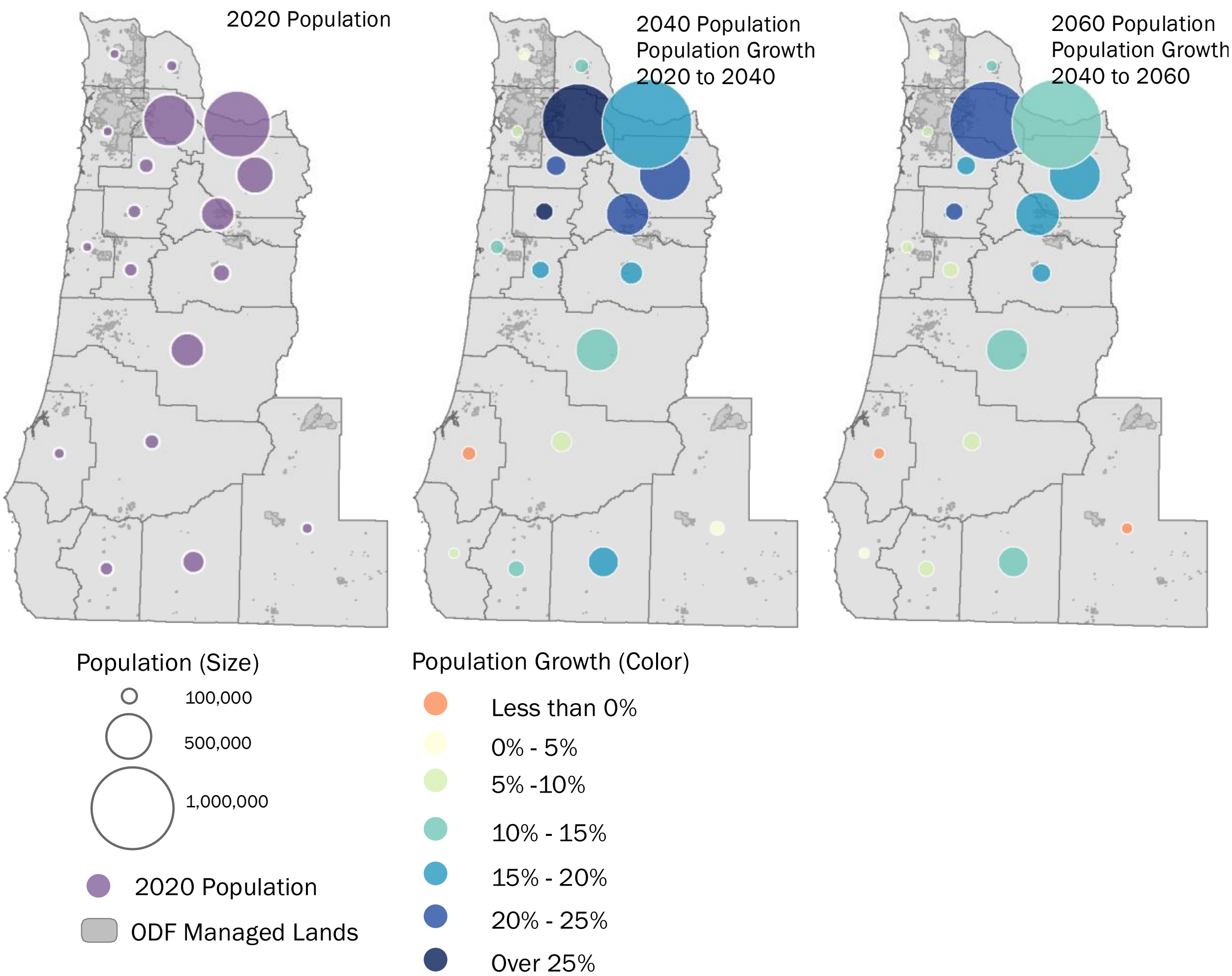
[25] Cordell, H.K. 2012. *Outdoor recreation trends and futures: a technical document supporting the Forest Service 2010 RPA Assessment*. Gen. Tech. Rep. SRS-150. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station.

annual days for nature-based viewing activities such as viewing birds, wildlife, fish, wildflowers/trees, and nature scenery.

- **Different cultural and ethnic groups have different preferences for outdoor recreation.** Studies suggest that preferences are not uniform across communities, and minority groups can have distinct demands.
- Primary motivations for with outdoor recreation include: **being outdoors, experiencing nature, getting away from the demands of everyday life, being with family, and contributing to health, physical exercise, and/or training.**

Projected population growth in Oregon is expected to be highest in the Willamette Valley, with Washington and Polk Counties expected to have the highest growth rates between 2020 and 2040 as shown in Figure 7-3. After 2040, growth rates are projected to slow across the state.

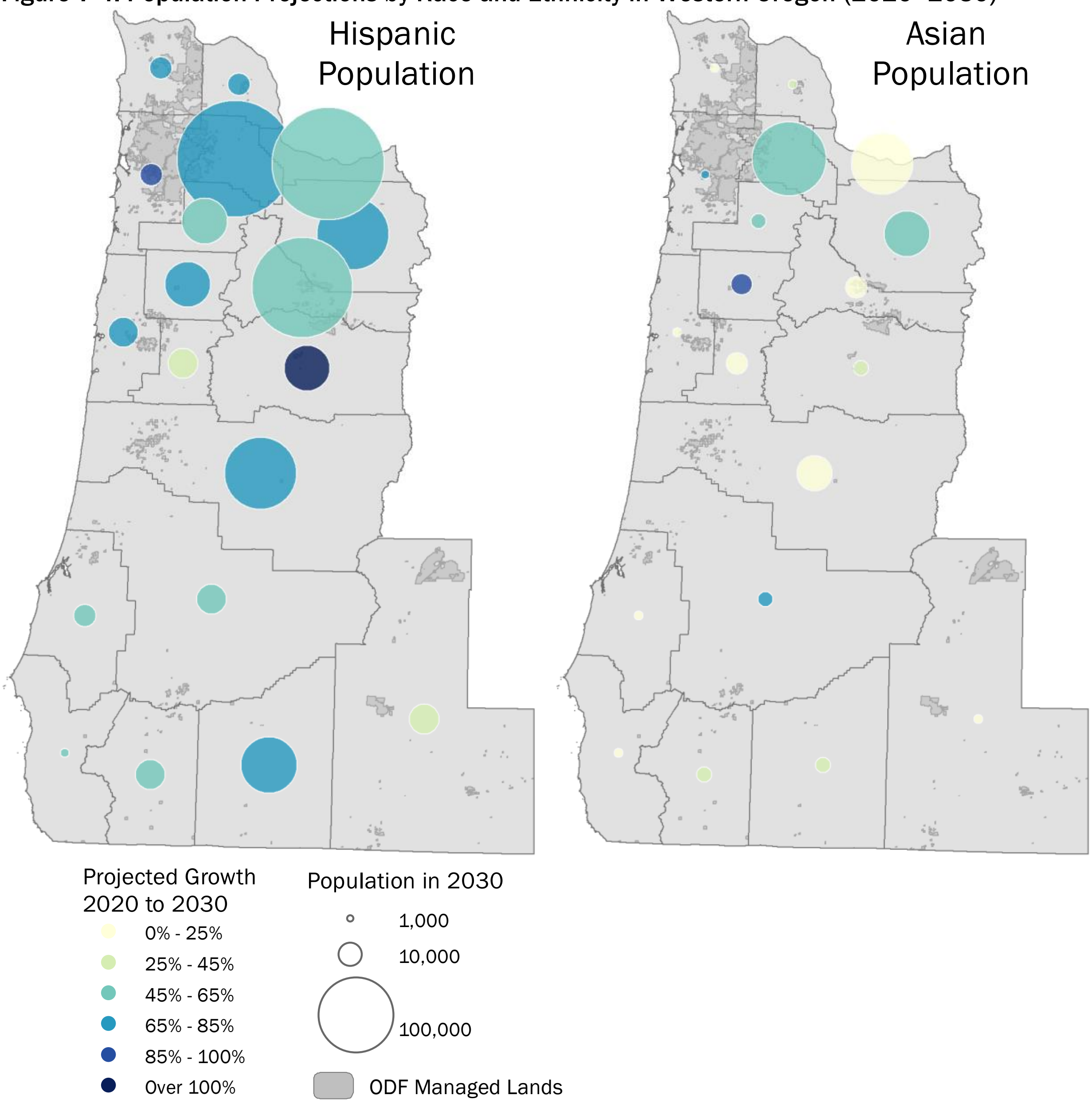
Figure 7-3. Population Projections in Western Oregon (2020–2060)



Sources: PSU Population Center 2020
Note: Projections are from 2017, 2018, 2019 and 2020 by county. Details of projection schedules available at https://www.pdx.edu/prc/current-documents-and-presentations

The Oregon Parks and Recreation Department (OPRD) has put a particular focus on understanding the needs of historically-underserved groups in its latest statewide assessment of outdoor recreation needs. Hispanic and Asian populations are projected to experience higher levels of population growth than the population as a whole. Growth is highest in Linn County for Hispanic populations and Polk County for Asian populations as seen in Figure 7-4. Black and Native American populations in Oregon have faced persistent barriers and exclusion from participation in outdoor recreation activities. SCORP data does not provide recreation estimates or population projections for these populations however improved access and service for these populations continues to increase in importance as Oregon's population becomes more diverse.

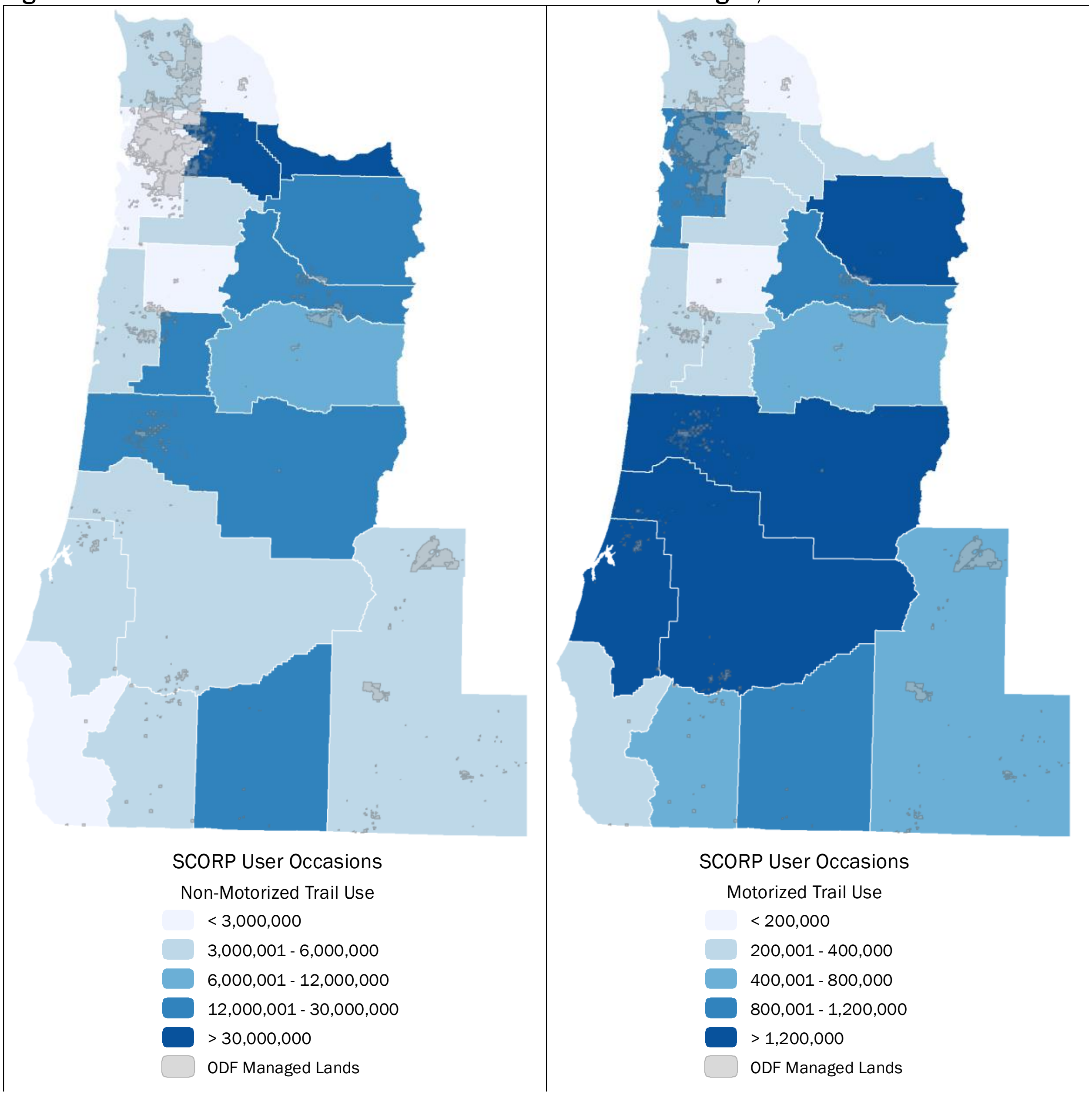
Figure 7-4. Population Projections by Race and Ethnicity in Western Oregon (2020–2030)



Sources: PSU Population Research Center 2019: Oregon Demographic and Social Trends Analysis For Oregon Parks and Recreation Department

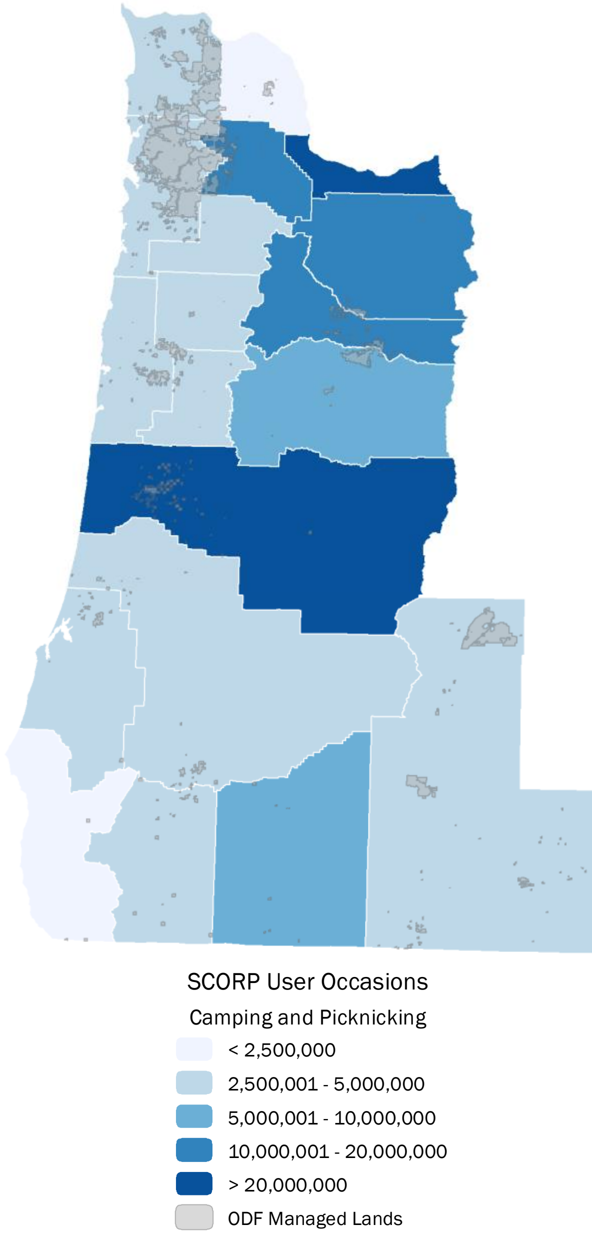
OPRD regularly conducts a survey of state resident outdoor recreation participation, demands, and needs as part of the Statewide Comprehensive Outdoor Recreation Plan (SCORP). For the 2013-2018 SCORP, county-level demand was assessed in terms of estimating per-capita participation by activity and average annual trips by participant. This was calculated both in terms of the county where the recreation occurred, as well as the county where the participant resided. Figure 7-5 shows the location of non-motorized and motorized trail use occasions in western Oregon. Figure 7-6 shows the camping and picnicking as well as the hunting and fishing activity in Western Oregon.

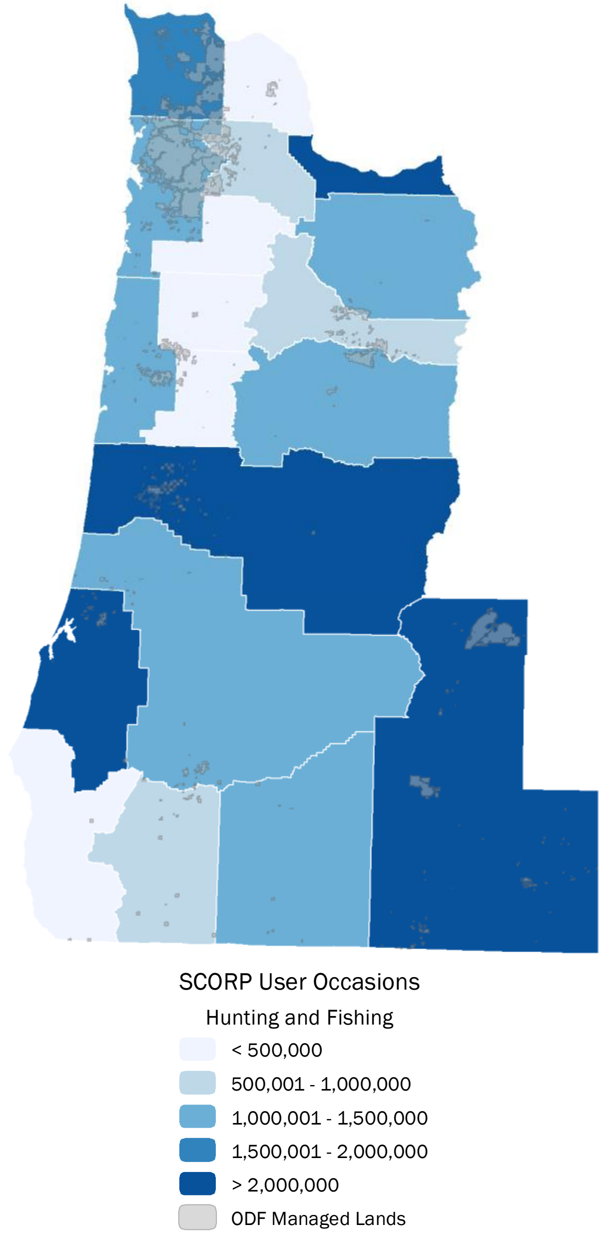
Figure 7-5. Non-Motorized and Motorized Trail Use in Western Oregon, 2013



Source: OPRD 2013-2018 SCORP Survey, ODF

Figure 7-6. Camping and Picnicking, Hunting and Fishing in Western Oregon, 2013





Source: OPRD 2013-2018 SCORP Survey, ODF

The most recent OPRD SCORP (2019-2023) provides the most current, forward-looking assessment of outdoor recreation demands and needs in Oregon. However, it does not provide the same geographic, county-level, specificity as the 2013-2018 SCORP.[26] The 2019-2023 SCORP

[26] Oregon Parks and Recreation Department. 2018. *Outdoor Recreation in Oregon: Responding to Demographic and Societal Change*. Accessed at https://www.oregon.gov/oprd/PRP/Documents/SCORP-2019-2023-Final.pdf

focuses more generally across all Oregonians, but recognizes demographic distinctions among the population, with a focus on emerging needs associated with:

> *"1. An aging population;*
>
> *2. An increasingly diverse population;*
>
> *3. Lack of youth engagement in outdoor recreation;*
>
> *4. An underserved low-income population; and*
>
> *5. The health benefits of physical activity."* (pg. 5)

Priority counties and Urban Growth Boundaries (UGBs) were identified for each trend above based on local growth.[27] Within the western Oregon Counties, OPRD considers youth populations and Asian populations to be high priority in Clackamas, Multnomah, and Washington Counties. Hispanic population growth included Clackamas, Lane, Marion, Multnomah and Washington Counties. Aging populations were more dispersed with this demographic identified as high priority in 11 of the 19 counties in western Oregon.

Overall, 83.2 percent of SCORP survey respondents had visited a state park, forest or game lands in the last 12 months and with 18.7 percent of recreation activities taking place there. Within Oregon's Latino population, state parks, forests or game lands accounted for 20 percent of recreation activities and 19 percent for Asian populations. The 2019-2023 survey identified the high importance of outdoor recreation to Oregonians across all groups, with 95 percent of Oregonians participating. The most important outdoor recreation opportunities identified were close-to-home walking and hiking, including dog walking on trails.

The recreation participants demonstrated differences in the types of recreation activities, infrastructure, and future priorities within each demographic area identified with emerging needs. Priority areas for future investment for the general statewide population included community trail systems and restrooms close to home, and RV/trailer campgrounds and facilities in dispersed areas, as well as more drive-in tent sites. Latino respondents placed a higher priority on improving children's playgrounds and play areas and larger gathering areas. Older populations placed a high priority on close to home parks and reported higher percentages of themselves or someone in their household having a disability, which increased the importance of accessible recreation activities.

[27] Population Research Center, Portland State University. 2019. *Oregon Demographic and Social Trends Analysis For Oregon Parks and Recreation Department*. Accessed at https://www.oregon.gov/oprd/PRP/Documents/SCORP-2018-Demographic-Social-Trends.pdf

Those who did not participant in recreation activities ranked fishing, hiking, and camping as the activities they would most like to participate in and identified improving accessibility, reducing fees, improving availability, and increasing advertising as factors that would most help them participate in outdoor recreation in the future.

7.4 Recreation Impacts of the Scenarios

ODF staff do not expect substantial changes in recreation management across scenarios in terms of the types of access or development investments. Under all scenarios including the HCP, state forests will generally remain open to the public. The intention is that recreation investments will continue to grow based on partnerships, OHV fuel tax revenue, donors, and direct investments by the state. Dispersed camping is expected to increase across all districts. The Tillamook and Forest Grove districts are expected to experience the greatest increase in demand, particularly for non-motorized trails and facilities for motorized and non-motorized activities including camping.

In general, ODF staff expect no major differences between scenarios in the level and value of outdoor recreation activity over the planning timeframe. Demand is expected to grow faster than investments and offerings however, so there will likely be increasing scarcity of outdoor recreation resources on state forests. Therefore, if any scenario does provide more net revenue stability, as is expected with an HCP, it would likely contribute to the potential for investment in resources to keep pace with recreation demand. The long-term predictability and opportunity for long-range resource planning with an HCP could also contribute to improved opportunities to make new investments in outdoor recreation on state forests. Previously, interviews with recreation group representatives for the BCA suggested that timber harvests were not a major disruption to the primary recreation activities on state forests. Therefore, any variation in timber harvest activity across scenarios would not be expected to have a substantial impact. These interviewees did identify the greatest negative impacts involve conflicts between user groups. This feedback would suggest that increasing scarcity of resources (e.g. facilities, trails) could lead to increased conflict. Accordingly, any opportunities to keep supply at pace with demand would be a mitigating benefit.

7.5 Cultural Effects

7.5.1 Cultural Benefits from Lands Currently Managed by ODF

ODF acknowledges that the lands managed by the state include traditional lands of indigenous people, including members of Native American tribes including the Confederated Tribes of Grand Ronde (including the Kalapuya, Takelma, Nehalem, Salmon River, Nestucca, Shasta, Cow Creek-Umpqua, Yoncalla, Yamhill, Tillamook, and Atfalati peoples), the Confederated Tribes of Siletz Indians (including the Siletz, Nehalem, Tillamook, Salmon River, Nestucca, Alsea, and Chinook peoples), the confederated tribes of the Warm Springs (including the Warm Springs, Wasco, and Paiute peoples), the Chinook Nation and the Cowlitz Nation in Washington State, and the Nez Perce Tribe in Idaho. ODF seeks to honor this relationship by working with tribes so that they may continue to be connected to and benefit from their traditional territories.

Lands currently managed by ODF provide important cultural and historic resources and benefits to Native American tribe members and others in Oregon and beyond. These benefits are not easily quantifiable but are nonetheless a key factor in the overall value of state forests in western Oregon. These benefits include access to non-timber forest products, health benefits, historic preservation, learning and teaching opportunities, as well as access to cultural resources and traditional practices. Forest management practices have the potential to improve and protect these benefits. Forest lands hold particular significance to the tribal nations who have lived on, tended to and engaged with the land in this region since time immemorial. ODF is committed to working with the nine federally recognized sovereign Tribes of Oregon and the Nez Perce Tribe in Idaho.

Traditional monetary means of measuring value are frequently seen by tribes as inappropriate for describing the value tribes gain from access to these lands. Tribal lands are not only used for resources, but also maintain a culturally and historically important element that cannot be substituted by an alternate site or by compensation. Tribes that have since moved to different areas may still consider a certain region culturally significant and use the space as a link between past and future generations. As a result, it can be difficult to quantify the importance of lands to tribes, as well as how this value may differ across the scenarios.

Non-timber forest products are a particularly tangible contribution of state forests. They include foraged berries and mushrooms, seeds, nuts, and floral greens as well as secondary wood products used for firewood, woodworking, or other creative uses. Besides supporting the continuation of traditional cultural activities, they can provide additional income or increase household resources. Exposure to nature can also have mental and physical health benefits, especially for learning and development in children. Historcial and archeological sites preserve Oregon's past for future generations.

The cultural significance of lands currently managed by ODF to tribes includes deep connections to many aspects of the land, species, and ecosystems. Forest materials are used for basketry, regalia, houses, and canoes. The land can also include burial sites, shell middens, historic structures, ancestral, and sacred sites, as well as sites used in cultural ceremonies and celebrations. Culturally significant species include redwood, redcedar, willow, camas, tule, huckleberry, beargrass, and many others including first foods.[28] Non-tribal residents of western Oregon also take advantage of non-timber forest products and access for cultural activities.

Under the three different scenarios considered in this report, resources available from state forests are likely to remain relatively similar as will access to the cultural benefits the forest

[28] Long, J., Lake, F. K., Lynn, K., & Viles, C. (2018). *Tribal ecocultural resources and engagement.* General Technical Report PNW-GTR-966. Accessed at https://www.fs.fed.us/pnw/pubs/pnw_gtr966_chapter11.pdf

provides. To the extent that certainty of access is increased under an HCP, access to non-timber forest products will be more consistent. However, there is no current evidence of a difference in access across scenarios. Many species that are managed under an HCP also have cultural significance, particularly for tribal nations in Oregon. To the extent that an HCP benefits these species, there will be added cultural benefits as well.

8 Costs

This section summarizes all financial costs borne by ODF under each scenario, other than the direct timber harvest costs discussed previously in the timber harvest section. The cost categories are similar to those provided in the 2018 BCA. Similarly, many of the assumptions regarding costs moving forward are the same as those applied in the 2018 BCA, with review and updating where appropriate. These cost estimates provided a basis for understanding differences in costs ODF should expect across the three scenarios, as well as providing a basis for estimating net operating income to ODF after timber revenue and timber payments.

8.1 ESA Administration Costs

8.1.1 cFMP and dFMP ESA Administration Costs

Administrative costs associated with ESA compliance have steadily increased in recent years. This includes staff time for administration of compliance activities such as coordination with state and federal wildlife agencies, and coordination with each district on management plans and individual harvest plans. It also includes species survey and monitoring costs, adaptive management costs, and costs of remedial measures for changed circumstances. Continuing the take avoidance strategy under the cFMP and dFMP is expected to result in increasing costs over time due to shifting and expanding ranges of listed species as well as new species listings. Furthermore, regulations protecting these listed species are expected, on average, to become more restrictive, requiring more time to adjust management and harvest activities.

Based on current data and recent trends in ODF staff costs for ESA administration, estimates for the amount of time ODF staff currently spend on the administration of ESA compliance are currently nearly $900,000 annually, and this is expected to increase 2.8 percent annually.[29] This trend results in $232 million in total ODF staff costs for ESA administration over 75 years (2023-2097, or discounted at 3 percent, a present value sum of $62 million (Table 8-1). These costs exclude the time spent to plan, oversee, implement, and analyze monitoring surveys and data.

Table 8-1. ODF Staff Costs for ESA Compliance (cFMP and dFMP)

ODF Staff	FTE	Initial Annual Salary + OPE per FTE [1]	Average Annual Cost Today	Assumed Annual Average Increase[2]	Total Cost Over 75 Years Undiscounted[3]	Total Cost Over 75 Years Discounted[3]
ESA Admin Staff	6.6	$137,217	$3,165,000	2.8%	$237,346,000	$61,132,000

Notes:
[1] OPE = other payroll expenses as of FY2021
[2] Due to increasing numbers of listed species, expanding species ranges, and increasing regulatory constraints for each species, based on

[29] See 2018 Business Case Analysis for more detail on underlying assumptions for the 2.8 percent annual increase in ESA administration costs.

historical and anticipated trends.
[3] Costs in 2020 dollars. Includes assumed increase in staff time. Discounted values at 3 percent annual.

8.1.2 HCP-Related ODF Staff Costs

With an HCP, staff at ODF would still need to spend time overseeing ESA compliance. However, staff time would shift from overseeing their current ESA compliance process of implementing take-avoidance strategies, to administering the HCP. HCP administration would include ensuring compliance with the incidental take permits, data tracking, and preparing annual compliance reports for the Services. ODF staff time would still involve staff at headquarters, coordination with state and federal wildlife agencies, and coordination with each district on management plans and individual harvest plans, but much more of the time with an HCP would be concentrated in headquarters, relieving district biologists from their current and substantial duties of ESA take avoidance.

It is assumed that staff time with an HCP would be constant over the permit term because of the "No Surprises" assurances and certainty the HCP provides. Initially there may be an increase in responsibility as the HCP is implemented and new compliance procedures are established, but over time ODF staff would develop efficient approaches to HCP compliance, possibly even reducing staff effort over time. With an HCP, annual staff costs would become much more predictable because staffing needs would not be subject to annual changes in species distribution or new species listings to demonstrate take avoidance. Changes in species distribution and new species listings would be anticipated with an incidental take permit, and HCP implementation would continue as planned regardless of these changes.

With an HCP there would be an initial increase in staff time related to habitat management and monitoring, but a decrease in time surveying for species ahead of harvest. On average though the annual staff costs of ESA administration would be 4.8 FTE with an annual total staffing cost of $432,000 (Table 8-2). Note that these costs are included in the total species management costs described later, and are not additive to the HCP total costs under Species Management.

Table 8-2. Ongoing Annual ODF Staff Costs for all HCP Maintenance Activities (HCP Scenario)

ODF Staff	FTE	Annual Salary + OPE per FTE [1] (FY 2019)	Average Annual Cost Today	Assumed Annual Average Increase[2]	Total Cost Over 75 Years Undiscounted[3]	Total Cost Over 75 Years Discounted[3]
All Staff	4.8	$100,392	$432,000	0%	$32,808,000	$12,868,000

Notes:
[1] OPE = other payroll expenses.
[2] Due to increasing numbers of listed species, expanding species ranges, and increasing regulatory constraints for each species, based on historical and anticipated trends.
[3] Costs in 2020 dollars. Includes assumed increase in staff time. Discounted values at 3 percent annual.

There are additional up-front costs of preparing an HCP including an Environmental Impact Statement (EIS) and process under the National Environmental Policy Act (NEPA), although a large portion of these costs have already been accrued, with substantial support from federal grants. To date costs of HCP development have totaled $2.7 million in direct costs and $500,000 in ODF staff costs (Table 8-3). ODF has received $1.4 million in grants thus far to support this work during Phases 1 & 2 from 2018 through the present (September 2020). This work has involved spatial analysis of habitat needs, drafting of the Habitat Conservation Plan document, and extensive coordination with scoping and technical committees in support of fully defining the HCP. Future costs not yet accrued that would be necessary to complete the HCP are expected to total $3.7 million in direct and staff costs. An additional $1.4 million in federal grant support is anticipated and considered to be likely, for a net cost to complete the HCP (and associated EIS) of $2.3 million. This additional $2.3 million in costs would accrue over the remainder of 2020 as well as 2021 and 2022. These costs are not included in calculations of total costs, net revenue, or net retained revenue by ODF for the analysis timeframe of 2023 to 2097, and should be considered additive.

Table 8-3. HCP One-Time Development Costs and Grants (HCP Scenario)

Cost Category	Cost	Federal Grant	Net Cost
Phases 1 & 2 Direct Costs	$2,700,000	$1,400,000	$1,300,000
Phases 1 & 2 ODF Staff Costs	$500,000	$0	$500,000
Total HCP Costs Accrued To-Date[1]	**$3,200,000**	**$1,400,000**	**$1,800,000**
Phase 3 Direct Costs	$3,200,000	$1,400,000[2]	$1,800,000
Phase 3 ODF Staff Costs	$500,000	$0	$500,000
Total HCP Costs Not Yet Accrued[3]	**$3,700,000**	**$1,400,000**	**$2,300,000**

Notes:
[1] Costs accrued have already been spent as of September 2020, and associated federal grants have already been received and applied.
[2] Phase 3 federal grant has not yet been received, but all indications suggest the federal support will continue.
[3] Costs not yet accrued have not yet been committed and can generally be avoided as of September 2020.

Federal Cost Share

Public agencies preparing HCPs are eligible to apply for federal grants to help pay for what can be a large share of HCP planning costs. The federal Cooperative Endangered Species Conservation Fund grant program, administered by USFWS, provides annual planning grants for large-scale HCPs throughout the country. Oregon Department of Forestry has already received grants totaling $1.4 million. The maximum grant allowed per plan each year is $1.0 million. Although the grant allocations are subject to annual federal budget authorizations, the program is expected to continue for the foreseeable future because of its popularity. ODF anticipates receiving an additional $1.4 million in federal grant support if it proceeds with HCP development.

8.1.3 Pre-harvest Species Survey Costs and Monitoring Costs

Pre-harvest species surveys include coordination between ODF biologists and foresters. Because surveys are labor intensive, contractors are often used to conduct the surveys in order to properly survey all harvest areas within the limited time periods when species are detectable. The cost of conducting pre-harvest surveys is shown in Table 8-4. The cost consists of the “on the ground” survey effort and coordination between ODF biologists and foresters on survey activities.

The cost to conduct pre-activity surveys is expected to increase over time for both the cFMP and dFMP scenarios, primarily because new species will be listed and these species will require surveys to avoid take. The relative cost to survey for northern spotted owl and marbled murrelet is also expected to increase as recovery efforts are successful and the species expand their range. Survey requirements are also expected for additional species as they become listed under the ESA. Without an HCP, ODF will need to demonstrate avoidance of impacts to those species in the same way they are demonstrating take-avoidance of northern spotted owl and marbled murrelet now. That will require pre-activity surveys to determine species presence and modification of harvest plans as needed. For the purposes of this analysis, it is assumed that pre-harvest species survey costs would increase only as a result of red tree vole becoming listed.

With an HCP species monitoring will shift from pre-harvest take avoidance surveys to effectiveness monitoring outlined in the HCP (Table 8-4). Without an HCP, annual survey costs are expected to start at $2.5 million but increase to $4.2 million after 10 years, based on an assumption of a new listing requiring significant survey effort (e.g., red tree vole). Additional species could drive the survey costs even higher. Over 75 years that results in $297 million in survey costs undiscounted ($102 million discounted). By contrast, if an HCP were completed, it is estimated that annual monitoring costs would be reduced to $1.7 million per year for a total of $128 million over 75 years undiscounted ($47.6 million discounted). The HCP monitoring costs therefore will be less than half of the equivalent survey costs of the cFMP or dFMP over the analysis timeframe. There are other monitoring-related activities that would be a part of the HCP, but they are more directly associated with species management activities and accounted for separately.

Table 8-4. Summary of Monitoring Costs in Western Oregon Forests by Scenario

Species	cFMP and dFMP Costs	HCP Costs[1]
Pre-Harvest Surveys		
Northern spotted owl	$1,583,000	$0
Marbled murrelet	$900,000	$0
Red tree vole	$1,733,000[2]	$0
Monitoring		
Terrestrial Species	$0	$1,500,000
Aquatic Inventory Program	$0	$200,000
Annual Cost	**$2,483,000 to $4,216,000**	**$1,700,000**
Total Cost - 75 Years Undiscounted	**$297,137,000**	**$127,500,000**
Total Cost - 75 Years Discounted	**$102,920,000**	**$47,595,000**

Notes:
[1] Other monitoring related activities will also be a part of the HCP, but included under species management costs.
[2] Red tree vole monitoring costs are estimated and assumed to begin to accrue after 10 years, and then all remaining years.

8.2 Species Management Costs

8.2.1 cFMP and dFMP Species Management Costs

Species management costs currently are limited to approximately $150,000 per year for stream restoration activities funded through grants. This level of expenditure would likely continue under the cFMP and dFMP assuming continuation of the corresponding grant and partner agency funding. For this analysis, no species management costs are assumed to be borne by ODF for the cFMP and dFMP.

8.2.2 HCP Species Management Costs

The HCP involves a series of active efforts to improve habitat conditions for covered species. Costs from this conservation strategy come from three main categories: aquatic restoration activities, upland restoration activities, and contributions to regional barred owl management programs. Including administration costs, adaptive management costs, and remedial action costs, these HCP species management costs total $1.6 million annually, and $120 million over 75 years ($45 million discounted) (Table 8-5). Note that these calculations assume that these costs extend for the full 75-year timeframe, although the permit timeframe is 70 years. This assumption is purely for the purpose of consistency in benefits and costs for this analysis, and does not indicate any commitment to expenditures beyond the HCP permit timeframe.

Table 8-5. HCP Species Management Costs

Species Management Activity	HCP Costs[1]
HCP Administration	$101,763
Conservation Strategy[2]	$1,257,273
Adaptive Management and Remedial Measures	$246,666
Annual Cost	**$1,606,000**
Total Cost - 75 Years Undiscounted	**$120,400,000**
Total Cost - 75 Years Discounted	**$45,000,000**

Notes:
[1] These costs include the ongoing annual ODF staff costs for HCP administration described earlier. Totals are rounded.
[2] Conservation strategy includes aquatic restoration, upland restoration, and barred-owl management.

Aquatic Restoration Activities

ODF plans to carry out stream enhancement activities during the permit term, including wood enhancement projects, stream restoration projects, and fish barrier removal projects. Over the last 23 years, ODF has implemented over 1,100 projects in these areas. Predicted costs for this section are based on the cost schedules for these prior projects. We assume the level and type of projects will be the same as before. In the past, aquatic restoration varied between $28,000 and $900,000, with an average annual cost of $310,000 per year.

Under the HCP, it is assumed that the level and type of restoration activities undertaken will be similar to what has been done in the past. It is expected that some of the project costs will be fulfilled by funding from other agencies and grant sources, however, increased reporting under the HCP increases the cost.

It is estimated that on average, ODF will spend $325,000 annually during permit term on aquatic restoration activities. This value will vary from year to year based on project types, the number of projects, and the success of grants.

Upland Restoration Activities

ODF plans to invest in the harvest of stands that have marginal habitat suitability or are not currently suitable and are unlikely to develop into a better habitat during the permit term(i.e. when a stand is stunted). This allows the treatment of stands infected with Swiss Needle Cast and converts stands to higher quality covered species habitat.

A conservation fund will be utilized to pay for reforestation and other restoration activities needed to establish healthy forests providing habitat for covered species. ODF plans to invest these improvements averaging annually 600 acres at a cost of $400 per acre, leading to an annual cost of $240,000. Over the 70-year permit term, ODF is estimated to spend a total of $6,000,000 on upland restoration activities. Activities are expected to be concentrated in the first 25 years.

Contribution to Regional Barred Owl Management

ODF has committed to contributing funds to programs conducting barred owl management practices across private, state, and federal lands in western Oregon. Partners include ODFW and USFWS. Money spent during first 20 years of plan implementation is targeted to increase the effectiveness of the northern spotted owl conservation strategy.

ODF is committed to an annual contribution of $250,000 towards regional barred owl management programs. The timing of this expenditure is dependent on the projects implemented, and will require further conversation with regional partners.

Adaptive Management and Remedial Action Costs

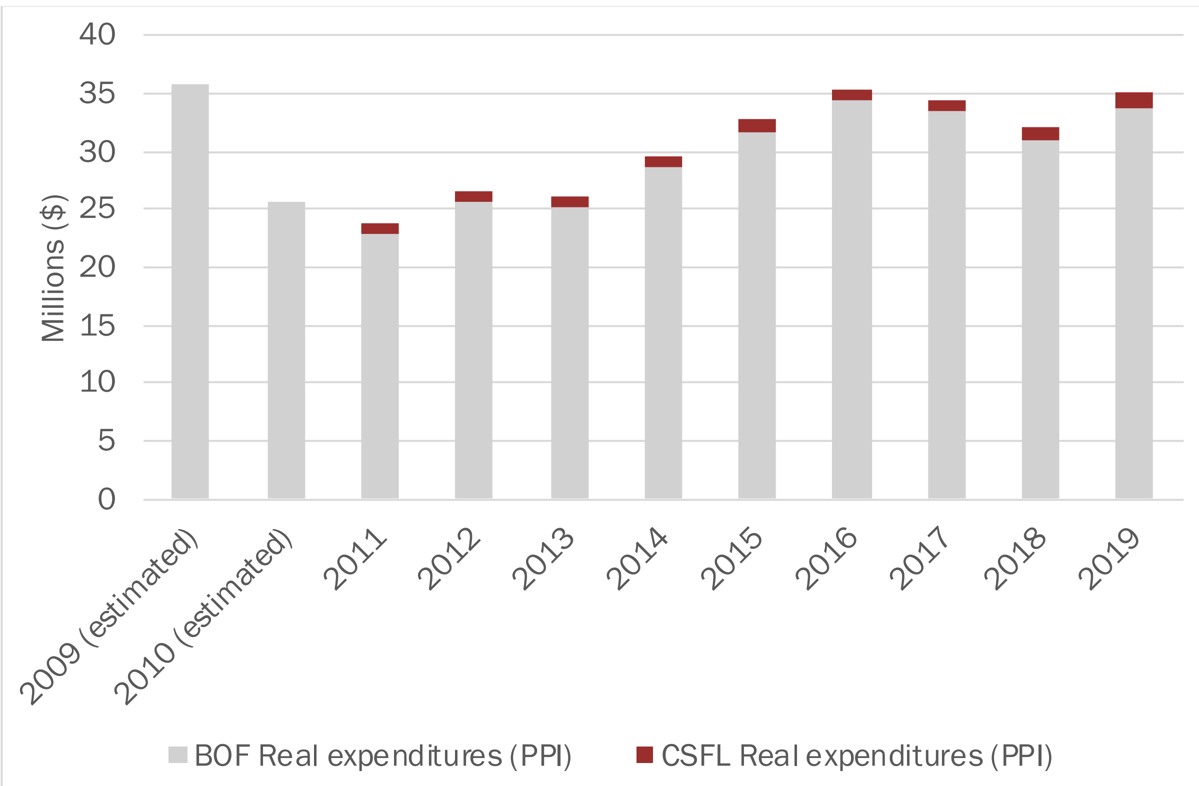
Adaptive management costs as part of the HCP are meant to accommodate specific uncertainties and potential responses to those uncertainties. Adaptive management costs are included as a 10 percent contingency on HCP monitoring costs over the permit term.

Remedial measures include actions to address anticipated and possible changes in circumstances that may affect the status of a covered species. They also include changes that alter the assumptions of information upon which the plan is based. Remedial measures for changed circumstances amount to 5 percent of the cost of the conservation strategy.

8.3 ODF General Administration Costs

For the purpose of this analysis, we project the costs of administering the BOF and CSFL forests based on considerations of historical budget data and expectations for future expenses. We look first at the historical costs over approximately the past 10 years for administering the BOF and CSFL forests. We attempt to differentiate between the specific events driving the budget in any given year and the broader trends of agency costs that may be continued into the future. Over the historical data's time period, both budgets experienced variation year over year with one outlier year (Figure 8-1). On the BOF lands, 2009 showed an unusually high cost level due to operating at lower profit margins. The CSFL experienced a large drop in costs between 2017 and 2018, primarily due to the transfer of management of the Elliott State Forest. Market and consumer conditions can explain some part of the changes in costs as well, as some costs of doing business increased.

Figure 8-1. Historical Board of Forestry and Common School Forest Costs Adjusted for Inflation, 2009-2019

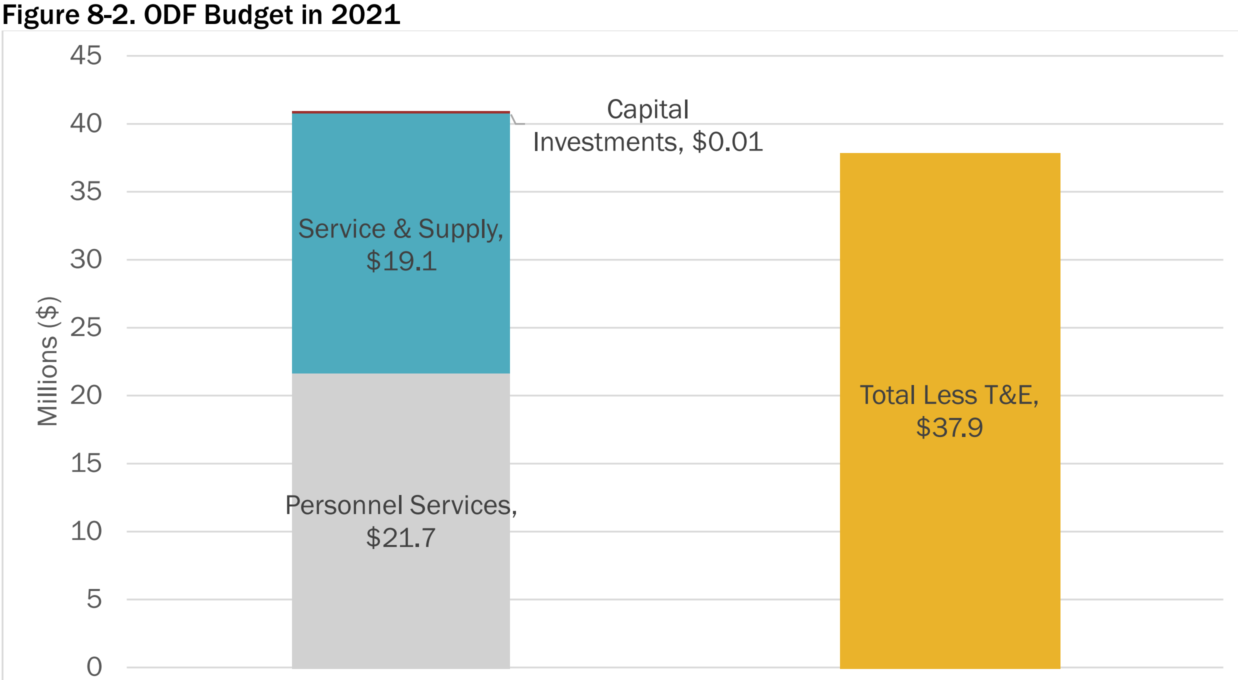


Source: ODF, Bureau of Labor Statistics Producer Price Index – All Commodity

Based on ODF's recent *Workforce Futuring Blueprint* publication, staffing is not likely to experience the same level of variability in the future as in the historical data. The budget is broken down into three categories as shown for 2021 in Figure 8-2. Personnel service costs (53 percent of total) include staff compensation and benefits, services and supply costs (47 percent of total) include agency expenses for current operations aside from staff and Capital investments include non-consumable items purchased for long term use. The changes to staffing procedures are expected to result in increased budget stability. We model the Service & Supply and Capital Investment costs to match inflation while Personnel Services costs increase by 5 percent annually based on expected increases in salary costs for the first 10 years of the time period before matching inflation. Accounting for an inflation rate of 1.9 percent annually[30], we project real personnel services costs to increase by 3.1 percent each year and other budget areas to neither increase nor decrease. With personnel service costs making up 53 percent of total administrative costs, the 3.1 percent annual increase equates to 1.6 percent annual real increase in total administrative costs.

Additional staff costs would be necessary to fully develop a Forest Management Plan under the dFMP. These costs are estimated at approximately $400,000 per year for two years (2021–2022). Some effort would be necessary under the HCP to develop a companion FMP as well, but much of the detail was developed as part of the HCP so ODF staff expect it would cost half of the cost estimate above ($200,000 per year for two years). These costs would occur prior to 2023 and are not part of the total cost estimates in this analysis. These planning costs are generally an ongoing part of administrative workload for staff at ODF and to some extent continue under all three scenarios. Certainties under the HCP suggest that the overall average annual planning effort would decrease over time under an HCP relative to the cFMP or dFMP, but this difference is not included in the analysis results in this chapter.

Figure 8-2. ODF Budget in 2021



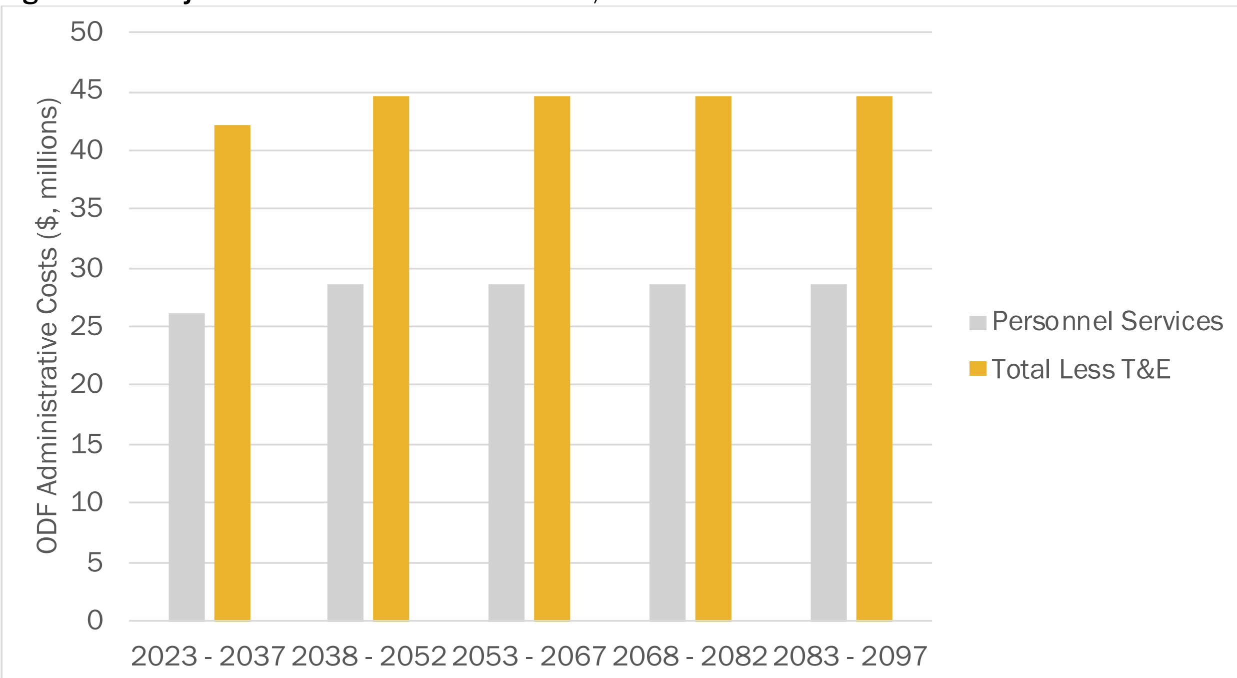
Source: ODF

Using the budget from fiscal year 2021 as a baseline, we project the annual budget to increase from $37,870,000 in fiscal year 2021 to $44,720,000 by fiscal year 2030 and stable at this level

[30] Based on the most recent legislative session projecting a 3.8 percent inflation for the biennium 2020-2021

through the end of the 75 year time period (Figure 8-3). To avoid double counting administration of the Endangered Species Act compliance, covered in a different section of this report, the costs associated with threatened and endanged species (T&E) management have been subtracted from the total.[31]

Figure 8-3. Projected Real Administrative Costs, 2023-2097



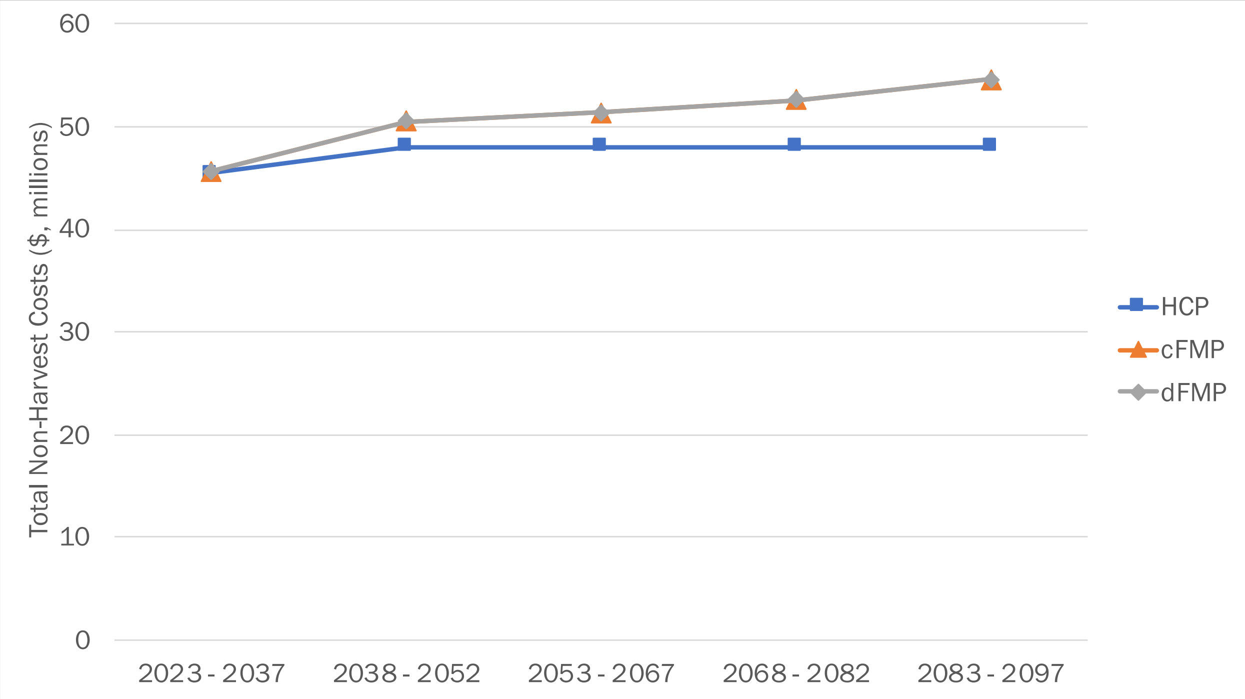
Note: Total does not include ESA-related costs (T&E)

8.4 Total Costs by Scenario

For costs that are not associated with harvest, Figure 8-4 shows a steady increase under the cFMP and dFMP scenarios while with an HCP, projected non-harvest costs are lower and relatively flat after the initial 15 year time period. These costs include spending on ESA compliance and species management as well as ODF's general administrative costs. Figure 8-5 shows the total costs projected over 75 years, discounted at 3 percent to calculate the net present value. These costs include timber harvest costs, ODF general administration, species monitoring and management, and ESA administration. The total costs do not include payments to counties. The HCP and dFMP scenarios are projected to have very similar total costs (discounted) over this time period, (HCP $3,076,000,000; dFMP $3,085,000,000) while the cFMP is slightly less ($2,808,000,000). More cost detail figures are provided in Appendix B.

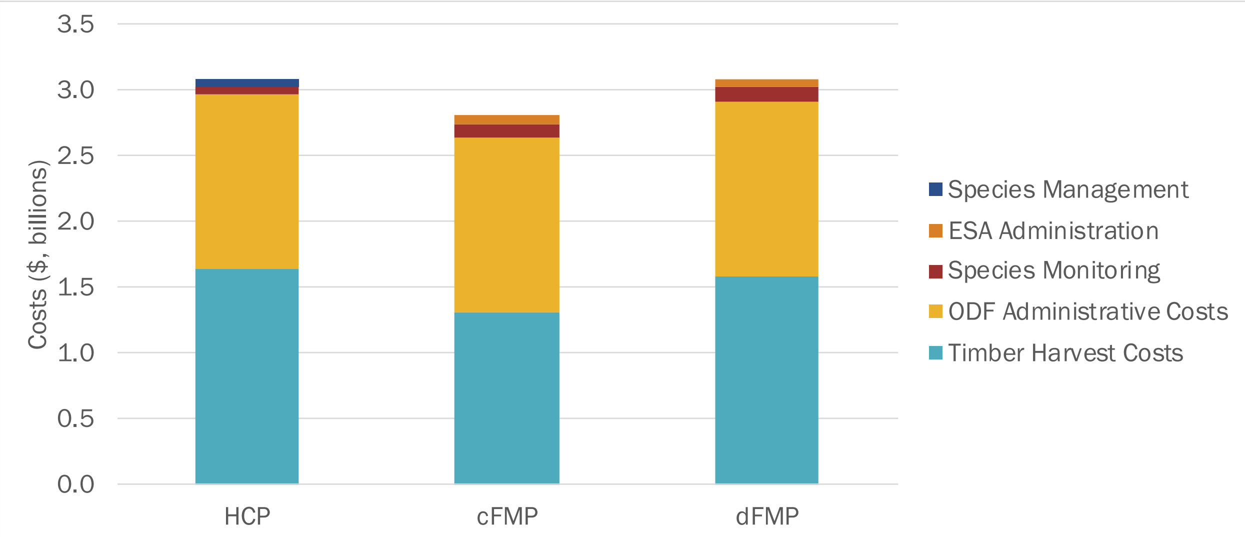
[31] T&E costs are estimated at $2.9 million for FY 2021. This amount is subtracted from the budget to avoid double-counting of other ESA, species and habitat costs estimated earlier in this cost section.

Figure 8-4. Projected Non-Harvest Costs, 2023-2097



Note: Includes all costs to ODF other than direct harvest costs (estimated by the Forest Management Model).

Figure 8-5. Projected Total Cost over 75 Years Discounted, 2023-2097



Note: Discounted at 3 percent

9 Sensitivity Considerations

9.1 Conservation

9.1.1 Changing Climate

Conservation outcomes in terms of the quantity and quality of suitable habitat that develops and persists across the landscape over time is largely based on existing stand-level inventories and forest growth projections. An implicit assumption in the modeling is that forest growth rates will remain constant overtime. Disturbance events such as fire, drought, windstorms have the same relative probability of occurring under each scenario and are not modeled. However, there may be differences in how these stressors may impact the areas designated for conservation. The HCAs are sized to build resilience to potential disturbance events, and they are large enough to sustain some loss without compromising their integrity. The large patch size provides a built-in buffer to fire, wind-throw and insect infestation. In addition, the operational flexibility afforded by the HCP will enable ODF to adapt operationally to changed circumstances both in and outside the HCAs more readily as conditions change than either of the FMP scenarios given the historic social resistance there has been to cutting and thinning of trees, application of fuel treatments, etc.[32] With the HCP in place, ODF will also be collecting valuable data on the effect of management practices on forest habitat over time. The money currently spent on species surveys for take avoidance would instead be invested in more meaningful investments in monitoring and adaptive management.

9.1.2 Funding to Invest in the Future Forest Quality

The revenue forecast, both in terms of predictability and overall outlook for both the FMPs is less favorable than the HCPs. This would likely translate into less favorable conservation outcomes in terms of the funding available for implementation of forest stewardship and aquatic habitat restoration activities. The less favorable the forecast the less likely that ODF will have sufficient funding for stewardship. The cFMP is predicted to perform better from a conservation perspective than the dFMP, but it also has the least favorable economic forecast, decreasing the likelihood that there will be sufficient funding for full FMP implementation (including implementation of stewardship actions).

9.1.3 Policy Change to Meet GPV

The forest management and habitat suitability models assume the areas designated for conservation under the cFMP and the dFMP would remain set of the entire 70-year permit term and that there would be no policy changes to adjust them for achieving GPV. This is a

[32] Spies, Thomas A. Giesen, Thomas W., Swanson, Frederick J., Franklin, Jerry F., Lach, Denise, Johnson, K. Norman. 2010. Climate change adaptation strategies for federal forests of the Pacific Northwest, USA: ecological, policy, and socio-economic perspectives. Landscape Ecology. 25:1185-1199. DOI 10.1007/s10980-010-9483-0. Downloaded: https://www.fs.fed.us/pnw/pubs/journals/pnw_2010_spies001.pdf

simplifying assumption that is very unlikely to occur. ODC and the BOF would likely be compelled to adjust management plans and the landscape design balance conservation with economic and social outcomes to meet statutory requirements related to achieving GPV.

9.2 Economic

9.2.1 Price Analysis

ODF functions as a price taker in the timber market, meaning the timing and volume of their sales do not have a substantial effect on the market price of their products (logs). The financial results in this analysis are directly sensitive to market prices. When ODF when conduct timber sales when the market has relatively higher prices, distributed revenue (county payments) and ODF's net operating income both increase. One identified potential benefit of the HCP for timber sales that was not incorporated into the harvest analysis in this study is the improved ability to time timber sales for favorable market conditions. The HCP is expected to substantially streamline the sale process, removing costly and time-intensive pre-harvest surveys and related regulatory compliance activities. ODF staff report that with an HCP sales could be clustered during relatively high price conditions (within plus or minus 2 to 3 years) and somewhat avoid sales when market prices are down.

To evaluate the sensitivity of the results to this potential added harvest revenue benefit of the HCP, we evaluated how average log prices would differ if ODF could avoid selling logs during down years. In this analysis, we use historic western Oregon log price data over a twenty-year period (1999 to 2019) provided by ODF staff to represent the composite price ODF faces in the timber market (Figure 9-1). This weighted index price represents an index of the value in prices for timber sales and demonstrates market trends and volatility. We standardized the prices to 2019 dollars using the Producer Price Index for lumber and wood products produced by the U.S. Bureau of Labor Statistics.

Figure 9-1. Western Oregon Log Prices and 5-Year Moving Average, 1999 to 2019

Source: Log price data from ODF

We posed the research question: "how much higher would the average log price have been for ODF if it could have avoided timber sale prices below the five-year rolling average?" The reasoning would be that ODF could avoid short-term (5-year) below-average sale prices with an HCP by hurrying or delaying sales 1 to 3 years. Recognizing that ODF does not have perfect information about future prices, we do not assume ODF could perfectly time the market and always capture the highest prices in a 5-year timeframe. Rather we identify prices below the 5-year average (surrounding that year) and calculate how much higher on averages prices would have been for the full 20-year timeframe (1999-2019) if sale prices for years below the 5-year average were adjusted up to the 5-year average.

Under this scenario, if ODF were able to time sales to avoid below-average prices (achieving the 5-year average instead), the overall average price would have been 4.4 percent greater. This would mean a 4.4 percent increase in gross harvest revenue over the full 20-year timeframe. An even more ambitious market timing strategy clustering sales at market peaks would provide average prices much greater at 20-year average of at least 10 to 20 percentage points higher.

Applying the 4.4 percent price increase to the HCP scenario would lead to an increase in harvest revenue of $5.7 million annually for a total increase in revenue of $427 million (undiscounted) over the 75-year analysis timeframe. This magnitude of change in price is relatively small in comparison decadal differences in timber prices that might be observed (e.g. as seen for actual prices in Figure 9-1). Other market conditions in terms of supply and demand, including changes in demand for various wood products or even new markets such as carbon, can potentially lead to even larger increases or decreases in prices and resulting revenue. These other factors though would generally affect all scenarios equally, and the comparative differences in effects would be minor. In general, changes in revenue, all else equal, will have a substantial effect on net revenue and net operating income, because a large portion of costs are fixed and do not vary with timber harvest volume or revenue.

9.2.2 Forest Yield

Forest (timber) yield can be expected to vary from year to year due to uncertainty in forest growth as well as disturbance events such as fire, disease, and wind damage. Forests can also grow faster than expected, and total inventory and potential harvest volumes can be greater than forecast. In this analysis, harvest volume, revenue, and carbon storage results are all sensitive to assumptions regarding forest yield over time. While the factors driving variation in yield over time or across the landscape cannot be predicted, studies have been conducted to calculate the sensitivity of yield and harvest forecasts to some of the most common sources of disturbance. Yield assumptions for the modeling in this study generally relied upon standard assumptions for forests in western Oregon that attempt to account for disturbance on average. But general trends in the research literature can inform understanding of how timber harvest yield may vary due to unanticipated disturbance.

A host of studies address fire-related forest management. Some studies have found fire to be the most important disturbance in terms of effects on forest yield.[33] Savage et al (2010) argues that fire can actually be ignored as a source of uncertainty for forests with a burn fraction of less than 0.45% and still have little impact on harvest volume over time. Van Wagner (1983) finds in a long-term timber supply model that when the annual area cut is below the maximum sustainable level, the volume of harvest is insensitive to fire.[34] Albert et al (2015) looked at how climate change affects drought and windthrow in forests. In their study of northern Germany, they found that windthrow was not a serious threat to forest growth, but drought was.[35]

Besides disturbance events, basic growth and mortality in forest stands can vary quite widely. In a study relevant to western Oregon forests by Diaz, Loreno, Ettl and Davies (2018) of Pacific Northwest Douglas-fir forests, models found differences between standard yield estimates and observational data of 5 to 49 percent by species and age class.[36] ODF staff generally report the potential for variation and uncertainty in yields sufficient to have real effects on volume, but these yield variations are not expected to differ in a predictable way across scenarios. As an

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[33] E.g., Sutherland, G., Eng, M., & Fall, S. (2004). Effects of uncertainties about stand-replacing natural disturbances on forest-management projections. *Journal of Ecosystems and Management*, *4*(2).; Savage, D. W., Martell, D. L., & Wotton, B. M. (2010). Evaluation of two risk mitigation strategies for dealing with fire-related uncertainty in timber supply modelling. *Canadian Journal of Forest Research*, *40*(6), 1136-1154.

[34] Van Wagner, C. E. 1983. Simulating the effect of forest fire on long-term annual timber supply. Can. J. For. Res. 13:451-457.

[35] Albert, M., Hansen, J., Nagel, J. (2015). Assessing risks and uncertainties in forest dynamics under different management scenarios and climate change. *Forest Ecosystems.* 2, 14.

[36] Diaz, D.D., Loreno, S., Ettl, G.J. and Davies, B., 2018. Tradeoffs in timber, carbon, and cash flow under alternative management systems for Douglas-Fir in the Pacific Northwest. *Forests*, *9*(8), p.447.

illustration of the significance of yield variation, if increased yield allowed for an increase in harvest volume of 5 percent would mean 9 to 11 million more board feet of timber harvest annually, for $215 to $287 million greater harvest revenue over the 75-year timeframe.

The improved efficiency and speed of timber harvests under an HCP might have some potential to mitigate disturbance events or improve timber yield. The capacity to quickly execute timber sales could mean that trees affected by disturbance events (fires, storms) might be salvaged with sufficient urgency as to preserve some of the value and generate revenue. ODF staff report that under the cFMP it can be challenging to execute salvage timber sales rapidly enough to be productive.

These same forest yield variations and uncertainties could affect carbon storage volumes in the same way. While some portion of increased yield would be harvested, this yield increase would take place in policy constrained and inoperable areas as well.

10 Conclusions

10.1 HCP Risk Management Benefits

A key finding across the investigations included in this study is the wide-ranging risk-management benefits of the HCP. The operating conditions ODF would experience under an HCP would be more certain and predictable and provide ODF with more operational flexibility in marketing and implementation of timber sales with the current and future levels of uncertainty and constraints associated with the cFMP and dFMP scenarios (Table 10-1). A take-avoidance approach to ESA compliance fundamentally leaves ODF vulnerable to disruption of management activities when listed species habitat is discovered during pre-harvest surveys or new species listings occur. With the reduction of these risks, more predictable use of resources and long-term dedication of acreage to specific priorities has benefits for conservation and timber harvest objectives. And similarly, the HCP design process identifies and ensures that the most suitable habitat is protected over time, as opposed to a take-avoidance approach where protections must be pursued when opportunities arise in conjunction with timber sale surveys. These improvements in long-term predictability and dedication of land use conditions provide a more stable context for other investments as well, such as outdoor recreation facilities.

Table 10-1. HCP Risk Management Benefits Relative to cFMP and dFMP

Risk Management Outcome	Rationale
Reduced habitat risk	Long-term commitments to habitat protection for covered species
Reduced timber harvest risk	Certainty of encumbrances from currently listed species and new species listings
Reduced litigation risk	Defined conservation commitments as well as timber management commitments
Reduced timber market vulnerability	Improved timber sale process to better time market and capture high market prices
Reduced disturbance event vulnerability	More resilient and connected habitat conditions for storms, wildfires, and other disturbances
Reduced outdoor recreation investment vulnerability	More predictable long-term land use designations provide a more predictable setting to plan and implement outdoor recreation investments such as facilities and trails.

One of the most significant benefits of an HCP is likely reduced litigation risk. An HCP provides substantially increased protection for ODF from lawsuits brought under the Endangered Species Act. Such suits otherwise could threaten timber harvest activities in some of the most productive state forests that ODF manages. And similarly, an HCP removes potential ambiguities regarding areas that can and cannot be harvested; ambiguities that can lead to challenges from stakeholders for ODF to harvest at higher levels than planned. The settled and defined land use definitions under an HCP therefore can reduce the risk of the costs and disruptions potentially imposed by lawsuits from both environmental and timber objectives.

Litigation risk can affect access to acres assumed to be available in this analysis. For example, a lawsuit could lead to an injunction on harvests for an entire district for a number of years. If for example a court ordered an injunction on harvests in the North Coast region, this could reduce timber harvests for a period of time by up to 70 percent. Efforts to avoid litigation risk can lead to avoidance of timber sales in certain areas, also contributing to risk of reduced timber harvests and available inventory. This risk is probably one for which the results both in terms of economic and conservation variables are most sensitive. HCPs have proven to generally stand up to court challenges when lawsuits have been brought elsewhere.

10.2 Key Findings

Under the take avoidance scenarios (cFMP and dFMP), acres available for harvest will be reduced due to new species listings and change/expansion of acres occupied by existing covered species. These scenarios would progressively reduce harvest levels, which would make it difficult to achieve ODF's mandate of GPV for the citizens of Oregon. The HCP mitigates risk for both harvest and conservation objectives because acres designated for harvest (available acres) and for conservation in HCAs would be secured, allowing focused management towards harvest objectives outside of HCAs and conservation management within HCAs.

There is also a greater likelihood that suitable habitat for covered species will be created and improved in a shorter time frame with the HCP compared to the take avoidance approaches. This difference is because the HCP includes active management and implementation of conservation measures coupled with systematic monitoring and adaptive management that provides information on species' responses to conservation actions. The cFMP operational surveys conducted for take avoidance do little to inform or improve conservation efforts because they primarily focus on establishing the presence or absence of currently listed species and are not designed to monitor trends in habitat or populations.

Key findings of the CA are as follows:

- *The HCP Scenario generates the greatest total harvest volume over the 75-year timeframe.*
- *ODF's costs are lowest under the HCP Scenario.*
- *Net revenue is greatest for the HCP Scenario, followed by the dFMP and finally the cFMP.*
- *The HCP Scenario would result in the protection and stewardship of more suitable habitat for covered species <u>within areas designated for conservation</u> relative to the cFMP and dFMP.*
- *The cFMP and HCP both have strong conservation outcomes for terrestrial species. The cFMP results in increased suitable habitat for covered species in the <u>entire permit area</u>.*
- *HCP conservation areas protect larger, less fragmented occupied and suitable habitat for covered species.*

- *Strategies for aquatic species for all three scenarios are strong; however, the HCP provides the best potential outcomes.*
- *Carbon sequestration is highest under the cFMP, due to anticipated reductions in harvest levels over time.*
- *All management scenarios provide benefits for recreation opportunities and culturally-significant uses. However, the funding stability afforded by the HCP provides more opportunities for investment.*

The **Summary of Relative Ranking of Key Outcomes** in Table 10-2 shows the relative ranking of the cFMP, dFMP, and HCP scenarios for key metrics evaluated in the Comparative Analysis in an at-a-glance format. The HCP clearly out-performs the other two scenarios on most metrics, with the dFMP second and the cFMP least favorable. The cFMP offers the most carbon storage, followed by the dFMP and HCP which are roughly equivalent.

Table 10-2. Summary of Relative Rankings of Key Outcomes (High = Most Preferred)[37]

		cFMP	dFMP	HCP
Conservation	Covered Terrestrial Species Habitat Quality	High	Low	Medium
	Covered Aquatic Species Habitat Quality	Tied	Tied	High
	Quantity and Quality of Monitoring	Low	Medium	High
Economic	Acres Available for Harvest	Low	Medium	High
	Annual Harvest Volume	Low	Medium	High
	ODF Costs	Low	Medium	High
	Net Revenue	Low	Medium	High
Social	Carbon Storage	High	Tied	Tied
	Recreation and Culture	Low	Medium	High

Notes:

- Shading is used to show relative rank: black=high; dark gray=medium; light gray=low
- "Tied" indicates there is no significant difference between the outcomes of each scenario
- Covered Terrestrial Species Habitat Quality includes modeled, stand-level habitat quality and conservation area configuration

10.3 Conclusion

These analyses suggest that conservation, economic (harvest, costs, revenue), and social outcomes would be more reliable and provide greater benefits when considering uncertainties under an HCP than under the dFMP or cFMP scenarios. The HCP provides the opportunity to identify and protect the highest quality habitat on ODF-managed forests in western Oregon. The cFMP may yield a higher stand-level habitat quality for covered terrestrial species, but the HCAs yield a better configuration of future suitable habitat. Furthermore, monitoring and management under the HCP provides more confidence in future habitat quality. The HCP also yields better conservation results specifically for covered aquatic species. The high degree of uncertainty without the assurances of an HCP mean that conservation outcomes will likely be

[37] Note the table presents a ranking of results of the Comparative Analysis for key metrics in terms of which scenario performs best over the full analysis timeframe.

less with either FMP than those guaranteed under an HCP. In addition, timber harvest volumes and ESA-related expenses have more certainty with an HCP. These results are sensitive to assumptions regarding future constraints on acres available to harvest, and driven by uncertainties inherent to a take avoidance approach to ESA compliance. Acreage available for timber harvest and harvest volume are greatest under the HCP scenario based on the best available estimates of future species take-avoidance constraints. Costs, other than those directly associated with harvest activity, are lowest under the HCP. Financial challenges for ODF do remain across all three scenarios, but the HCP provides the best ESA compliance framework for moving forward.

Appendix A. Constraints by Sub-geographic Region and for Common School Forest Lands

Northwest Sub-geographic Region

Table A-1. Net Acreage Constrains by Category for the Northwest Sub-geographic Region

	Group	Constraint Type	cFMP	dFMP	HCP
	Inoperable	Roads	12,027	12,027	12,027
		Non-Forest	2,360	2,360	2,360
		Admin	5,019	5,019	5,019
		Inoperable	86,989	86,989	86,989
	Subtotal		**106,394**	**106,394**	**106,394**
Regulatory and Policy Constrained	**FPA**	FPA Wild	188	188	188
		NSO Core	317	317	317
		LSPS *	4,332	4,332	4,332
	FMP/HCP	Riparian **	43,325	43,325	43,325
		Inner Gorge	10,121	10,121	10,121
		TA/HCP MMMA	6,727	6,727	6,727
		HCP MAMU			39,699
		TA/HCP NSO Best 40	8,657	8,657	10,195
	Policy	Old Growth	7	7	5
		Land. Des./HCAs	81,948	71,355	68,357
		TAS	340	-	-
	New FMP TA	Add. TA	60,699	68,756	-
	Subtotal		**216,661**	**213,786**	**185,602**
	Available	None	178,691	181,566	209,750
	Percent		36%	36%	42%
	Total Area		**501,746**	**501,746**	**501,746**

Net Acres. Constraints have a hierarchy, according to the order listed. Net Acre are calculated by subtracting overlapping acres from the preceding constraint types (e.g. net non-forest types subtracts the roads acreage). Areas reported are based on the model polygon layer.

Table A-2. Lands Designated for Conservation under Each Scenario in the Northwest Sub-geographic Region

Scenario	Description	Acres (gross)	Percent of the Permit Area
cFMP	LD (with Terrestrial Anchors)	172,000	34%
dFMP	ELD	170,000	34%
HCP	HCAs	216,000	43%

Willamette Valley Sub-geographic Region

Table A-3. Net Acreage Constrains by Category for the Willamette Valley Sub-geographic Region

	Group	Constraint Type	cFMP	dFMP	HCP
Inoperable		Roads	2,574	2,574	2,574
		Non-Forest	1,619	1,619	1,619
		Admin	1,465	1,465	1,465
		Inoperable	3,630	3,630	3,630
	Subtotal		**9,289**	**9,289**	**9,289**
Regulatory and Policy Constrained	**FPA**	FPA Wild	-	-	-
		NSO Core	650	650	644
		LSPS *	-	-	-
	FMP/HCP	Riparian **	6,501	6,501	6,714
		Inner Gorge	54	54	53
		TA/HCP MMMA	3,848	3,848	3,809
		HCP MAMU	--	-	3,907
		TA/HCP NSO Best 40	6,148	6,148	8,273
	Policy	Old Growth	-	-	-
		Land. Des./HCAs	15,441	10,144	7,480
		TAS	29	-	-
	New FMP TA	Add. TA	11,723	15,643	-
	Subtotal		**44,394**	**42,988**	**30,880**
Available		None	30,331	31,737	43,845
	Percent		36%	38%	52%
Total Area			**84,014**	**84,014**	**84,014**

Net Acres. Constraints have a hierarchy, according to the order listed. Net Acre are calculated by subtracting overlapping acres from the preceding constraint types (e.g. net non-forest types subtracts the roads acreage). Areas reported are based on the model polygon layer.

Table A-4. Lands Designated for Conservation in the Willamette Valley Sub-geographic Region

Scenario	Description	Acres (gross)	Percent of the Permit Area
cFMP	LD (with Terrestrial Anchors)	26,000	31%
dFMP	ELD	28,000	33%
HCP	HCAs	33,000	39%

Southwest Sub-geographic Region

Table A-5. Net Acreage Constrains by Category for the Southwest Sub-geographic Region

Group		Constraint Type	cFMP	dFMP	HCP
Inoperable		Roads	1,158	1,158	1,158
		Non-Forest	1,224	1,224	1,224
		Admin	315	315	315
		Inoperable	3,588	3,588	3,588
	Subtotal		**6,285**	**6,285**	**6,285**
Regulatory and Policy Constrained	**FPA**	FPA Wild	3	3	3
		NSO Core	400	400	415
		LSPS *	312	312	309
	FMP/HCP	Riparian **	3,441	3,441	3,768
		Inner Gorge	-	-	-
		TA/HCP MMMA	3,028	3,028	2,992
		HCP MAMU	-	-	6,582
		TA/HCP NSO Best 40	4,870	4,870	2,067
	Policy	Old Growth	-	-	-
		Land. Des./HCAs	8,833	6,341	7,035
		TAS	-	-	-
	New FMP TA	Add. TA	9,764	10,671	-
	Subtotal		**30,650**	**29,065**	**23,172**
Available		None	15,968	17,553	23,446
	Percent		30%	33%	44%
Total Area			**52,903**	**52,903**	**52,903**

Net Acres. Constraints have a hierarchy, according to the order listed. Net Acre are calculated by subtracting overlapping acres from the preceding constraint types (e.g. net non-forest types subtracts the roads acreage). Areas reported are based on the model polygon layer.

Table A-6. Lands Designated for Conservation in the Southwest Sub-geographic Region

Scenario	Description	Acres (gross)	Percent of the Permit Area
cFMP	LD (with Terrestrial Anchors)	16,000	30%
dFMP	ELD	19,000	36%
HCP	HCAs	25,000	47%

Common School Forest Lands

Table A-7. Net Acreage Constrains by Category for Common School Forest Lands

Group		Constraint Type	cFMP	dFMP	HCP
Inoperable		Roads	564	564	564
		Non-Forest	839	839	839
		Admin	313	313	313
		Inoperable	1,983	1,983	1,983
	Subtotal		**3,699**	**3,699**	**3,699**
Regulatory and Policy Constrained	**FPA**	FPA Wild	-	-	-
		NSO Core	117	117	115
		LSPS *	63	63	63
	FMP/HCP	Riparian **	2,083	2,083	2,058
		Inner Gorge	296	296	349
		TA/HCP MMMA	1,370	1,370	1,350
		HCP MAMU	-	-	2,689
		TA/HCP NSO Best 40	1153	1153	1,099
	Policy	Old Growth	5	5	5
		Land. Des./HCAs	4,238	4,238	3,702
		TAS	384	384	-
	New FMP TA	Add. TA	3,235	3,235	-
	Subtotal		**12,944**	**12,634**	**11,429**
Available		None	9,067	9,377	10,582
	Percent		35%	36%	41%
Total Area			**25,710**	**25,710**	**25,710**

Net Acres. Constraints have a hierarchy, according to the order listed. Net Acre are calculated by subtracting overlapping acres from the preceding constraint types (e.g. net non-forest types subtracts the roads acreage). Areas reported are based on the model polygon layer.

Appendix B. Harvest, Revenue, Cost, and Inventory Supplementary Data

Gross Revenue and Total Costs

Note these costs do not include revenue distributions (county payments).

Figure B-1. Gross Revenue and Total Costs (cFMP Scenario)

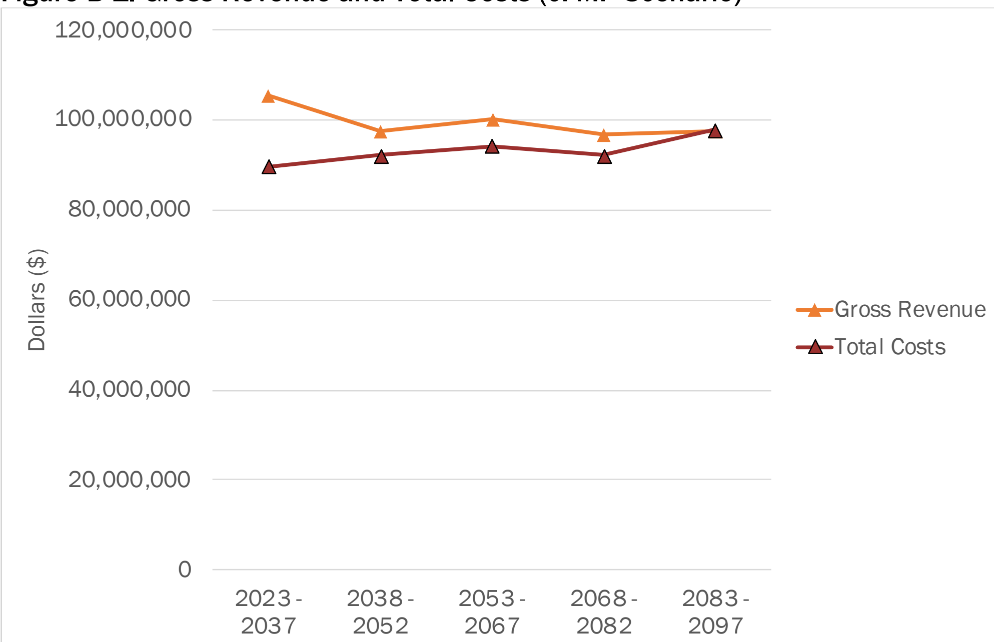


Figure B-2. Gross Revenue and Total Costs (dFMP Scenario)

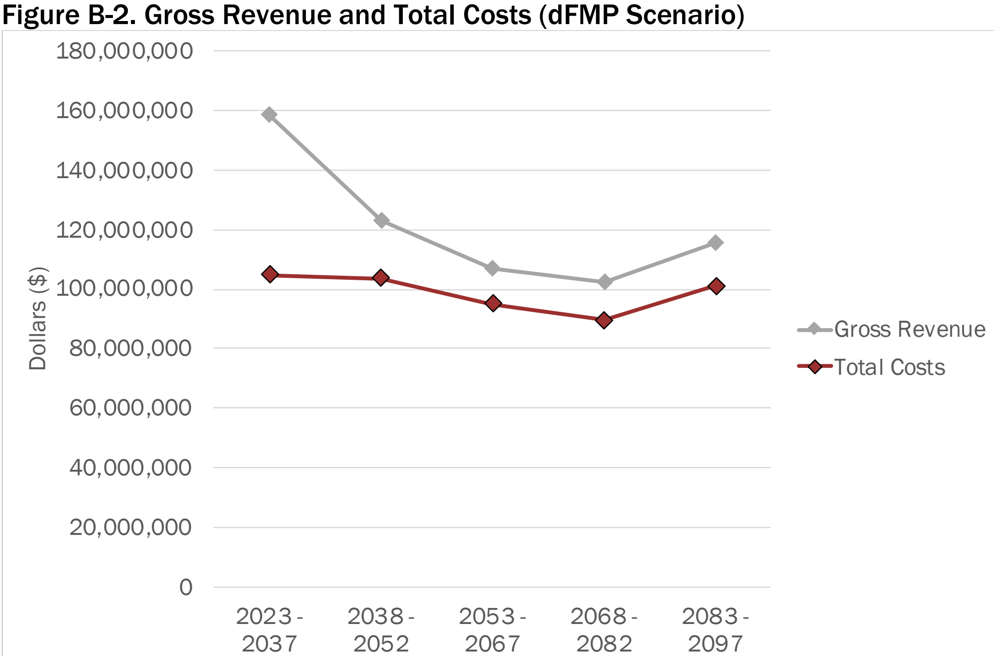
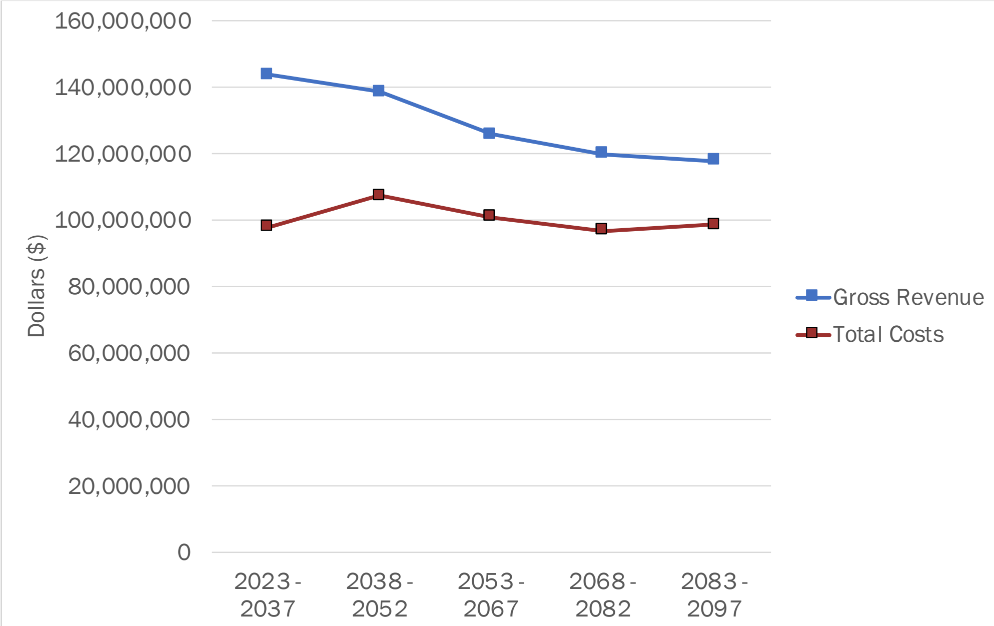


Figure B-3. Gross Revenue and Total Costs (HCP Scenario)



Net Harvest Revenue

Table B-1. Harvest Revenue – 15-year Average (All Scenarios)

Year	Undiscounted HCP	Undiscounted cFMP	Undiscounted dFMP
2023 - 2037	$91,545,000	$61,671,000	$99,333,000
2038 - 2052	$79,175,000	$55,876,000	$69,953,000
2053 - 2067	$73,121,000	$57,291,000	$63,171,000
2068 - 2082	$71,234,000	$57,191,000	$65,670,000
2083 - 2097	$67,382,000	$54,201,000	$69,163,000
Undiscounted 75-year Total	$5,736,873,000	$4,293,458,000	$5,509,351,000
Discounted 75-year Total	$2,505,399,000	$1,797,628,000	$2,474,619,000

Note: Some totals do not sum due to rounding.

Harvest Volume by Region

Figure B-4. Harvest Volume (All Scenarios)

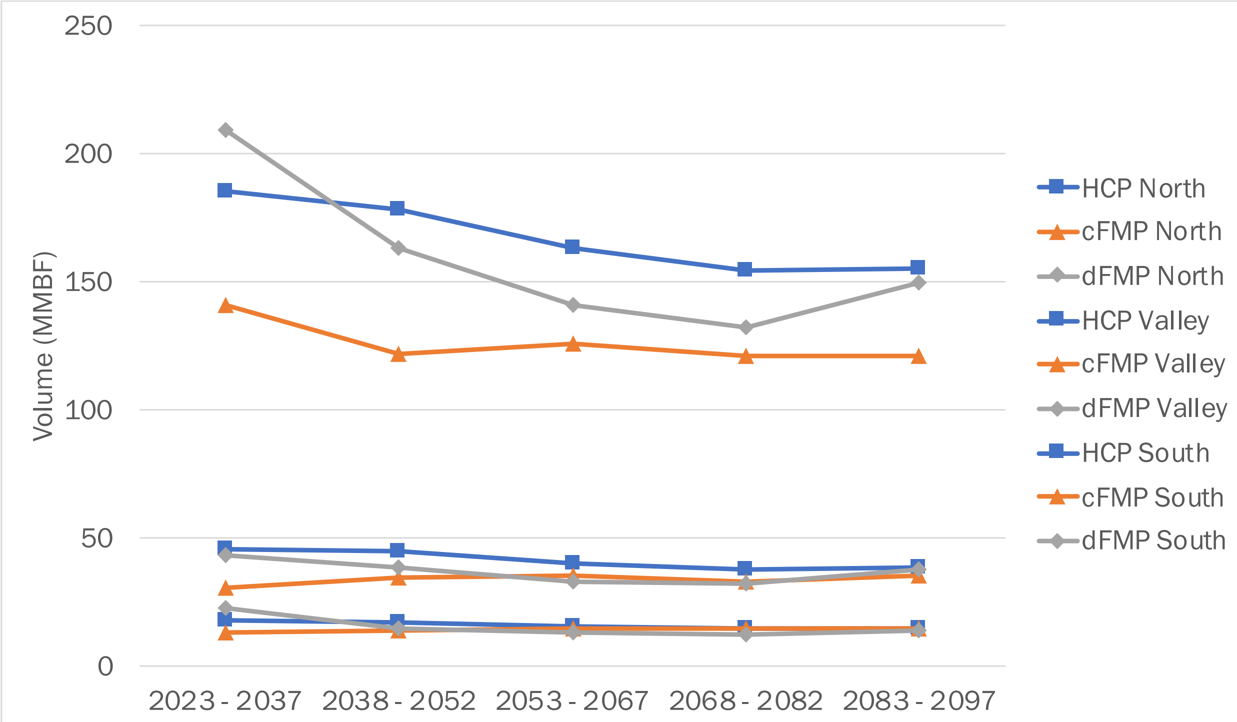


Figure B-5. Harvest Volume (North Coast Region)

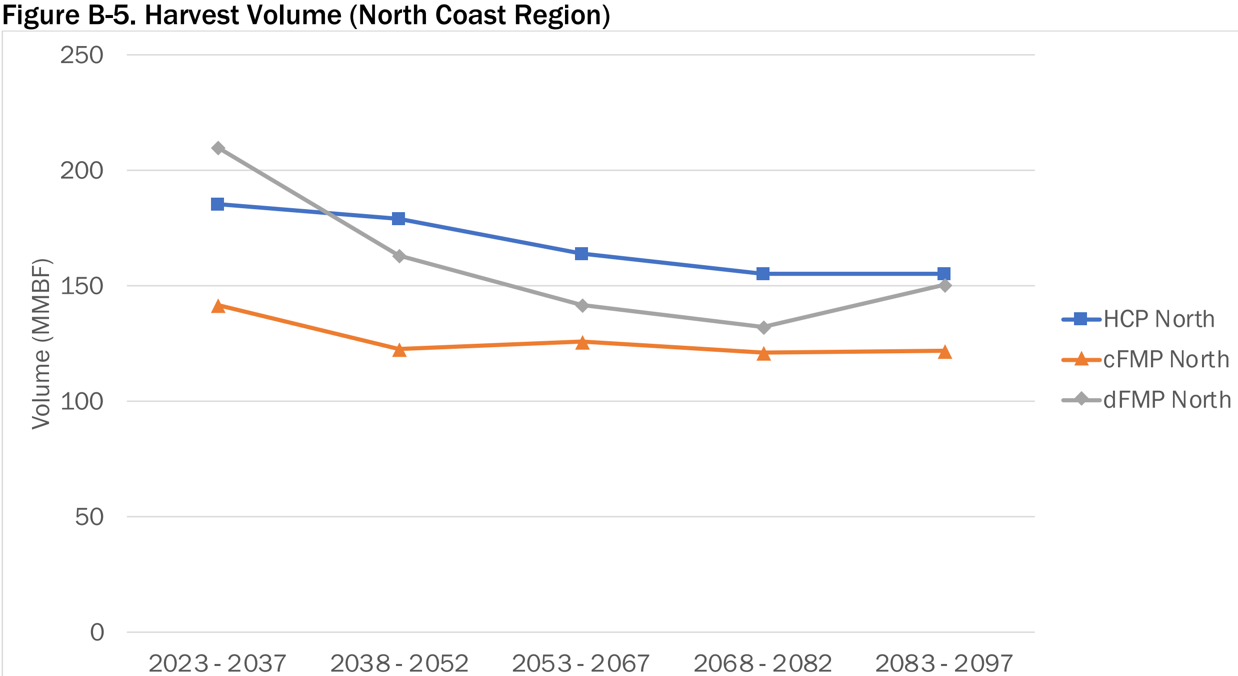


Figure B-6. Harvest Volume (Valley Region)

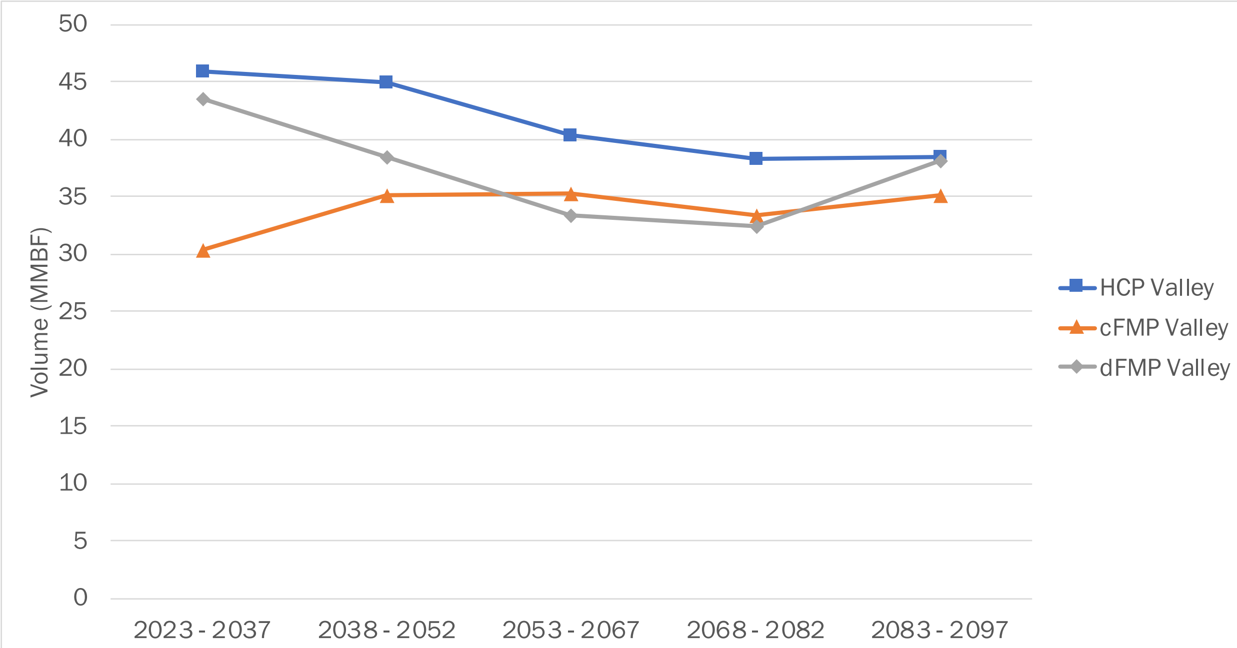
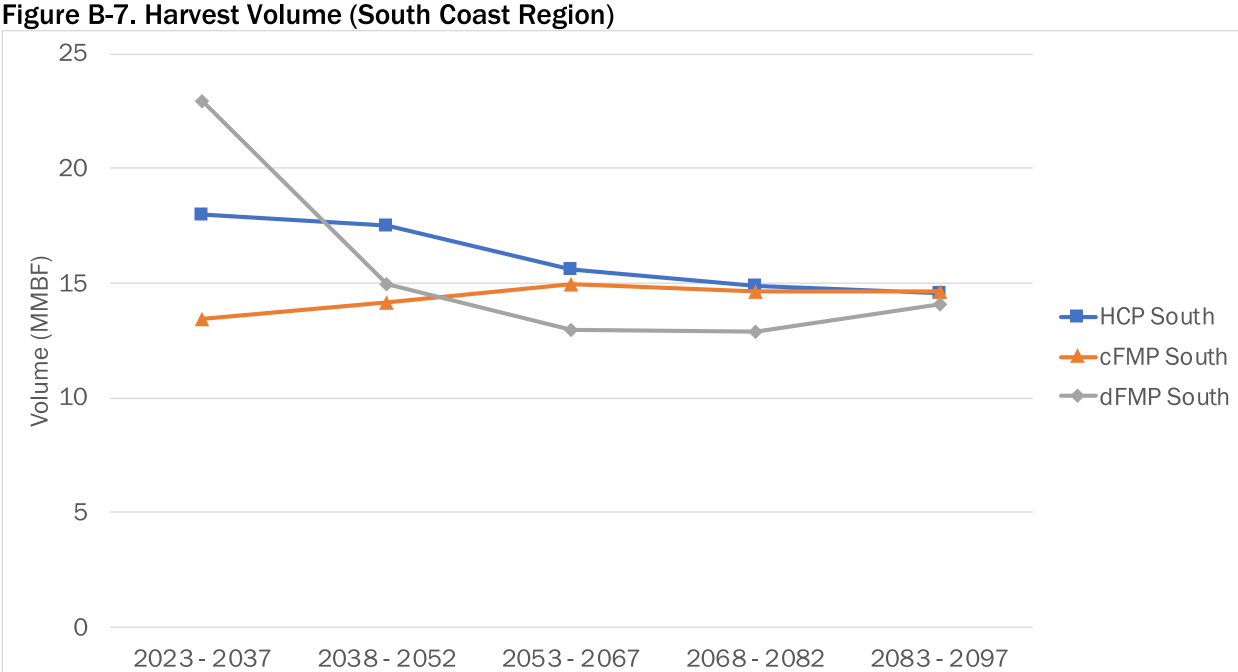


Figure B-7. Harvest Volume (South Coast Region)



Harvest Volume by County

Note that these tables of county-level harvest volume reflect harvests only on BOF forests. They do not include CSFL harvest activity, which is included in the total and regional results, and thus will not sum consistently with those results.

Table B-2. Harvest Volume (MMBF) by County (cFMP Scenario)

County	2023 - 2037	2038 - 2052	2053 - 2067	2068 - 2082	2083 - 2097	75-year Total
Benton	2.5	3.4	3.8	3.9	2.9	246.9
Clackamas	2.2	2.0	1.2	2.1	2.1	145.0
Clatsop	54.6	46.5	46.6	44.3	45.2	3,559.1
Columbia	4.3	5.7	2.5	2.3	1.8	250.9
Coos	2.1	2.9	2.3	2.6	2.1	179.1
Douglas	0.4	1.7	2.4	1.9	1.7	121.4
Josephine	0.3	0.1	0.1	0.4	0.1	15.7
Lane	9.1	8.3	8.4	8.0	8.4	632.6
Lincoln	6.2	9.4	9.7	7.5	10.0	643.2
Linn	6.0	7.2	10.7	9.1	6.1	587.6
Marion	9.0	7.8	5.1	5.1	9.0	539.7
Polk	1.8	2.2	1.5	1.7	2.8	149.1
Tillamook	57.2	57.2	62.3	60.1	60.0	4,451.5
Washington	23.5	10.2	13.4	12.5	12.5	1,082.3
Yamhill	0.0	0.0	-	0.0	0.0	1.4
Total	179.3	164.6	170.1	161.8	164.6	12,605.5

Table B-3. Harvest Volume (MMBF) by County (dFMP Scenario)

County	2023 - 2037	2038 - 2052	2053 - 2067	2068 - 2082	2083 - 2097	75-year Total
Benton	2.9	3.9	4.1	3.4	3.3	265.2
Clackamas	3.0	1.3	1.7	2.4	2.6	164.7
Clatsop	90.6	50.8	60.8	66.9	47.4	4,748.6
Columbia	3.6	7.6	3.7	3.4	1.4	295.0
Coos	1.9	3.3	1.7	1.8	1.9	158.5
Douglas	0.6	2.6	3.2	0.3	0.6	110.3
Josephine	0.0	0.8	0.7	0.2	0.1	28.5
Lane	18.9	7.3	4.5	9.4	11.2	769.2
Lincoln	9.6	10.8	10.0	7.6	11.1	737.2
Linn	12.9	7.4	7.7	8.5	8.0	669.1
Marion	10.5	8.0	5.7	5.9	6.4	548.2
Polk	1.8	2.6	1.6	1.6	3.1	160.9
Tillamook	88.3	86.4	62.7	41.7	86.2	5,478.8
Washington	25.0	14.4	12.3	18.9	13.0	1,253.7
Yamhill	0.0	0.0	0.0	0.0	0.0	2.1
Total	269.7	207.4	180.5	171.9	196.4	15,389.9

Table B-4. Harvest Volume (MMBF) by County (HCP Scenario)

County	2023 - 2037	2038 - 2052	2053 - 2067	2068 - 2082	2083 - 2097	75-year Total
Benton	4.9	6.6	4.9	3.3	5.4	377.1
Clackamas	3.6	2.2	3.0	2.0	2.7	201.0
Clatsop	72.0	39.1	51.2	55.5	37.8	3,833.0
Columbia	5.6	5.5	8.1	5.1	3.0	408.5
Coos	0.7	2.5	3.2	3.5	2.1	179.9
Douglas	0.2	1.1	1.5	2.1	2.4	109.3
Josephine	0.0	0.1	0.6	0.6	0.6	27.5
Lane	16.0	12.3	9.4	7.5	7.8	793.1
Lincoln	7.5	11.9	11.9	13.9	8.8	810.5
Linn	14.0	10.9	7.9	7.2	9.7	745.2
Marion	9.4	5.5	5.8	5.0	5.6	467.8
Polk	3.4	3.9	3.3	3.1	3.5	257.8
Tillamook	79.6	105.5	77.5	72.6	88.1	6,349.8
Washington	26.3	26.1	24.1	20.2	24.4	1,816.1
Yamhill	0.0	0.1	-	0.0	0.0	2.5
Total	243.2	233.1	212.4	201.4	201.8	16,379.1

Harvest Revenue by Region

Table B-5. Harvest Revenue by Region – 15-year Average (cFMP Scenario)

Year	North	South	Valley		
2023 - 2037	$46,921,000	$4,192,000	$10,558,000	$61,671,000	$51,197,000
2038 - 2052	$40,039,000	$3,915,000	$11,922,000	$55,876,000	$29,378,000
2053 - 2067	$40,214,000	$4,288,000	$12,789,000	$57,291,000	$19,341,000
2068 - 2082	$40,559,000	$4,559,000	$12,073,000	$57,191,000	$12,406,000
2083 - 2097	$38,632,000	$3,853,000	$11,717,000	$54,201,000	$7,520,000
75-year Total	$3,095,470,000	$312,115,000	$885,890,000	$4,293,455,000	$1,797,629,000

Note: Some totals do not sum due to rounding.

Table B-6. Harvest Revenue by Region – 15-year Average (dFMP Scenario)

Year	North	South	Valley	Undiscounted Total	Discounted Total
2023 - 2037	$74,455,000	$8,091,000	$16,788,000	$99,333,000	$82,872,000
2038 - 2052	$52,780,000	$4,063,000	$13,110,000	$69,953,000	$37,039,000
2053 - 2067	$48,464,000	$2,899,000	$11,808,000	$63,171,000	$21,317,000
2068 - 2082	$49,039,000	$4,590,000	$12,042,000	$65,670,000	$14,224,000
2083 - 2097	$51,353,000	$4,488,000	$13,322,000	$69,163,000	$9,523,000
75-year Total	$4,141,360,000	$361,950,000	$1,006,050,000	$5,509,345,000	$2,474,618,000

Note: Some totals do not sum due to rounding.

Table B-7. Harvest Revenue by Region – 15-year Average (HCP Scenario)

Year	North	South	Valley	Undiscounted Total	Discounted Total
2023 - 2037	$67,179,000	$6,523,000	$17,843,000	$91,545,000	$75,564,000
2038 - 2052	$57,909,000	$5,571,000	$15,696,000	$79,175,000	$41,881,000
2053 - 2067	$55,075,000	$4,525,000	$13,522,000	$73,121,000	$24,753,000
2068 - 2082	$54,444,000	$4,209,000	$12,581,000	$71,234,000	$15,542,000
2083 - 2097	$49,964,000	$4,186,000	$13,232,000	$67,382,000	$9,286,000
75-year Total	$4,268,560,000	$375,205,000	$1,093,110,000	$5,736,870,000	$2,505,399,000

Note: Some totals do not sum due to rounding.

Net Harvest Revenue by Region

Figure B-8. Harvest Revenue (North Coast Region)

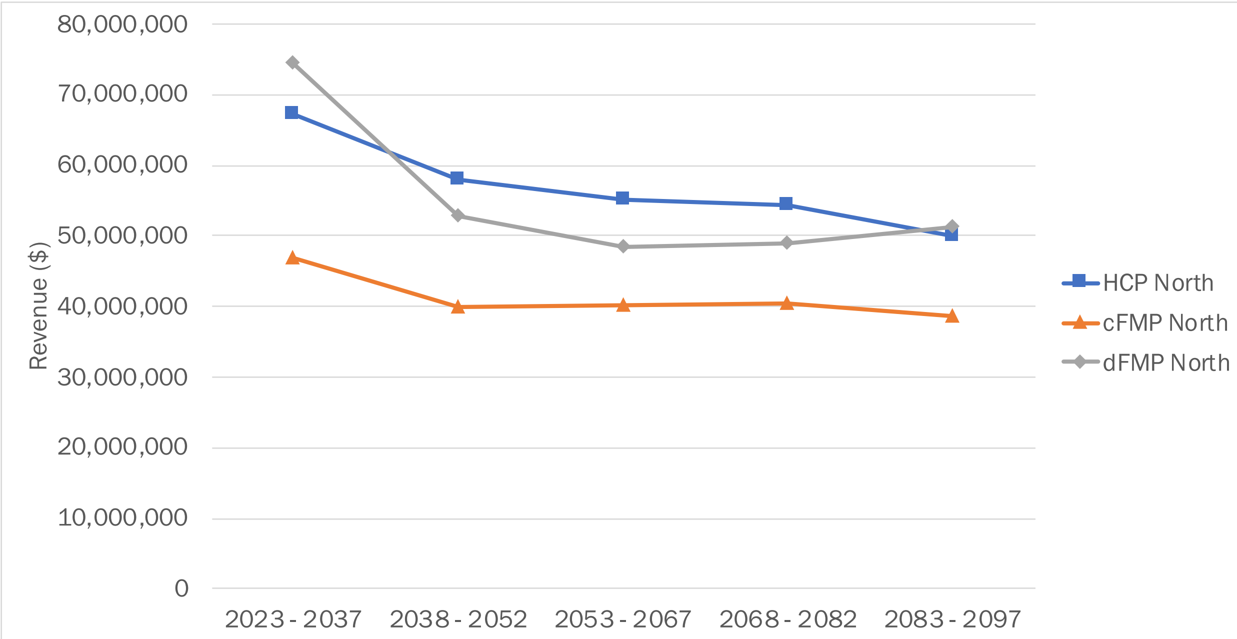


Figure B-9. Harvest Revenue (Valley Region)

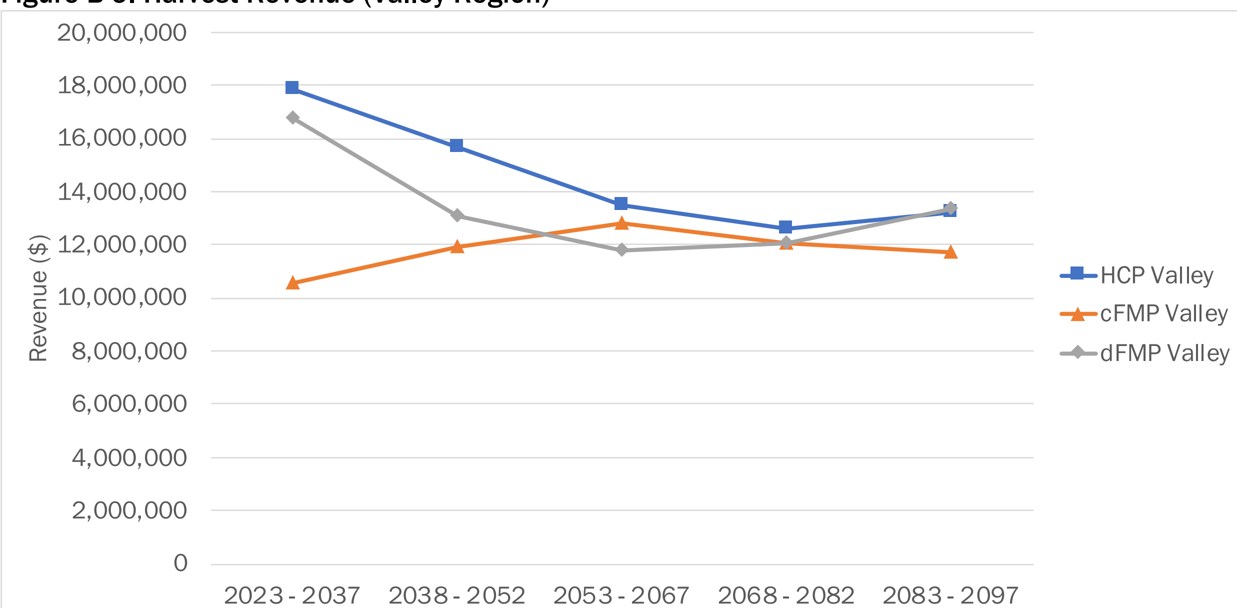
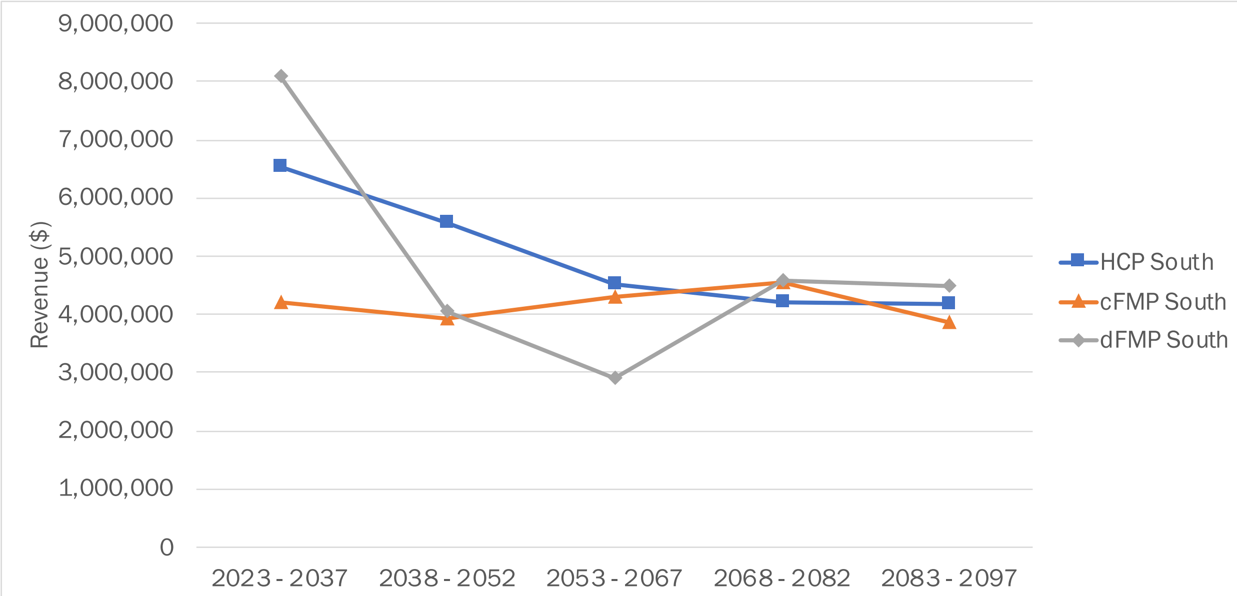


Figure B-10. Harvest Revenue (South Coast Region)



County Payments

Note that these tables of county payments reflect revenue from harvests only on BOF forests. They do not include CSFL harvest activity, which is included in the total and regional results, and thus will not sum consistently with those results.

Table B-8. County Payments – 15-year Average (cFMP Scenario)

County	Undiscounted						Discounted
	2023 - 2037	2038 - 2052	2053 - 2067	2068 - 2082	2083 - 2097	75-year Total	75-year Total
Benton	$491,000	$774,000	$883,000	$879,000	$643,000	$55,064,000	$20,719,000
Clackamas	$423,000	$363,000	$278,000	$407,000	$395,000	$27,980,000	$11,600,000
Clatsop	$11,760,000	$10,314,000	$10,365,000	$9,759,000	$9,890,000	$781,336,000	$333,832,000
Columbia	$1,068,000	$1,459,000	$619,000	$537,000	$421,000	$61,544,000	$30,443,000
Coos	$359,000	$446,000	$365,000	$420,000	$326,000	$28,758,000	$11,555,000
Douglas	$35,000	$198,000	$307,000	$204,000	$177,000	$13,808,000	$4,498,000
Josephine	$20,000	$0	$10,000	$46,000	$6,000	$1,230,000	$463,000
Lane	$2,084,000	$1,749,000	$1,778,000	$1,910,000	$1,808,000	$139,954,000	$58,936,000
Lincoln	$1,240,000	$1,861,000	$2,070,000	$1,646,000	$2,031,000	$132,715,000	$49,571,000
Linn	$1,552,000	$1,806,000	$2,731,000	$2,275,000	$1,385,000	$146,220,000	$56,649,000
Marion	$2,158,000	$1,778,000	$1,172,000	$1,251,000	$1,994,000	$125,275,000	$55,692,000
Polk	$357,000	$439,000	$326,000	$388,000	$561,000	$31,059,000	$11,760,000
Tillamook	$11,460,000	$10,891,000	$11,662,000	$12,425,000	$11,575,000	$870,213,000	$351,419,000
Washington	$5,322,000	$2,322,000	$2,780,000	$2,778,000	$2,368,000	$233,561,000	$114,196,000
Yamhill	$5,000	$5,000	$0	$5,000	$3,000	$265,000	$128,000
Total	$38,334,000	$34,405,000	$35,346,000	$34,931,000	$33,583,000	$2,648,981,000	$1,111,462,000

Note: Some totals do not sum due to rounding.

Table B-9. County Payments – 15-year Average (dFMP Scenario)

County	Undiscounted						Discounted
	2023 - 2037	2038 - 2052	2053 - 2067	2068 - 2082	2083 - 2097	75-year Total	75-year Total
Benton	$715,000	$870,000	$979,000	$839,000	$731,000	$62,003,000	$25,220,000
Clackamas	$650,000	$230,000	$338,000	$479,000	$576,000	$34,100,000	$14,044,000
Clatsop	$21,042,000	$11,516,000	$14,613,000	$16,477,000	$11,073,000	$1,120,805,000	$509,390,000
Columbia	$953,000	$1,956,000	$942,000	$816,000	$313,000	$74,693,000	$35,593,000
Coos	$324,000	$509,000	$289,000	$265,000	$300,000	$25,299,000	$10,762,000
Douglas	$91,000	$316,000	$298,000	$30,000	$61,000	$11,950,000	$5,245,000
Josephine	$4,000	$99,000	$63,000	$22,000	$11,000	$2,974,000	$1,282,000
Lane	$4,317,000	$1,537,000	$982,000	$2,299,000	$2,449,000	$173,754,000	$84,831,000
Lincoln	$2,016,000	$2,170,000	$2,106,000	$1,696,000	$2,367,000	$155,324,000	$62,733,000
Linn	$3,543,000	$1,830,000	$1,939,000	$2,143,000	$1,933,000	$170,815,000	$80,145,000
Marion	$2,840,000	$1,858,000	$1,322,000	$1,471,000	$1,526,000	$135,262,000	$64,538,000
Polk	$338,000	$506,000	$357,000	$351,000	$637,000	$32,838,000	$12,445,000
Tillamook	$18,500,000	$16,092,000	$12,263,000	$9,088,000	$17,959,000	$1,108,523,000	$481,841,000
Washington	$6,597,000	$3,275,000	$2,693,000	$4,603,000	$2,900,000	$301,024,000	$145,210,000
Yamhill	$10,000	$5,000	$1,000	$5,000	$7,000	$414,000	$185,000
Total	$61,938,000	$42,769,000	$39,184,000	$40,584,000	$42,843,000	$3,409,777,000	$1,533,464,000

Note: Some totals do not sum due to rounding.

Table B-10. County Payments – 15-year Average (HCP Scenario)

County	Undiscounted						Discounted
	2023 - 2037	2038 - 2052	2053 - 2067	2068 - 2082	2083 - 2097	75-year Total	75-year Total
Benton	$1,189,000	$1,468,000	$1,078,000	$713,000	$1,184,000	$84,472,000	$36,845,000
Clackamas	$840,000	$429,000	$560,000	$397,000	$556,000	$41,731,000	$19,067,000
Clatsop	$16,631,000	$8,769,000	$12,172,000	$13,439,000	$8,506,000	$892,752,000	$400,690,000
Columbia	$1,521,000	$1,435,000	$2,101,000	$1,269,000	$686,000	$105,191,000	$47,155,000
Coos	$120,000	$435,000	$526,000	$560,000	$332,000	$29,583,000	$9,817,000
Douglas	$31,000	$157,000	$211,000	$256,000	$276,000	$13,958,000	$3,983,000
Josephine	$9,000	$8,000	$83,000	$68,000	$78,000	$3,685,000	$967,000
Lane	$3,690,000	$2,606,000	$1,941,000	$1,588,000	$1,724,000	$173,231,000	$85,457,000
Lincoln	$1,676,000	$2,451,000	$2,419,000	$2,848,000	$1,770,000	$167,449,000	$63,992,000
Linn	$3,654,000	$2,718,000	$1,891,000	$1,575,000	$2,290,000	$181,917,000	$87,468,000
Marion	$2,502,000	$1,312,000	$1,273,000	$1,098,000	$1,335,000	$112,796,000	$54,284,000
Polk	$816,000	$790,000	$689,000	$614,000	$717,000	$54,395,000	$23,802,000
Tillamook	$17,301,000	$19,824,000	$15,092,000	$14,990,000	$16,793,000	$1,260,003,000	$529,108,000
Washington	$6,998,000	$6,344,000	$5,188,000	$4,634,000	$5,494,000	$429,869,000	$190,080,000
Yamhill	$7,000	$10,000	$0	$6,000	$7,000	$465,000	$185,000
Total	$56,985,000	$48,755,000	$45,225,000	$44,055,000	$41,747,000	$3,551,497,000	$1,552,897,000

Note: Some totals do not sum due to rounding.

Total Costs

Figure B-11. Total Costs (cFMP Scenario)

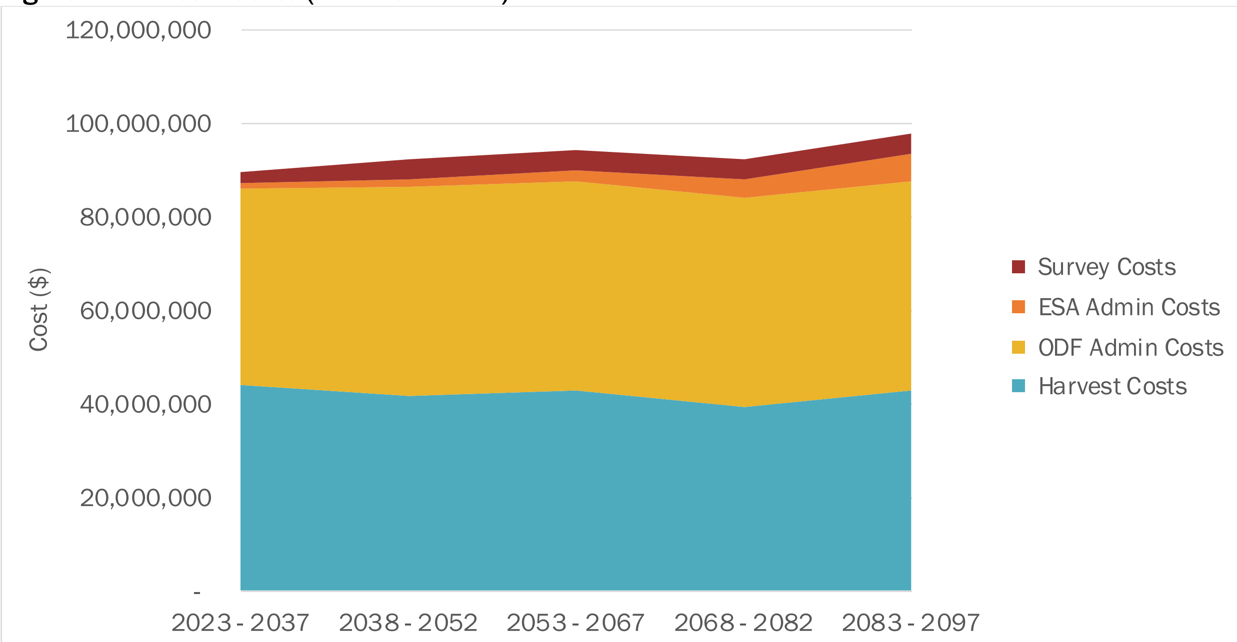


Figure B-12. Total Costs (dFMP Scenario)

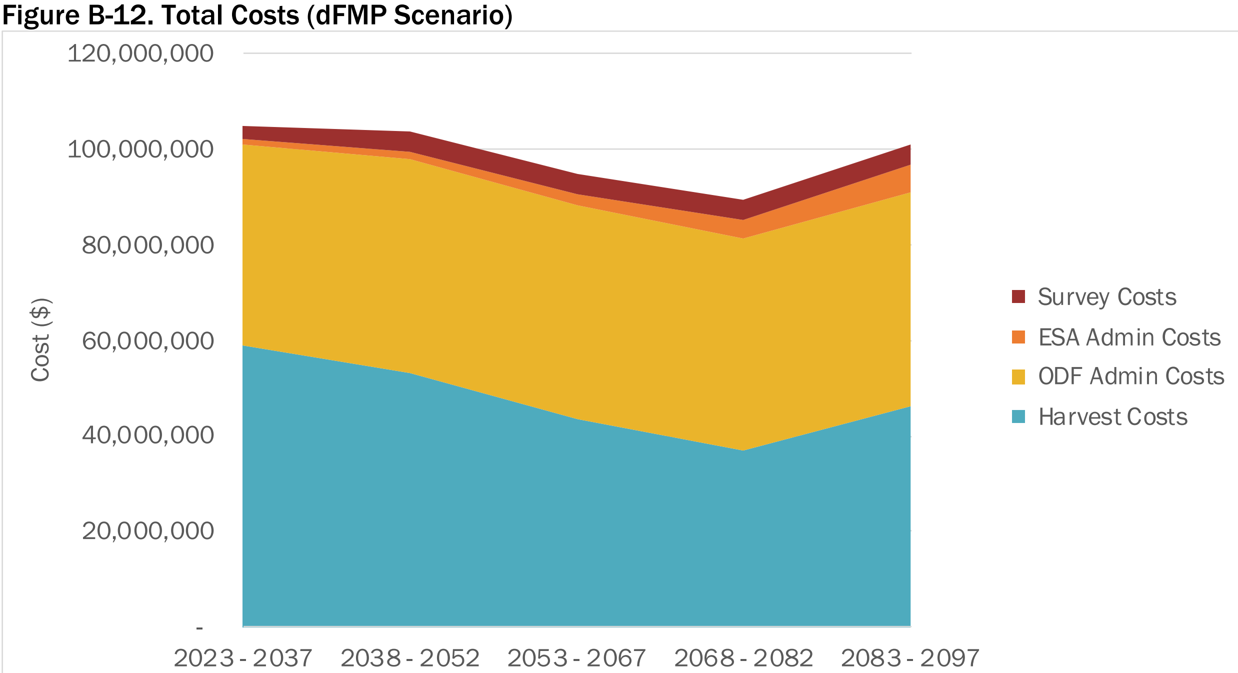
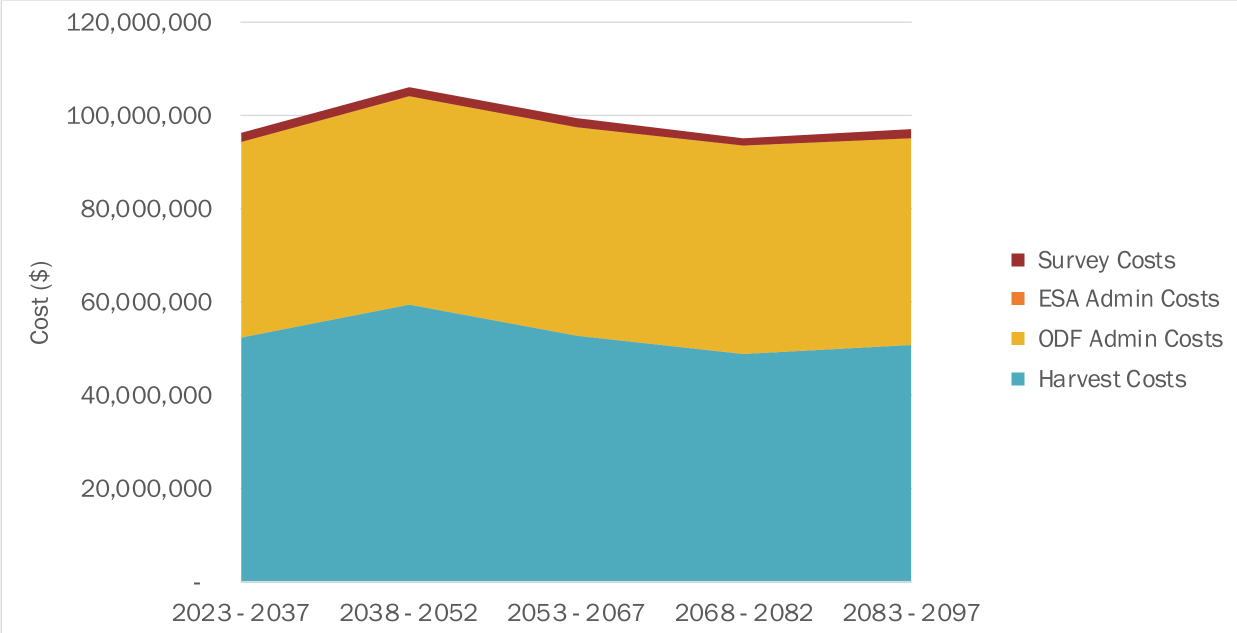


Figure B-13. Total Costs (HCP Scenario)



Inventory

Figure B-14. Available Inventory (All Scenarios)

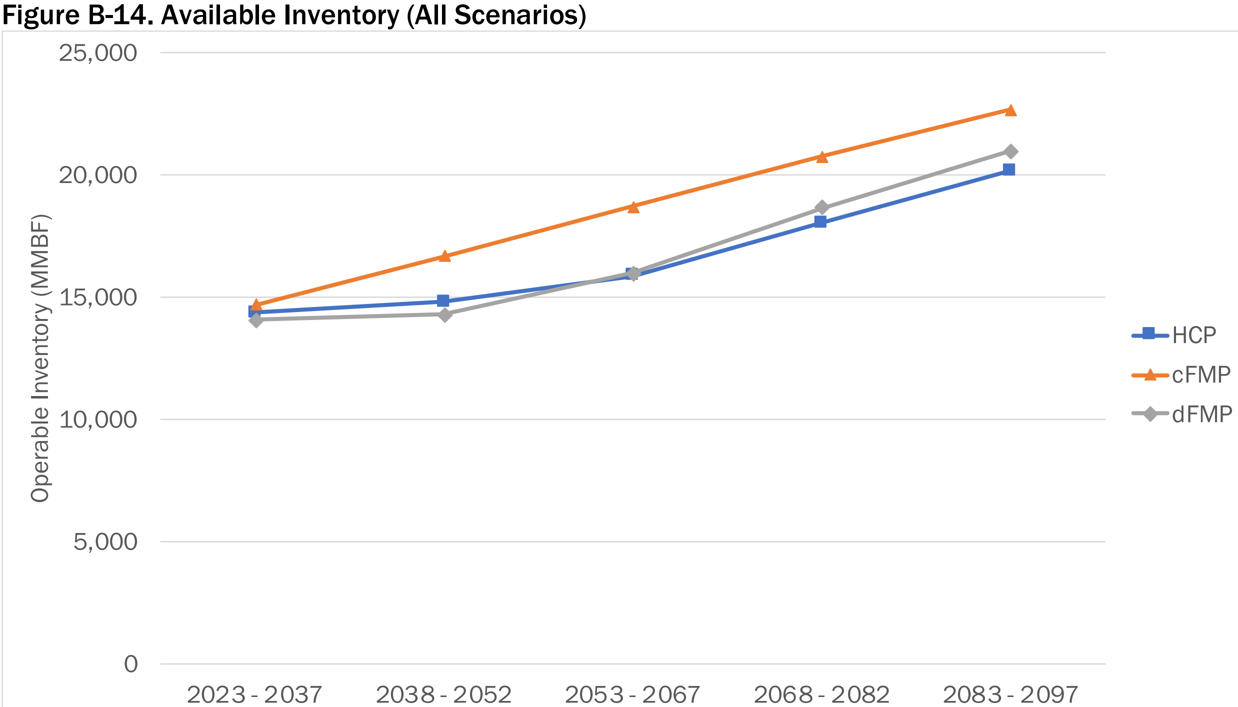


Figure B-14. Total Inventory (Available and Inoperable, All Scenarios)