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

Comparative Analysis

Executive Summary

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Prepared for:

Oregon Department of Forestry

Prepared by:

ECONorthwest
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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 within areas designated for conservation 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 entire permit area.*
- *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

[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).

[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

[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.

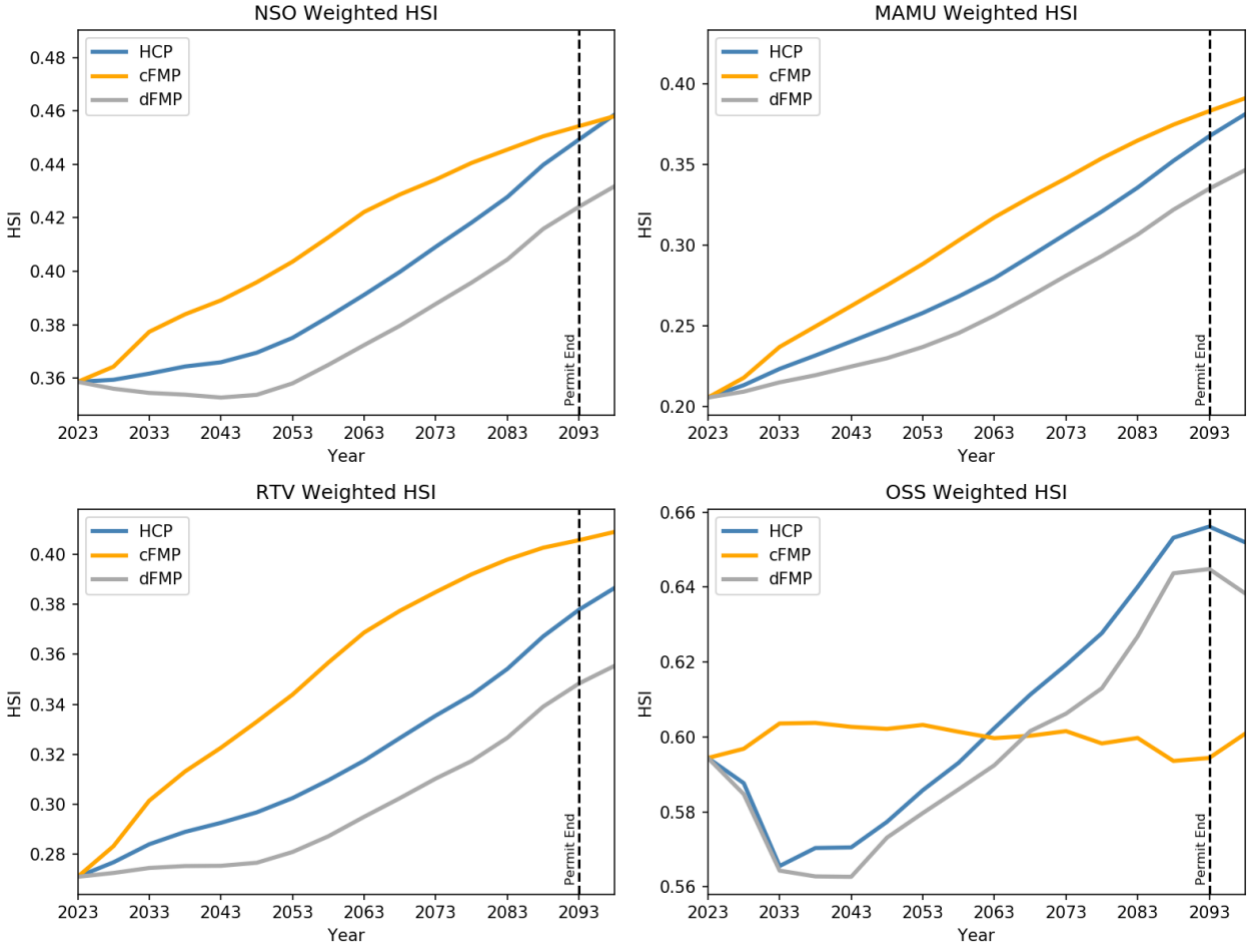
Similarly, the forest management model was designed to produce policy level outputs to compare scenarios generally, and has a limited set of silvicultural prescriptions from which to draw. This generalized prescription set results in a potential overestimate of the development of suitable habitat outside 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

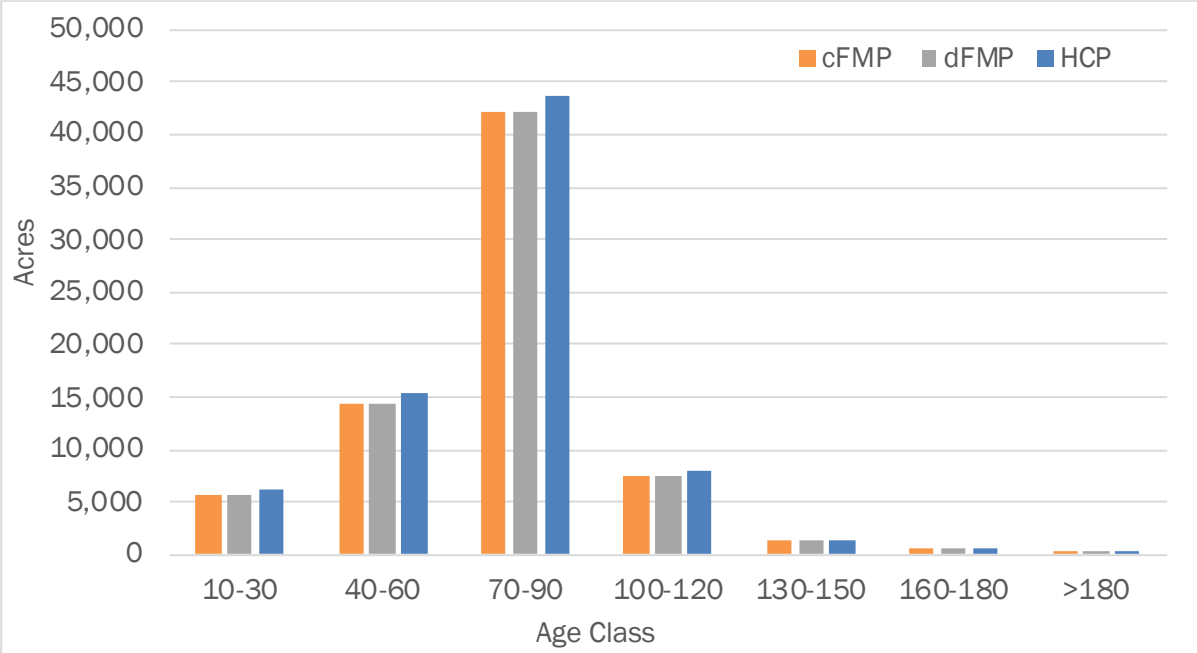
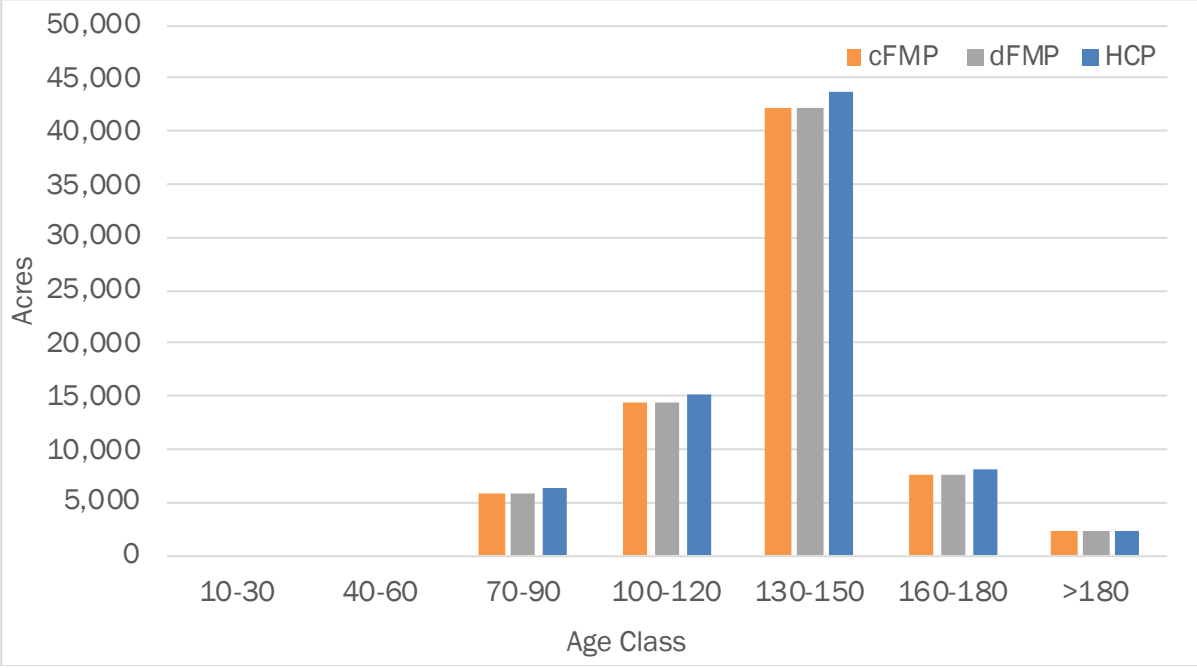


Figure 4. Riparian Age Class Distribution, 2083–2097



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

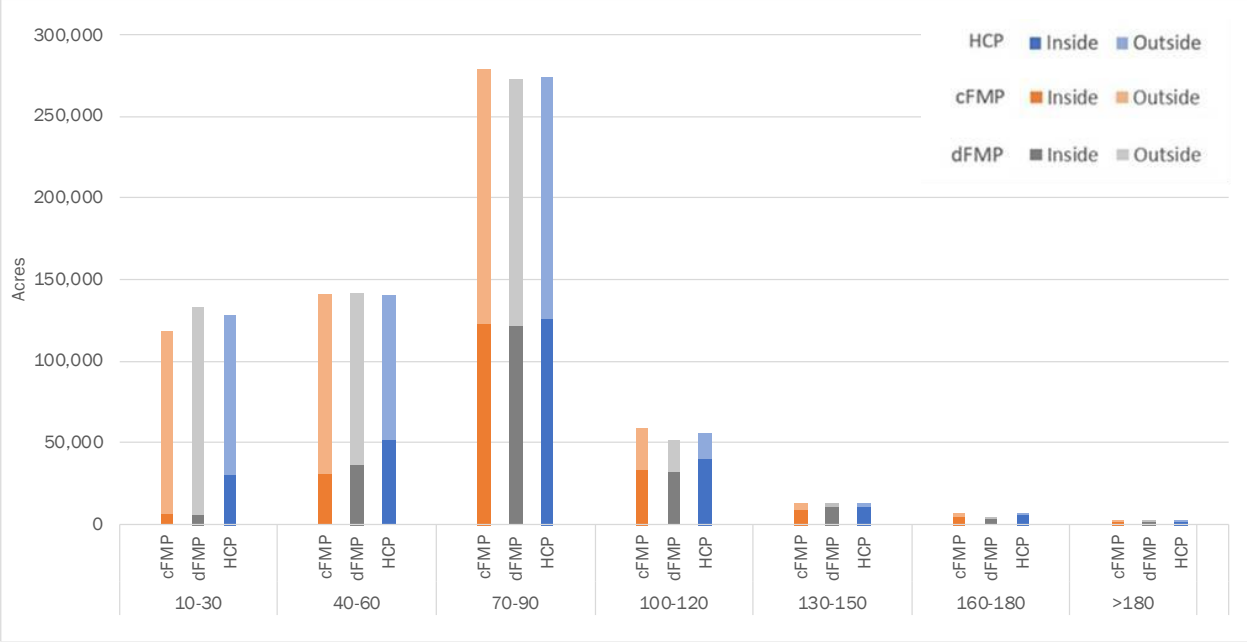
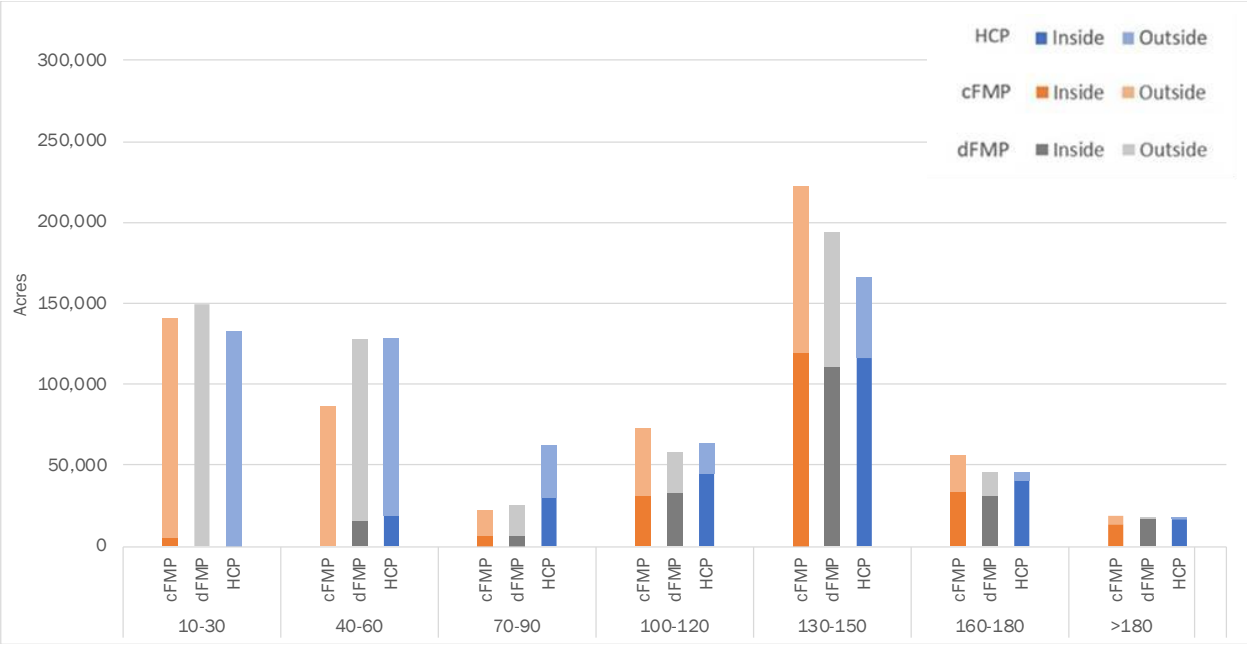


Figure 6. Average Forest Stand Age Class Distribution in the Permit Area Inside and Outside Areas Designated for Conservation, 2083–2097



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)

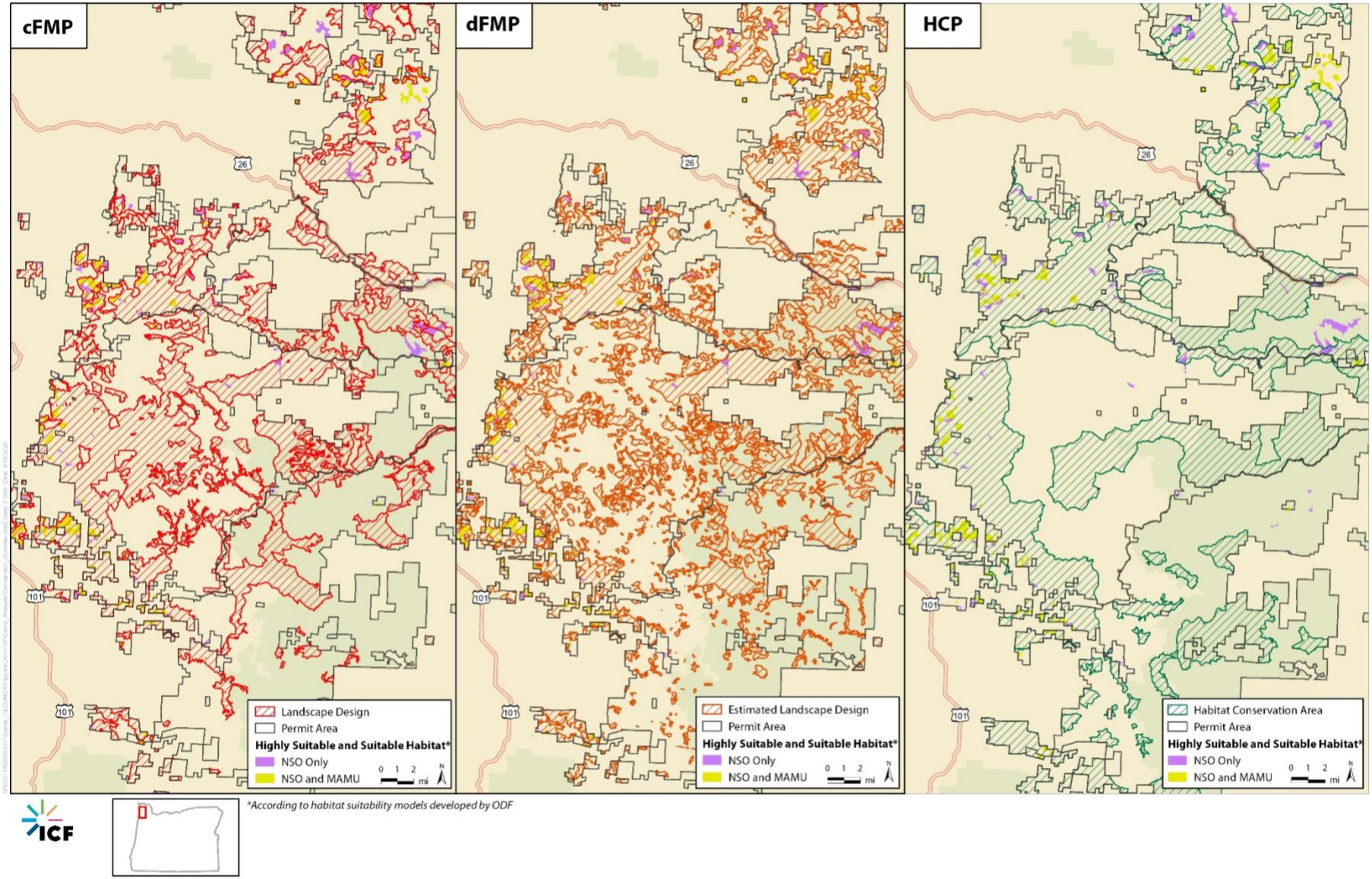


Table 4 shows the level of alignment between areas designated for conservation and current suitable habitat across the permit area, and Figure 7 shows examples of these areas for the Tillamook District. Across the entire permit area, the ELD is best aligned with currently modeled habitat, encompassing 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

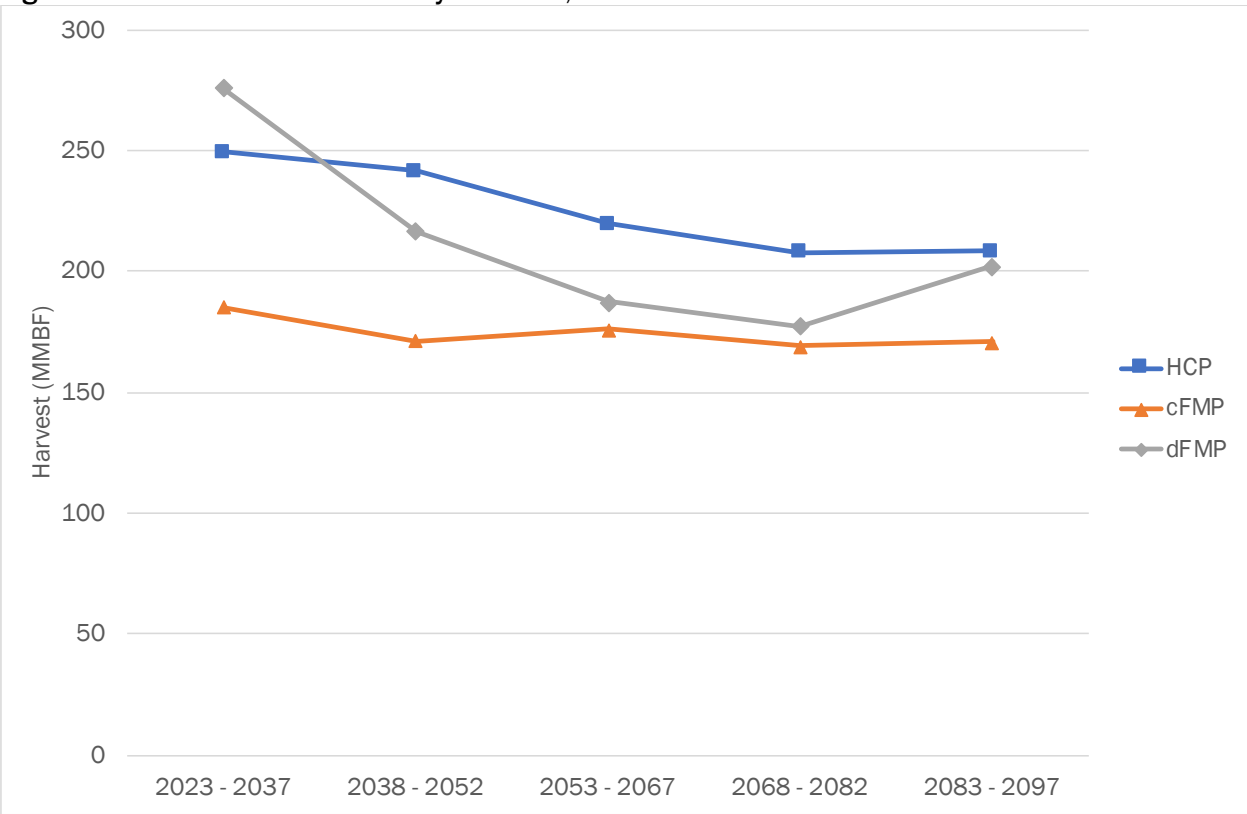
Harvest Volume

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

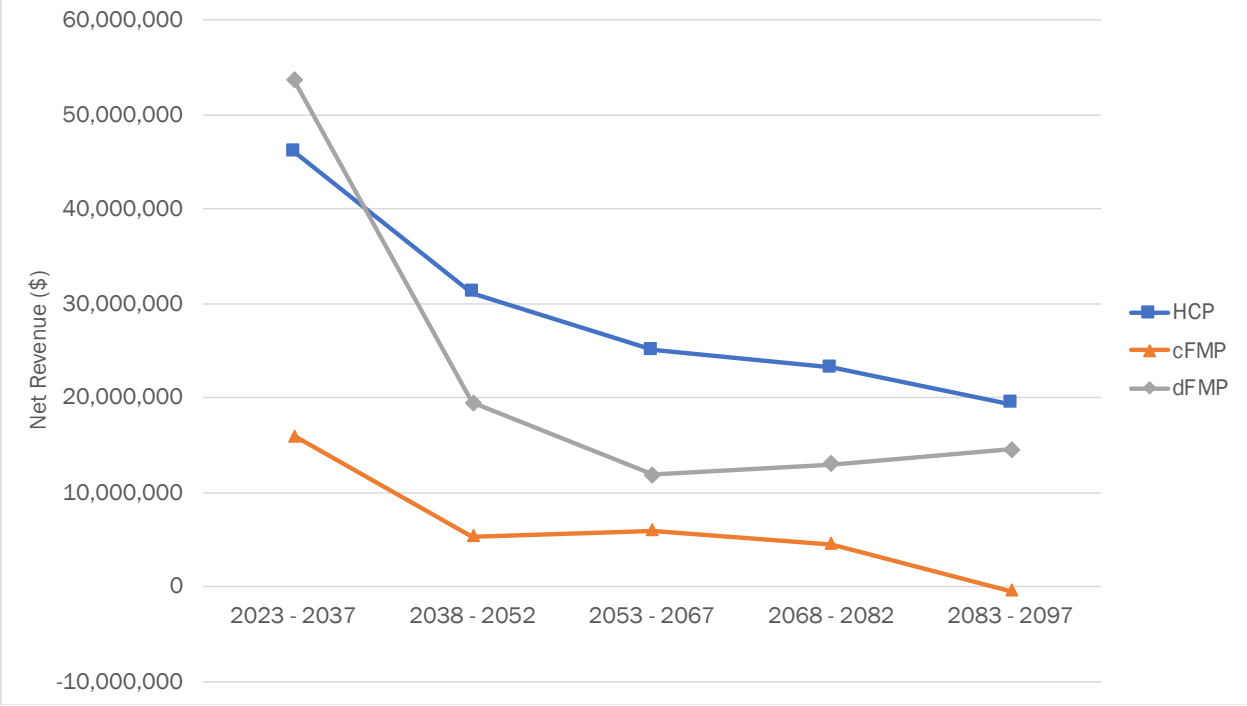
Cost Category	cFMP and dFMP	HCP	Annual HCP Cost Savings
ESA Administration	$3,165,000	$348,000	$2,816,000
Species Management [a]	$4,216,000	$3,095,000	$1,121,000
Total	$7,381,000	$3,444,000	$3,937,000

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.

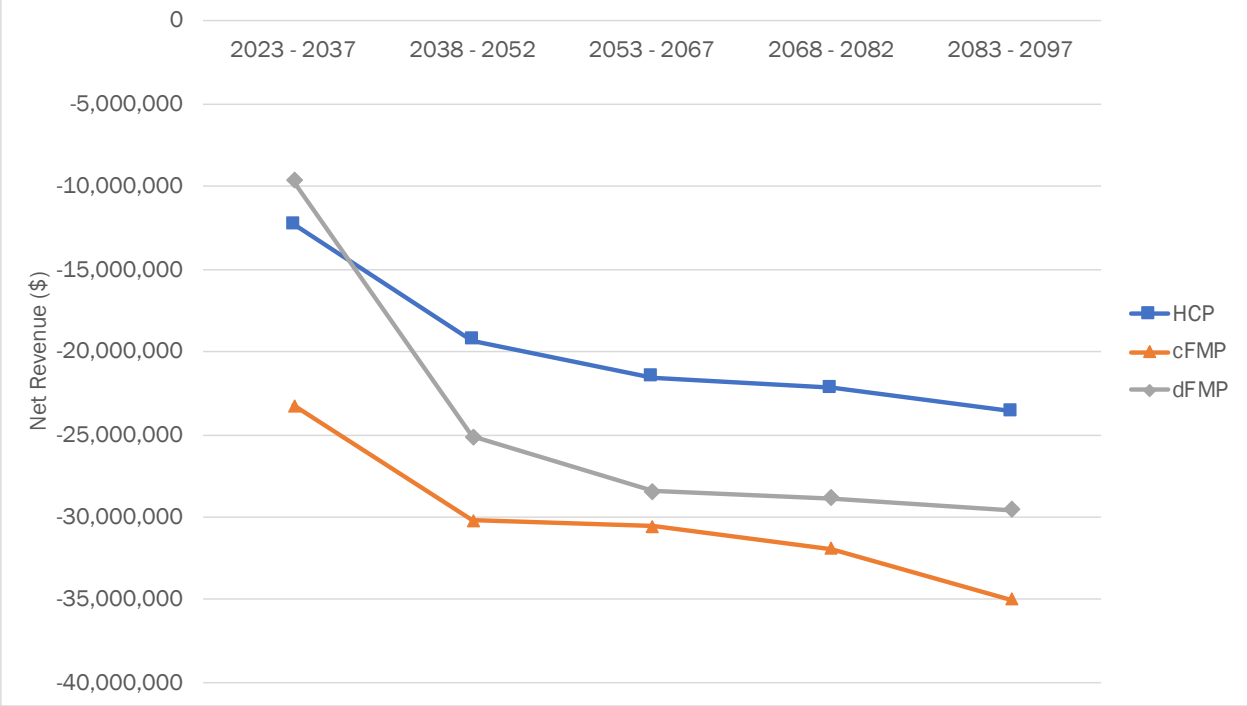
Figure 9. Annual Net Revenue (Harvest Revenue Minus ODF Costs) Across All Scenarios



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 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 Retained Revenue for ODF after Revenue Distributions



Note: Points represent 15-year averages.

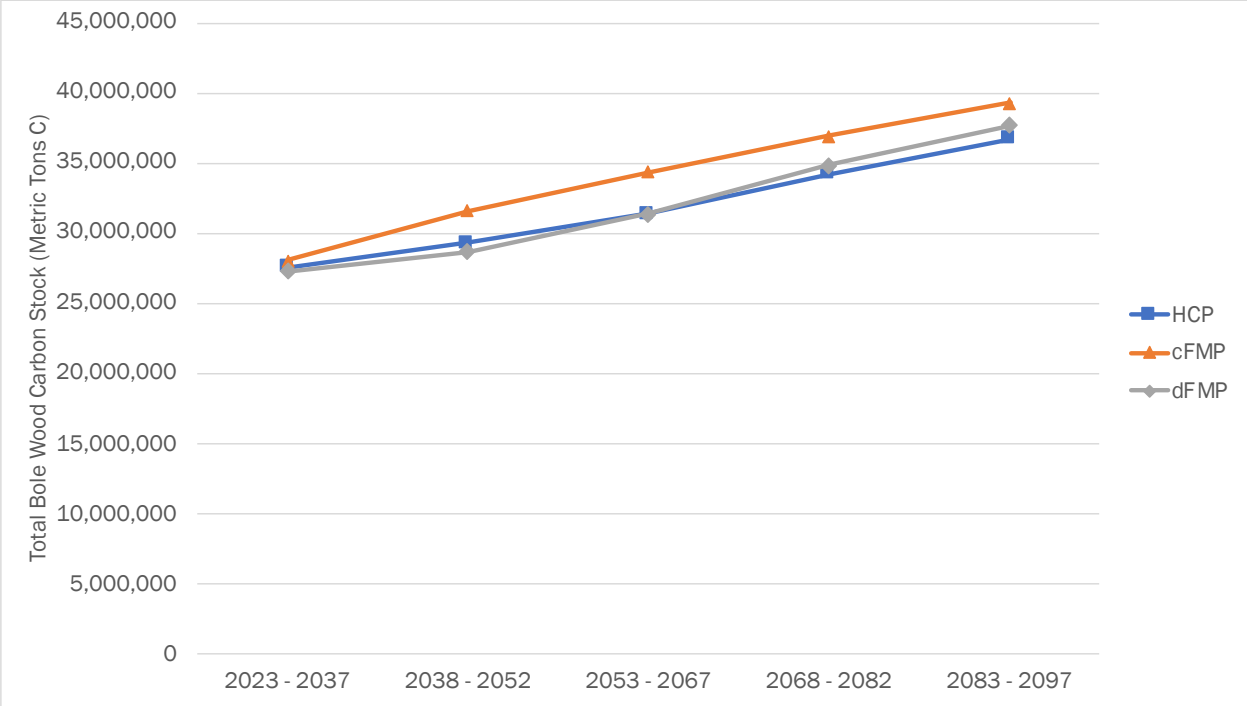
Social Outcomes

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.