

Chapter 4

ENVIRONMENTAL CONSEQUENCES

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Environmental Consequences

This chapter identifies any potential impacts under each alternative on the affected environment described in Chapter 3. Potential mitigation is identified where necessary.

■ Identifying impacts

Because the alternatives are limited to evaluating different approaches for marbled murrelet conservation, identifying adverse impacts to natural resources can be challenging. By design, the alternatives do not propose changing any other management approaches other than the marbled murrelet conservation strategy. Because of this, we would not expect considerable adverse impacts to other resources. Nevertheless, there can be subtle, indirect, and/or cumulative impacts that occur to natural resources due to the varying degrees of conservation proposed for marbled murrelets under the alternatives. It is the intent of this chapter to assess and understand, to the best we can, what impacts might occur to the natural and built environment from the different alternatives.

■ Asking the right questions

Each section of this chapter begins with questions that provide a framework for the analysis of environmental consequences. These “analysis questions” are designed to focus specifically on aspects of the environment likely to be impacted by the alternatives.

■ Evaluation criteria and measures

Determining whether there is an impact from the alternatives requires a methodology to evaluate whether and how an action alternative changes or affects the current conditions under the no action alternative. For some elements of the environment (such as climate and marbled murrelet populations), environmental conditions will change even under the no action alternative. These changes are also evaluated.

Evaluation criteria rely on the existing conservation or management objectives, policies, or rules that are being and would continue to be implemented under the no action alternative. *Measures* either qualitatively or quantitatively identify changes that the action alternatives create to elements of the environment relative to these criteria. Each section of this chapter identifies the evaluation criteria and measures used.

Determining the level of impact

This DEIS is designed to meet the requirements of both SEPA and NEPA. Both laws require the DEIS to evaluate adverse impacts. NEPA requires the identification of impacts that can be either beneficial or adverse.

CONSIDERING SCALE AND CONTEXT

The analysis area covers over 1.3 million acres of DNR-managed land. The evaluation of impacts must consider whether identified potential impacts are significant relative to scale and context. The impact of an alternative on a single campground, for example, may not be significant when looked at in the context of available recreation facilities within the scale of analysis area, but that could be different when considered locally. Most alternatives are evaluated at the analysis area scale, although some are looked at by planning unit or county where appropriate data may be available to measure the potential impact.

CONSIDERING INTENSITY

The term “intensity” refers to the severity of the impact. Intensity considers the duration and/or level of the impact. Some impacts can be relatively short in duration, and others may have longer-term consequences for an element of the environment. Indirect and cumulative impacts are also considered when determining the overall intensity of an impact to an element of the environment.

4.1 Earth: Geology and Soils

This section describes the potential effects of the alternatives on landslide potential and soil resources in the analysis area.

Analysis question

- *Would the action alternatives affect the potential for landslides or increase soil erosion or compaction within the analysis area?*

Evaluation criteria

This analysis considers the existing policies, regulations, and procedures in place to protect soil resources and soil productivity and address landslide hazards, including the *Washington State Forest Practices Board Manual, Policy for Sustainable Forests*, and the 1997 HCP.

Scale of analysis

As described in Chapter 1, this DEIS is considering DNR activities at the strategic level. Therefore, the scale of analysis for negative impact to soils and landslide hazards is the analysis area, with some additional analysis conducted at smaller scales to understand how marbled murrelet-specific conservation would overlap with areas of potential slope instability.

How impacts are measured

Impacts to soil resources or areas of landslide potential are measured qualitatively, based on whether the proposed action alternatives would affect consistency with forest practices rules and other best management practices to protect potentially unstable slopes or whether the alternatives would increase potential for soil damage from forest management activities.

Summary of direct, indirect, and cumulative impacts

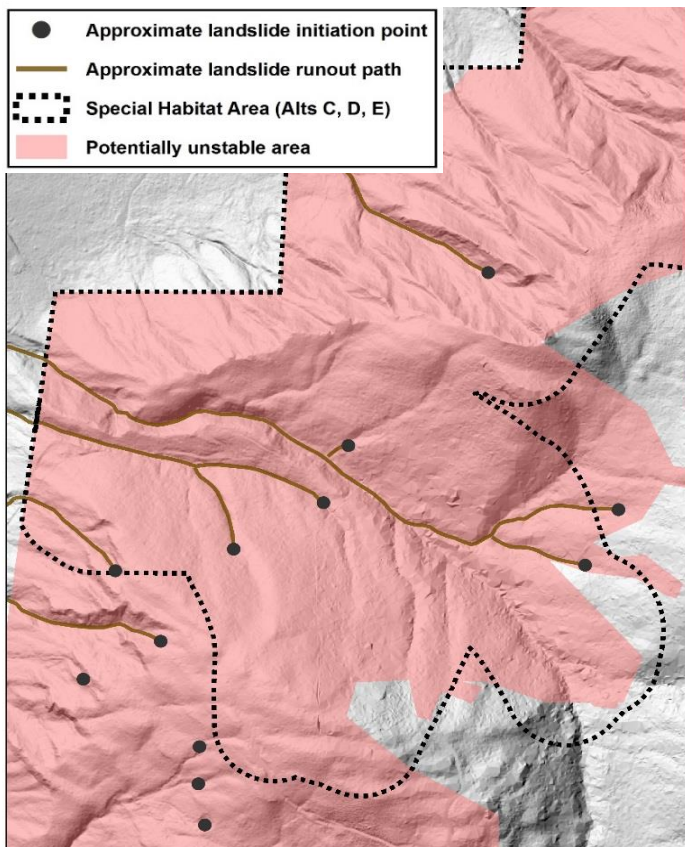
Effects on soil productivity, risk of compaction, and erosion

Because timber harvest activities are limited in areas of long-term forest cover (LTFC), the proposed action alternatives are not likely to increase levels of surface erosion or compaction or otherwise adversely impact soil productivity. All action alternatives except Alternative B add conservation acres to LTFC. However, even with the reduction of approximately 27,000 acres of LTFC under Alternative B (compared with the no action alternative), all existing policies and regulations governing forest practices that manage



Standard best management practices to minimize erosion include placing crushed surface rock on roads. Photo: DNR

Figure 4.1.1. Example of Special Habitat Area With Potentially Unstable Areas



for soil productivity would remain. This would also apply to any area that is currently protected as marbled murrelet habitat under the interim strategy but may become available for management as conservation areas shift under the action alternatives.

Risk of landslides

In marbled murrelet conservation areas, restrictions on harvest, thinning, road building, and related activities mean that active management will be limited. Some of these conservation areas are mapped as potentially unstable, but this does not mean they are definitely at risk of a landslide occurring during the planning period.

Figure 4.1.1 illustrates an area where a proposed special habitat area overlaps an area indicated in DNR's GIS data as having potential landslide hazard risk. It is

important to recognize that the area identified as potentially unstable in Figure 4.1.1 may be an overestimation of where the landslide risk specifically exists. Field verifications would be needed to more precisely analyze where the landslide risk is likeliest. The figure shows areas (landslide initiation points and runout paths) where actual landslides occurred following an extreme storm event in 2009.

Lands identified as potentially unstable would continue to be managed as provided for under current regulations, policies, and procedures, which are designed to minimize landslide risks. For these reasons, there is no expected increased landslide risk compared with current conditions, even on the 27,000 more acres made available for active management under Alternative B (as compared with the no action alternative).

Under any alternative, additional lands could be designated as a potentially unstable slope in the future, or land currently designated could be removed from that designation. No changes in the management of these areas are anticipated as a result of the proposed action.

Conclusions

Under all alternatives, including the no action alternative, DNR would continue to minimize the potential for landslides and damaging impacts to soils through the existing regulatory framework. This includes the 27,000 acres of land that would no longer remain in the interim conservation strategy for murrelets under Alternative B. Some areas of potential slope instability or high erosion potential would be included in marbled murrelet conservation areas, but forest management activities would be restricted in these areas. Table 4.1.1 summarizes these conclusions.

Table 4.1.1. Summary of Potential Impacts to Geology and Soils

Key questions	Criteria	Measures	Potential impacts
Would the alternatives affect the potential for landslides or increase soil erosion or compaction within the analysis area?	<p>Whether the alternatives would reduce DNR's ability to protect soils.</p> <p>Consistency with Washington State Forest Practices Rules and other best management practices to protect potentially unstable slopes.</p> <p>Whether the alternatives would increase potential for soil damage from forest management activities.</p>	<p>Acres currently deferred that would no longer have restrictions for marbled murrelet.</p> <p>Net acreage of LTFC under each alternative.</p> <p>Acres of potentially unstable slopes.</p> <p>Percentage of LTFC that is potentially unstable slope.</p> <p>Percentage of potentially unstable slopes in interior forest.</p>	<p>None. No alternative would increase risks to soils or increase landslide potential. Compared with the no action alternative, Alternative B slightly increases the acreage available for new timber harvest and road building, but the existing regulatory framework designed to minimize soil impacts from these activities would apply to these areas.</p>

4.2 Climate

This section evaluates possible relationships between the marbled murrelet conservation strategy alternatives and climate change.

Analysis questions

- *Do any alternatives cause more greenhouse gases to be emitted than sequestered?*
- *What effects will climate change have on the action alternatives or their expected environmental impacts?*

Evaluation criteria

Carbon sequestration in the analysis area and potential climate-related impacts to elements of the environment, particularly loss of complex forest structure in LTFC, are the primary measures used in this analysis to evaluate the relationship between the alternatives and climate change.

Greenhouse gas emissions and carbon sequestration

The 2016 guidance from the Council on Environmental Quality (CEQ) recommends that “agencies use the projected GHG emissions associated with proposed actions as a proxy for assessing proposed actions’ potential effects on climate change in NEPA analysis.” CEQ allows for a qualitative analysis where agencies do not have reasonable available data to support calculations for a quantitative analysis.

DNR does not have data on how much basal area will be removed from each stand in the future, how much basal area remains in each stand following a treatment, and how much carbon is sequestered through time as each thinned or unharvested stand grows. Without such data, a quantitative analysis is difficult and would likely produce questionable results. Given the lack of quantitative data, this carbon analysis uses principles to develop a relative ranking of proposed alternative impacts to a changing climate.

As described in detail below, our analysis concludes that all alternatives are likely to result in more carbon sequestered than emissions generated. Because the proposed action is to develop a long-term conservation strategy for marbled murrelets, all alternatives are analyzed based on area conserved rather than area harvested.

Text Box 3.2.1

Do the alternatives influence carbon sequestration?

All alternatives are likely to increase the amount of carbon sequestered by DNR-managed forests.

Climate-related effects on elements of the environment

Potential impacts of climate change to elements of the natural environment within the analysis area are evaluated below. The analysis focuses particularly on forest structure within LTFC, evaluating whether potential climate-related declines in complex forest structure would be exacerbated by area conserved under each alternative. We chose to focus on complex forest structure within LTFC because complex forest structure is more likely to provide marbled murrelet nesting habitat, and the intent of a long-term strategy is to conserve and promote nesting habitat within LTFC. Potential impacts of climate change to marbled murrelets are further discussed in Chapter 5.

Scale of analysis

Carbon sequestration is analyzed at the scale of DNR-managed lands in western Washington. This is appropriate because a determination of net carbon emissions for each alternative must consider both the carbon sequestration in the analysis area and the emissions from managing the same area.

The analysis to determine whether the alternatives exacerbate the impacts of climate change on the environment is analyzed at the same scale. While climate will influence the future forests of Washington, including DNR-managed lands, the science to date cannot be applied at an individual DNR-managed stand level scale.

How impacts are measured—carbon sequestration

Our analysis assumes that carbon emissions, which contribute to climate change, are greater than carbon sequestered if any of the following conditions are met:

1. If DNR harvests older stands and replaces them with stands to be harvested on shorter rotations;
2. If DNR's final harvest rotation shortens with time; or
3. If volume, and by association carbon, removed by thinning is greater than residual stand volume growth.

These conditions rarely, if ever, occur on DNR-managed lands. Due to various policies already in place, in addition to lands included under most of the alternatives, DNR effectively does not harvest older forest stands. All alternatives assume DNR does not change the age when a final harvest is conducted. Therefore, the rotation length does not shorten. Even under Alternative B, more currently harvestable land may remain available to harvest, but the rotation length is not assumed to change. While this condition is likely true on lands managed for short rotations (i.e., scheduled for final harvest sometime after thinning), the condition does not apply to DNR-managed lands that are periodically thinned but never final harvested, as is found in LTFC lands.¹

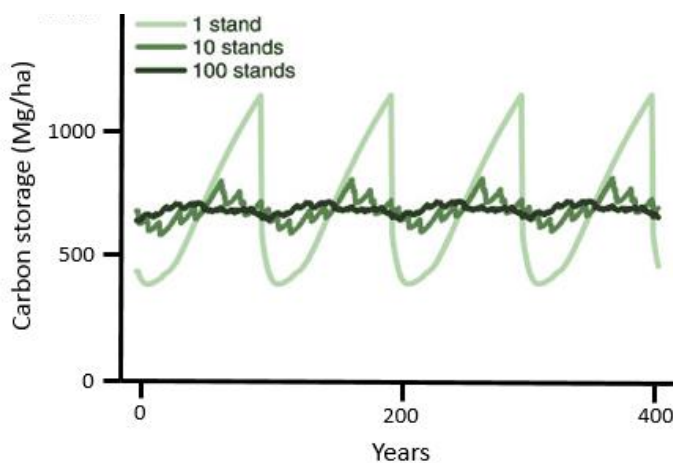
¹ This analysis does not include quantitative data about harvest or thinning acres or volumes. Potential harvest schedules are being developed as part of an update to the sustainable harvest calculation (currently being drafted).

Given these factors, we can expect the following principles to apply to the analysis area:

HARVEST ROTATIONS

1. *Across the landscape and through time, lands that DNR manages on final-harvest rotations are in a steady-state carbon balance because the frequency of final harvests does not change over time, and there is no additional acreage being converted from old growth to second growth. This means the overall impact of harvesting to the carbon balance on DNR's forested land base for the life of the HCP is neutral.* This principle is partly illustrated in Figure 4.2.1 where the carbon stored in a single managed stand greatly varies with time; however, because different stands are harvested in different years, the overall variation in carbon storage across the entire landscape is neutral. If harvest frequencies would increase with time, both the graph and principle would no longer be correct.

Figure 4.2.1. Variation in Carbon Storage at Different Spatial Scales (Adapted from McKinley and others 2011)

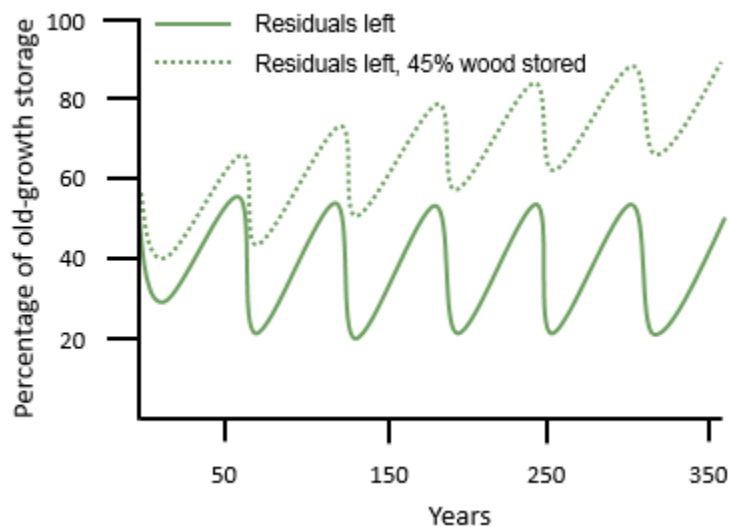


Note the average carbon store remains similar across scales, but the range in carbon storage differs depending on whether one examines a single stand or stands of varying ages across a landscape.

a single 60-year harvest rotation (and the life of the HCP) is slight (Figure 4.2.2). Please note we use the example of old growth to illustrate the principle. DNR's current policies preclude the actual harvest of old-growth forests.

When the entire wood product life cycle is considered, the total amount of carbon stored may increase with time as carbon from harvested trees remains in some durable wood products like lumber (Figure 4.2.2). However, after accounting for typical wood product fates, that additional carbon storage accumulates only slowly, taking well over 400 years to recover toward old-growth storage levels on a per-acre basis (dashed line in Figure 4.2.2). With repeated 60-year rotation, the time required to achieve the same amount of old-growth carbon storage is much slower than that attained by simply letting stands age (steep rises preceding harvests on Figure 4.2.2) and is sufficiently slow that any additional carbon stored in wood products during

Figure 4.2.2. Variation in Carbon Storage Under 60-Year Rotations (Adapted from Harmon and others 1990)



This graph illustrates the additional carbon storage gained when wood products (called "wood stored" in the figure) are included in a carbon analysis.

The current DNR land base within the analysis area is largely comprised of highly productive forested lands. If climate change were to reduce forest productivity, the total amount of sequestered carbon across the landscape would lower but would still result in neutral sequestration patterns as shown in Figure 4.2.1. Carbon released by vehicles and equipment related to timber sales would also lower the total amount of carbon sequestered. However, such annual emissions would be largely uniform though the life of the HCP assuming no shortening of harvest rotation length, thereby resulting in a neutral carbon balance.

THINNING TREATMENTS IN LTFC

- On DNR-managed lands in the analysis area, the carbon removed from a thinning treatment in stands with no final harvest will be less than carbon eventually sequestered in the residual trees. The overall impact of these treatments to the carbon balance would be neutral to positive. Studies of Douglas fir in the Pacific Northwest have shown that volume removed from repeated thinning entries is greater than the residual volume growth on stands with 50-year rotations (Curtis and others 1997, Curtis and Marshall 2009); however, due to continued rapid growth following thinning, the studies also concluded that residual live tree volume would exceed volume removed with moderately extended rotations. This result suggests carbon sequestered in thinned (from below) stands without a final harvest should generally exceed thinning-related carbon loss. While stand ages vary on DNR-managed lands in this management category, many stands that already have or might be thinned within LTFC would exceed 50 years at the end of the HCP. Furthermore, the previously cited studies typically included five thinning treatments whereas the DNR lands in this category may have one or two treatments during the remainder of the HCP, and therefore are likely to near or exceed a positive carbon balance. Taken together, more volume, and therefore carbon, will generally remain in stands through time on thinned acres relative to the volume removed from thinning treatments.

UNMANAGED LTFC

3. *The more acreage added to unmanaged LTFC, the greater the sequestration benefit.* The most effective way to sequester carbon within these forests is to allow them to age (Mackey and others 2013, Keith and others 2014). As illustrated in Figures 3.2.1 and 3.2.2, it would take several centuries of 50–60 year final harvests to achieve the same level of carbon storage as is found within intact old forests, and the rate of carbon storage is much slower than that by letting forests age. Alternatives with more acres in LTFC will sequester more carbon than those with fewer acres in LTFC.

Summary of direct, indirect, and cumulative impacts

Greenhouse gas emissions and carbon sequestration

Alternative B would potentially emit more greenhouse gases related to harvest activities² than the no action alternative (Alternative A) because Alternative B releases 27,000 acres of forest for potential harvest. Emissions will likely decrease under Alternatives C through F relative to the no action alternative because these alternatives make fewer acres available for harvest.

The most carbon would be sequestered under Alternative F, followed by Alternatives E, C, D, A, and B in that order. Although listed in order of the amount of carbon sequestered, the absolute difference in carbon stored among Action Alternatives B, C, D, and E is likely minimal because of the narrow difference in acres in LTFC. Because all alternatives sequester more carbon than is emitted, this analysis concludes that no alternative likely results in a significant adverse impact to climate change from emissions.

Text Box 3.2.3

Will climate change be affected by changes in carbon sequestration under the alternatives?

Because all alternatives sequester more carbon than is emitted, no alternative results in a significant adverse impact.

² As stated in Chapter 3.2, carbon is the leading type of greenhouse gas emitted from DNR forest management activities and therefore is the focus of this analysis.

Impacts of climate change on elements of the environment critical to a long-term conservation strategy

VEGETATION

Growth and retention of structurally complex forest throughout the planning period is a key component to the success of a long-term conservation strategy. Forest growth (productivity) is affected by climate change. For reasons noted in Chapter 3.2, forest productivity will increase or decrease seasonally and annually depending on tree species and location (Littell and others 2008, Peterson and Peterson 2001, Stephenson 1990, 1998). However, broad generalizations about productivity can be made based on current energy and moisture limitations (Milne and others 2002, McKenzie and others 2003, Littell and Peterson 2005). For example, while low elevation lands in the Puget Trough and the northeast portion of the Olympic Peninsula are more likely to decline in productivity with increasing temperatures and moisture stress, this loss might be offset by increased forest productivity at higher elevations and other locations where warming temperatures extend the growing season. Yet even with increases in annual tree productivity, warmer and drier summers, combined with more intense droughts, will increase summer moisture stress and likely reduce summer productivity, even in some locations that are currently energy-limited. What is unclear is if such declines in summer productivity will more than offset increases in productivity during the rest of the year. With both increases and decreases in forest productivity likely, habitat goals could be reached sooner or later in different portions of DNR-managed lands. Overall, it is not yet possible to conclude when climate-related influences to forest productivity on DNR-managed lands within LTFC will be positive, negative, or neutral through the planning period. No significant productivity differences are anticipated within LTFC between the no action alternative and the action alternatives, nor between action alternatives.

Text Box 3.2.2

Are older forests more resilient to climate change?

Conserving older forest while allowing forests to grow with minimal human intervention is a reasonable strategy to promote west-side forest resilience under a changing climate. Thinning to accelerate late-successional conditions in younger second-growth forests can help facilitate the goal of forest resilience.

Forest conditions can be changed through management. Thinning to accelerate late-successional conditions in younger second-growth forests could increase forest resilience because it may reduce drought-related stress in younger and more moisture-sensitive trees and foster structural and compositional diversity at both the landscape scale (since most of the landscape is young to mid-seral and old forest therefore provides some complement) and at the stand scale (since older forests have the broadest range of tree sizes and species). Thinning will occur in LTFC on a limited basis, primarily outside marbled murrelet conservation areas (with the exception of MMAs and emphasis areas) and with a purpose to accelerate development of structurally complex forest.

DISTURBANCE

The forests of western Washington have evolved with largely stand-replacing disturbance events for millennia (Agee 1993). Episodic wind events have and continue to affect coastal Washington forests, but their influence in the rest of western Washington is more muted. While both wind and insects have helped shape the forests, fire has historically been the key driver of broad-scale stand initiation and related structural development across western Washington (Franklin and others 2002). For example, the Yacolt Burn of 1902 burned approximately 239,000 acres of forest in Clark, Cowlitz, and Skamania counties in less than a week. Importantly, the forests of western Washington are rarely fuel-limited; the maritime climate largely limits wildfires in these forests. As such, these forests are therefore both adapted and resilient to stand-replacing disturbance regimes. While these forests have been resilient to stand-replacing disturbances in the past, future resilience to such disturbances becomes less certain with time as the climate changes. Based on the long-term relationship between stand-replacing disturbances and western Washington forests, maintaining existing forest cover is a reasonable strategy to promote west-side forest resistance (e.g., forestall change) and resilience under a changing climate. Retaining older forested stands would help resist eventual change because older trees are better able to persist through unfavorable conditions created by disturbances than young trees and seedlings.

In addition, promoting well-distributed habitat patches is likely better than few, large patches to better increase the probability that some habitat will persist when a wildfire occurs (which will eventually happen). With projected increases in wildfire, some may argue for a more active management approach to reduce potential future wildfire severity. However, such a goal cannot be attained without fundamentally altering the structure of these systems and thus affecting the forest's value as murrelet habitat.

EARTH

As described in Section 3.1, management of potentially unstable slopes and soils will be the same under each of the action alternatives as under the no action alternative. Management of potentially unstable slopes are designed to minimize the impacts of activities. These impacts will continue to be minimized. Any future changes in landslide timing, frequency, or severity due to climate change will likely be similar across all of the alternatives.

AQUATIC RESOURCES

As described in Section 3.2, changes in vegetation composition and disturbance are expected due to climate change. Timing, frequency, and severity of landslides are projected to change as well. These effects of climate change will impact aquatic resources. However, since the no action and action alternatives have similar amounts of activity in riparian areas and follow the same policies and procedures for management of riparian areas and watersheds (refer to Section 3.4), little difference in impacts to aquatic resources is expected between the action alternatives and the no action alternative. Likewise, there is little difference expected between action alternatives.

WILDLIFE

As described in Chapter 3.5, wildlife species can be organized into guilds. A guild is a group of species that utilizes the same class of resources in a similar way. The preceding analysis of impacts to vegetation shows that no difference in impacts due to climate change to vegetation is expected between the action alternatives and the no action alternative, and no difference is expected between action alternatives. Based on this conclusion, little difference in impact on wildlife guilds is expected between the action alternatives and the no action alternative, nor between action alternatives.

Similarly, little difference in impact of climate change on marbled murrelet or other endangered wildlife is expected between the action alternatives and the no action alternative, nor between action alternatives. Climate change impacts on the marbled murrelet are more specifically discussed in Chapter 5.

Conclusions

This analysis has determined that retaining more (and well-distributed) area in long-term forest cover sequesters more carbon, and, given trends in precipitation and temperature, increases resilience of LTFC by reducing uncertainty of disturbance and vegetation trends in specific locations and reducing the potential loss of LTFC to large, stand-replacing wildfire.

All alternatives distribute LTFC across the analysis area. Potential impacts from climate change on LTFC is likely lowest for Alternative F, owing to its addition of 114,000 acres of LTFC relative to the no action alternative. Alternatives C, D, and E also all increase LTFC area relative to Alternative A. Yet relative to Alternative A, Alternatives C, D, and E will all likely provide a similar level of benefit from a climate change perspective, with a maximum difference of approximately 20,000 acres across all four alternatives (including Alternative A). Any reduction in resilience to climate change impacts is probably slight under Alternative B, with a 27,000 acre LTFC decrease from the no action alternative (which is approximately 2 percent of DNR-managed lands in the analysis area).

This analysis concludes that none of the action alternatives will likely result in a net increase of greenhouse gas emissions or exacerbate impacts to elements of the environment from climate change.

Figure 4.2.3. Summary of Potential Impacts Related to Climate Change

Key questions	Criteria	Measures	Potential impacts
Do any alternatives cause more greenhouse gases to be emitted than sequestered?	Greenhouse gas emissions do not exceed sequestration	Potential carbon emission and sequestration on managed lands, thinned LTFC, and untouched LTFC lands	Sequestration is greater than emissions under all alternatives.
What effects will climate change have on the action alternatives or their expected environmental impacts?	Whether conservation or management approaches in LTFC exacerbate climate change impacts or reduce climate-related resilience	Differences in amount of LTFC Changes in management of elements of the environment Changes in complex forest structure	Climate change will have impacts on elements of the environment. However, the action alternatives are not expected to exacerbate these impacts. Relative to Alternative A, Alternatives C through F are expected to increase resilience of LTFC to climate change in similar ways. Alternative B would only slightly reduce resilience.

4.3 Vegetation

This section describes the potential effects of the alternatives on forest conditions, forest health, and vegetation in special management or conservation status.

Analysis questions

- *Do any of the action alternatives result in changed forest conditions that predispose forest stands to a specific detrimental effect or create the potential to spread insects, pathogens, or disturbance to other forest stands?*
- *Do any of the action alternatives affect the conservation status of old-growth forests, gene pool reserves, or rare plants?*
- *Do any of the action alternatives affect the conservation objectives of natural areas?*

Evaluation criteria

Scale of analysis

This analysis looks at vegetation across the analysis area and focuses on potential changes to forest conditions within proposed marbled murrelet conservation areas. Some specific natural areas are considered where vegetation management could be impacted by the alternatives.

How impacts are measured

Data on forest conditions are used to qualitatively assess whether forests in LTFC in the action alternatives are at any higher risk to forest health issues than forest in LTFC in the no action alternative. The analysis also looks at whether the alternatives would require significant changes to how rare plants, old growth, genetic resources, or natural areas are managed or otherwise affect the conservation status of these resources.

Summary of direct, indirect, and cumulative impacts

Based on the analysis below, no significant adverse effects are expected to general forest conditions as a result of the action alternatives. Some positive impacts are expected to vegetation benefitting from older forest conditions.

High-density stands

There is little change in the area of high-density (RD >85) forest in LTFC between Alternative A and action alternatives compared to the total acres of LTFC.

Where thinning can occur in high-density stands, a short-term risk of disturbance may develop (Mitchell 2000). Under the action alternatives, thinning would be limited in extent as described in Chapter 2. The area of marbled murrelet habitat or security forest subject to thinning under the action alternatives is expected to be a small percentage of the total habitat area, so the short-term risk to marbled murrelet habitat and security forest is expected to be low. In the long term, such treatments are expected to encourage the development of structurally complex forest and security forest.

Table 4.3.1. Change in High-density Forest (RD>85) in LTFC from the No Action Alternative (Alternative A; Rounded to Nearest 1,000), Beginning of the Planning Period

	Total acres	Acres change from Alternative A				
	Alt. A (no action)	Alt. B	Alt. C	Alt. D	Alt. E	Alt. F
RD >85	104,000	-4,000	2,000	0	3,000	17,000

For species benefitting from older forest conditions, there is a beneficial impact expected in LTFC due to more acres being in a protected status (refer to Section 3.7).

DNR-management and land use activities outside of LTFC would be the same under each action alternative. Forests will be harvested, thinned, and replanted pursuant to the sustainable harvest calculation, *Policy for Sustainable Forests*, Forest Practices rules, 1997 HCP, and associated laws, policies, and procedures as described throughout this DEIS; therefore, forest conditions outside LTFC are expected to be unaffected by the action alternatives.

Forest health risks

The sources of forest damage identified in the 2015 aerial forest health survey occur in both managed and unmanaged forests at approximately the same rates. Current rates of damage are small relative to the acres in the analysis area. Changes in management due to the action alternatives are not expected to change

these overall rates of damage. Types of damage associated with smaller trees, such as bear damage, are expected to become less common as forests mature in LTFC. Areas of root disease are present in both managed and unmanaged stands, including areas of marbled murrelet habitat. However, root disease spreads slowly and does not affect each tree species equally. Due to this, root disease is not expected to pose a specific risk to marbled murrelet habitat.

Vegetation in special management or conservation status

LTFC under every alternative includes forestlands managed for conservation purposes pursuant to the 1997 HCP, DNR's *Policy for Sustainable Forests*, and/or state law. These lands are managed primarily to maintain biodiversity or unique natural features of regional or statewide significance. Conservation measures under the action alternatives were evaluated to determine if those measures would conflict with these existing conservation commitments.

OLD GROWTH, GENETIC RESOURCES, RARE PLANTS, AND UNCOMMON HABITATS

DNR policies protecting old growth and gene pool reserves would be unchanged by any alternative. Potential impacts to rare plants are already part of site-specific assessments conducted for forest management activities. However, because every location of every rare plant is not known, this vegetation can be at risk from forest management activities. Unknown occurrences of rare plants or plant communities would likely get an indirect conservation lift if they are located within a marbled murrelet conservation area that is protected from active forest management activities (for example, within an occupied site or a special habitat area).

NATURAL AREAS

Under the no action alternative, management of natural areas would continue as provided in state law and DNR management plans for these areas, with consultation between DNR and USFWS on any forest management or land use activities with potential to disturb marbled murrelet habitat.

The proposed conservation measures are not anticipated to impact the maintenance and development of marbled murrelet habitat on natural areas. Most conservation measures are compatible with management objectives for these lands. For example, no new roads are anticipated to be developed within natural areas. Existing roads are maintained for low-impact recreation or environmental education. No new leases or easements are issued in natural areas inconsistent with conservation goals; some existing property rights (for example, mineral exploration rights) may still exist where they were not acquired when DNR acquired the property.

Where special habitat areas, which include areas affected by conservation measures that prohibit most forest management activities, overlap with NAPs and NRCAs, some minor impacts could be expected. Alternative D proposes 965 acres of special habitat areas that overlap NAPs and over 2,500 acres that overlap NRCAs. Because Alternative D proposes prohibiting facility and trail development in special habitat areas, this could impact the development of future trails in some natural areas (although there are no specific trail plans within these areas and within special habitat areas at this time). Alternative E includes 426 acres of NAPs within its designated special habitat areas, but the proposed conservation

measure for trail development is more flexible under this alternative. Non-motorized trail development may occur on some NRCAs for environmental education or low-impact recreation purposes. Motorized trails or uses are not allowed on NAPs or NRCAs.

Forest restoration treatments are planned for several coastal natural areas (Bone River NAP, Niawiakum River NAP, Ellsworth Creek NRCA, and Elk River NRCA). Thinning or removal of larger trees may occur to accelerate older forest characteristics. Marbled murrelet habitat considerations will be part of developing treatment prescriptions; therefore, impacts from the action alternatives on proposed restoration activities are anticipated to be minor or negligible.

Figure 4.3.1. Summary of Potential Impacts to Vegetation

Key questions	Criteria	Measures	Potential impacts
Do changed forest conditions predispose forest stands to a specific detrimental effect or create forest conditions with the potential to spread detrimental effects to other forest stands?	Acres of at-risk stands	Acres of forest health concerns Acres of high-density stands (RD >85) of disturbance	No increase in area of forest health concerns expected. Minimal change in area of high-density stands under the action alternatives.
Do any alternatives affect the conservation status of rare plants, old-growth forests, or gene pool reserves?	Conservation policies in <i>Policy for Sustainable Forests</i> , OESF forest land plan	Acres of vegetation in conservation status	The conservation status of rare plants, old-growth forest, or gene pool reserves would not be changed under any alternative. Rare plants whose locations are not currently known could receive an indirect benefit where they are included in marbled murrelet conservation areas and protected from active forest management.
Do any of the alternatives affect the conservation objectives of natural areas?	RCW 79.70 and NAP management plans; RCW 79.71 and NRCA management plans	Planned projects on NAPS or NRCAs	Alternatives D and E could limit the expansion or development of new low-impact trails for educational purposes in NAPs or NRCAs where special habitat areas overlap these lands. Forest restoration activities planned in NAPs or NRCAs might be affected by thinning limitations; however, a mitigation for these planned activities could be to follow a marbled murrelet habitat-enhancement treatment prescription.

4.4 Aquatic Resources

This section describes the potential effects of the alternatives on aquatic resources in the analysis area, focusing on key aquatic functions and habitat.

Analysis questions

- *How would the action alternatives affect riparian functions, including riparian habitat, wetlands, water quality and quantity, and fish populations and habitat?*
- *Would marbled murrelet conservation areas or measures restrict DNR's ability to conduct active management under the HCP riparian conservation strategies to restore functioning riparian habitat?*

Evaluation criteria

This section considers how proposed changes in LTFC configuration in and adjacent to aquatic resources could potentially alter key aquatic functions using the following criteria:

- Riparian habitat function is maintained. Key positive indicators of riparian function are large woody debris recruitment; stream shade, which is considered one of the primary factors influencing stream temperature; leaf and needle litter recruitment, which provides nutrients to streams that support the aquatic food chain; and microclimate (DNR 2013). Negative indicators of riparian habitat function are elevated peak flow, which refers to periods of high stream flow associated with storm events and spring snowmelt, and sediment delivery.
- Water quality is in compliance with state and federal water quality standards, specifically the federal Clean Water Act and the state Water Pollution Control Act (RCW Chapter 90.48).
- The criterion for fish habitat is functioning riparian habitat, with the same previously identified functional indicators.

The analysis also evaluates whether the action alternatives would affect DNR's ability to achieve the objectives of the 1997 HCP riparian conservation strategies.

Scale of analysis

Because the proposed action is a non-project action under SEPA³ and takes place over a large landscape scale, this section cannot consider exactly when and where project-specific forest management activities would occur adjacent to aquatic resources. Those decisions would be made at the project-specific (operational) level of planning. This section considers overall trends and effects of the proposed alternatives on aquatic resources at the scale of the analysis area. The existing riparian conservation strategies and regulatory framework governing water and fish protection remain unchanged under the action alternatives.

How impacts are measured

Potential effects on aquatic resources are considered qualitatively, focusing on the degree to which the management of these resources and the resulting impacts to the key functions they provide might be changed by the proposed alternatives.

Summary of direct, indirect, and cumulative impacts

As described in Section 3.4, forest management activities that could affect aquatic resources are addressed by an extensive framework of regulations, policies, and plans. These include the Forest Practices Act and Board Manual, State Environmental Policy Act, the riparian conservation strategies of the 1997 HCP and the RFRS.

The proposed alternatives do not change this existing regulatory framework. DNR would continue to implement the riparian conservation strategy objectives of the 1997 HCP and OESF forest land plan, which are designed to achieve long-term, continuous landscape-level restoration of riparian functions over time. Therefore, no significant direct impacts to aquatic resources are expected as a result of implementing a long-term marbled murrelet conservation strategy under any of the alternatives.

Indirect adverse effects may occur as follows:

- Through localized increases in forest management activities that could occur in certain areas where current marbled murrelet restrictions would be lifted under one or more of the alternatives.
- Through conservation measures that limit potential harvest or thinning in some riparian areas (for example, within occupied sites or special habitat areas).

³ Non-project actions are “governmental actions involving decisions on policies, plans, or programs that contain standards controlling use or modification of the environment, or that will govern a series of connected actions.” (SEPA Handbook, Chapter 4)

The following sections focus on these potential indirect effects of the alternatives on key functions of aquatic resources. These effects are generally considered to be minor or beneficial at the scale of the conservation strategy.

Indirect effects on key functions of aquatic resources

LARGE WOODY DEBRIS RECRUITMENT

DNR has defined riparian management zones based on the area of influence for large woody debris recruitment. The 1997 HCP riparian strategies are specifically designed to promote the long-term recovery of large woody debris recruitment potential within this zone.



Example of large woody debris. Photo: DNR

None of the action alternatives would significantly alter how DNR manages for large woody debris recruitment. Even on lands where potential timber harvest activities may increase under one or more of the alternatives, riparian buffers would remain that would continue to provide large woody debris.



Stream in peak flow condition. Photo: DNR

PEAK FLOW

The term “peak flow” refers to periods of high stream flow associated with storm events and spring snowmelt. In western Washington watersheds with significant snow, peak flow occurs during winter storms when heavy rain falls on top of an existing snow pack, dramatically increasing the amount of runoff. These are commonly referred to as “rain-on-snow” events.

Alternatives C, D, E and F would increase LTFC across the analysis area, which would have the potential to reduce peak flows, rather than increase them.

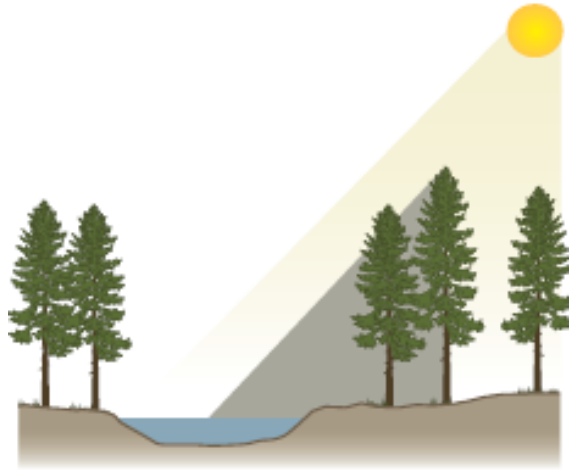
While Alternative B results in less LTFC than the no action alternative, it does not alter the DNR’s existing approach to address peak flows through DNR watershed-level planning. This approach ensures that measurable increases in peak flow conditions are avoided and are consistent with the *Policy for Sustainable Forests*, Forest Practices Act and Board Manual, and 1997 HCP (which includes objectives for hydrologic maturity in the rain-on-snow zone).

STREAM SHADE

Stream shade refers to the extent to which incoming sunlight that would otherwise shine on the stream channel is blocked by trees, hillslopes, or other features. Stream shade is considered a primary factor that keeps water temperatures sufficiently cool to support native fish species (Beschta and others 1997).

Accordingly, the Forest Practices Act and the 1997 HCP riparian conservation strategies specifically emphasize protection and restoration of stream shade. Therefore, even though some localized increases in timber harvest may occur under all action alternatives, the stream shade functions of riparian areas would be maintained under all alternatives as required by the existing riparian management framework, including the Forest Practices Act, Board Manual, and 1997 HCP.

Figure 4.4.1. Illustration of Stream Shade



FINE SEDIMENT DELIVERY

Increased levels of fine sediment can have detrimental effects on both water quality and fish habitat (Hicks and others 1991, Cederholm and Reid 1987). Forest roads and road-drainage features near streams are the most common source of fine sediment on state trust lands (DNR 1997, Potyondy and Geier 2011). The Forest Practices Act sets strict requirements for the design, operation, and maintenance of forest roads to avoid and minimize these impacts.

None of the action alternatives would substantially change the overall density of forest roads (refer to Section 4.8, Forest Roads). Additional miles of road may need to be built to avoid marbled murrelet habitat impacts. However, none of the action alternatives would alter existing forest practices regulations nor DNR procedures regarding road design and maintenance (refer to Section 4.8, Forest Roads). Therefore, none of the alternatives are likely to increase fine sediment delivery to wetlands, streams, or any other waters.

LEAF AND NEEDLE LITTER RECRUITMENT

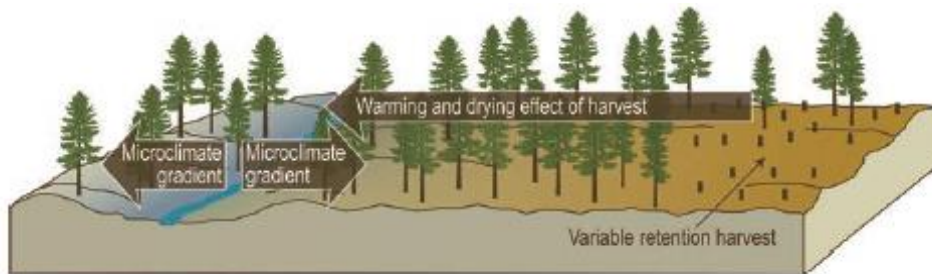
Leaf and needle litter are organic debris produced by the forest canopy that provide nutrients to streams that support the aquatic food chain. Leaf and needle litter accounts for the majority of nutrient inputs in small headwater streams and is critically important for the healthy function of these ecosystems (Wallace and others 1997).

Generally speaking, the majority of leaf and needle litter recruitment comes from vegetation within one site-potential tree height of a stream (FEMAT 1993), and these zones are already protected by the HCP riparian conservation strategies. Therefore, none of the alternatives are likely to alter leaf or needle litter recruitment.

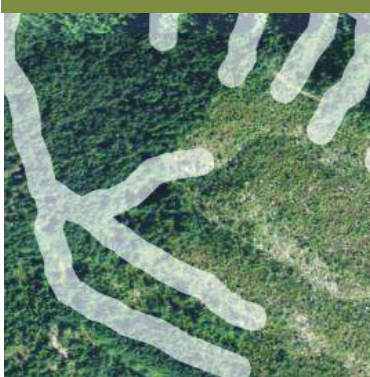
MICROCLIMATE

Forest cover surrounding wetlands and streams creates a microclimate that lowers the temperature of air, soil, and water and increases humidity (Meehan 1991, Naiman 1992). Removing significant amounts of forest cover within or adjacent to riparian areas can alter microclimate and harm moisture-dependent species such as amphibians and a wide range of invertebrates, plants, and fungi (Spence and others 1996).

Figure 4.4.2. Timber Harvest Effects on Riparian Microclimate (Copied From OESF RDEIS)



Text Box 4.4.1



How do isolated riparian areas factor into aquatic resource impacts?

LTFC includes riparian areas that are less than 200 meters wide. These “stringers” are predominantly narrow riparian management zones where adjacent uplands have not been designated as LTFC.

Studies by Brosfoske and others 1997 demonstrated that streams exert a cooling effect on both soil and air temperatures at distances of up to 164 feet from the stream. In addition, they noted increased relative humidity at distances up to 122 feet from the stream. The heating and drying effects of harvest can extend up to approximately 545 feet into the surrounding unharvested areas (Chen 1991, Chen and others 1995, FEMAT 1993).

Timber harvest may occur well within this 545-foot zone of influence, potentially affecting the microclimate in adjacent areas of LTFC. However, microclimate is a relatively small component of overall riparian health. Changes in microclimate are not expected to significantly affect riparian habitat function within LTFC or within the analysis area as a whole.

Using “stringer” configuration as a proxy for potential risk of changes to microclimate (refer to Text Box 4.4.1 and Chapter 2), only Alternative B would result in a net increase in stringer habitat across the entire analysis area (a 5 percent increase compared to current conditions under Alternative A). Under all other alternatives (Alternatives C, D, E and F), riparian management zones (RMZs) within the stringer configuration would decrease between 3 and 19 percent from current conditions in Alternative A. Forest cover adjacent to riparian habitat and associated microclimate function values would increase as forest stands within LTFC mature.

Indirect and cumulative effects on riparian restoration strategies: Limitations on active management

Some riparian harvest (including hardwood conversions) and thinning is allowed or even prescribed under the riparian restoration strategies of the 1997 HCP and the RFRS. Conservation measures proposed under the action alternatives would restrict harvest of riparian areas within occupied sites, buffers, MMMAs, special habitat areas, and P-stage 0.47 habitat identified in Alternatives C and E. These measures prohibit thinning of riparian areas in the special habitat areas of Alternatives C, D, and E. Refer to Table 2.2.4 in Chapter 2 for details on thinning rules in conservation areas.

The significance of this potential effect would generally track with the total amount of marbled murrelet conservation areas to be designated under each alternative. Since implementation of the RFRS, the DNR has been commercially thinning only a small portion of the total riparian acres available with timber sales for ecological or administrative reasons. Non-commercial thinning would still be allowed in most areas, so the overall effect of this reduced ability to conduct commercial thinning within RMZs, while conceptually adverse, is not likely to significantly reduce the ability of DNR to reach aquatic resource management objectives defined in the 1997 HCP.

None of the alternatives are likely to result in adverse impacts on aquatic resources that would significantly contribute to cumulative effects of forest management activities on aquatic habitats.

Table 4.4.1. Summary of Potential Impacts to Aquatic Resources

Key questions	Criteria	Measures	Potential impacts
<p>How would alternatives affect riparian functions, including riparian habitat, wetlands, water quality and quantity, and fish populations and habitat?</p>	<p>Functions of riparian and wetland habitat for wildlife and water resources are maintained (1997 HCP, <i>Policy for Sustainable Forests</i>).</p>	<p>Degree to which these functions are already adequately protected by the existing framework of regulations, policies, and plans.</p> <p>The degree to which the alternatives would change allowable forest management activities.</p>	<p>The existing framework of regulations, policies and plans would adequately address potential effects on aquatic resources.</p> <p>All action alternatives would maintain or enhance aquatic functions, with the possible exception of riparian microclimate, which could see increased impacts under Alternative B (which has less LTFC than the no action alternative).</p>
<p>Would marbled murrelet conservation areas or measures restrict DNR’s ability to conduct active management under the HCP riparian conservation strategies to restore functioning riparian habitat?</p>	<p>No substantive change in ability of DNR to reach riparian strategy objectives on state trust lands.</p>	<p>Qualitative review of the type of restrictions in active management of riparian areas under each alternative.</p>	<p>Restrictions in commercial thinning within special habitat areas under Alternatives C, D and E could potentially delay some RMZs from reaching restoration objectives in these areas. This, in turn, may affect one or more of the various indicators of riparian functioning. However, these effects are not likely to significantly reduce the ability of DNR to reach aquatic resource management objectives defined in the 1997 HCP riparian conservation strategies.</p>

4.5 Wildlife and Biodiversity

This section considers whether any of the strategies to conserve marbled murrelets could have unintended consequences to other species of wildlife, particularly federally listed species or other wildlife species that are sensitive to disturbance, have low population levels or restricted ranges, or are otherwise important for recreational, commercial, cultural, or ecological values.

Analysis question

- *Do areas proposed for marbled murrelet conservation under the action alternatives potentially impact federally listed species or other wildlife species?*



DNR-managed lands in South Puget planning unit. Photo: DNR

Evaluation criteria

This analysis considers the following criteria:

- Wildlife habitat and species diversity, and the ecological functions needed to support them within the analysis area, are maintained by the alternatives.
- Northern spotted owl habitat targets and conservation strategies are maintained by the alternatives.
- Species listed as threatened or endangered are not experiencing adverse impacts by the alternatives.

Scale of analysis

For this DEIS, wildlife habitats and biodiversity are considered in terms of trends over the entire analysis area and through the planning period (5 decades).

How impacts are measured

Impacts are measured based on the degree to which alternatives would potentially change 1997 HCP strategies for species other than the marbled murrelet or the 2006 *Policy for Sustainable Forests*' objectives. The degree to which the alternatives would affect habitat and species diversity is measured by considering species-habitat associations and trends in forest stand development stages.

Effects on regionally important species are considered based on a qualitative assessment of anticipated habitat changes (based on LTFC conditions).

Summary of direct, indirect, and cumulative impacts

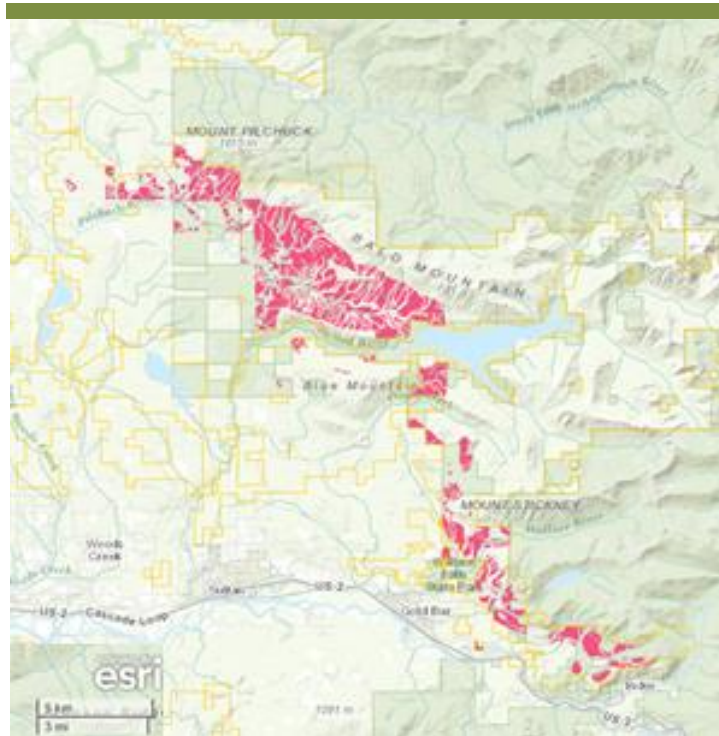
Habitat and species diversity

All alternatives are expected to maintain overall wildlife habitat and species diversity across DNR-managed lands, as habitat both within and outside of LTFC would continue to be managed to improve forest productivity, wildlife habitat, and species diversity.

Silvicultural methods such as variable retention harvest and variable-density thinning will continue to create and maintain differing wildlife habitats and biodiversity within the working forest landscape (DNR 2013, p. 3.23).

Within the analysis area, overall habitat and species diversity would remain similar to that which would occur under the no action alternative. Some localized impacts to the habitat supporting some species guilds may occur, but these pose little to no risk to overall species diversity.

Text Box 4.5.1



Example of local increase in LTFC under Alternative F (indicated by magenta) north of U.S. Highway 2, North Puget planning unit.

Under Alternative F, lands currently mapped as low-quality northern spotted owl habitat would be included as additional LTFC (Alternatives A through E only include high-quality owl habitat as LTFC). This could change the way forests develop in these areas as low-quality owl habitat matures into more structurally complex forest. HCP habitat targets are still expected to be met in these areas.

Under all alternatives other than Alternative F, low-quality owl habitat would continue to be managed according to HCP thresholds.

INCREASE IN LTFC AND STRUCTURALLY COMPLEX FORESTS

All alternatives except Alternatives A and B would result in a net increase in LTFC on DNR-managed lands. Alternative A reflects current practices and does not increase LTFC, but Alternative B decreases LTFC from current conditions. A small increase in structurally complex forests and associated wildlife diversity would be expected over time under these alternatives, accompanied by a corresponding decrease in ecosystem initiation stage forests and associated wildlife communities.

Alternatives C, D, and E would result in larger but very similar amounts of LTFC, adding between 14,000 and 20,000 acres compared with the no action alternative. This amount of change may have local effects on wildlife habitats within special habitat areas and emphasis areas, where most additional LTFC would be established. The wildlife guild associated with ecosystem initiation stages could be locally affected as those forests enter the competitive exclusion stage, which supports fewer species. Wildlife guilds associated with more structurally complex forests would benefit as forests mature over time.

REDUCTION IN EARLY STAGE FORESTS AND ASSOCIATED WILDLIFE

Lands outside of LTFC can be harvested, providing ecosystem initiation stage forests. Within LTFC, areas available for harvest are reduced under all action alternatives except Alternative B. Alternative F would result in the greatest increase in LTFC compared with the other alternatives, with an approximate increase of 18 percent (114,000 acres) in LTFC compared with Alternative A.

INCREASED PATCH SIZE/DECREASED EDGE

As illustrated in Section 4.6, Marbled Murrelets, all of the alternatives except Alternative B would result in an increase in “interior” forest habitats, which for this DEIS are defined as LTFC areas that are at least 100 meters from any edges with actively managed forest. This increase in interior habitat is expected to improve habitat for interior guild species. Increases range from 21 percent under Alternative A to 67 percent under Alternative F.

Increases in interior habitat will result in localized reductions of edge-associated species. However, all alternatives would maintain a majority of LTFC within stringer and edge configurations. Therefore, impacts to edge habitats and associated wildlife guilds and species diversity are not expected to be significant.

REDUCED DISTURBANCE AND FOREST MANAGEMENT ACTIVITIES

All alternatives would reduce disturbance during the murrelet nesting season, which would likely benefit other species of wildlife that breed during the same periods. Proposed conservation measures under the action alternatives would also result in changes to road management, with most new road building likely to occur outside marbled murrelet conservation areas.

Sensitive and regionally important wildlife

None of the alternatives are likely to affect populations of species listed in Appendix L at the scale of the analysis area. Species associated with ecosystem initiation forests may experience some local declines under Alternatives C, D, E, and F.

All of these changes would potentially increase breeding and resting/hiding habitat for several sensitive species while at the same time reducing foraging habitats. However, these effects would be noticeable for the most part only at the local level, primarily within designated special habitat areas, emphasis areas, and marbled murrelet management areas. In the larger analysis context of the 1.377 million acres of DNR-managed lands, populations and distribution of sensitive species on DNR-managed lands would be maintained.

GAME SPECIES

Black bears often select structurally complex forests for denning. Therefore, bear populations may benefit from additional denning habitat provided by forest stands managed to develop marbled murrelet nesting habitat under all alternatives. However, it is unlikely that additional den habitat would significantly increase bear populations, as other factors such as hunting pressure, food availability, and density-dependent competition are also important factors in keeping bear populations in check.

Increasing LTFC—as would occur under Alternatives C, D, E, and F—would increase structurally complex forest over time. These forests are likely to provide cover habitat for deer and elk. (Cover habitat is used for protection from predators and inclement weather.) Proportional decreases in timber harvest activities could decrease foraging habitat in some areas (reducing the amount of forest in the ecosystem initiation stage), but this decrease is not expected to be significant at the scale of the analysis area. No alternative is expected to have negative effects to deer or elk.

BIRDS

Likewise, forest owls may benefit from LTFC designation, although reduced edge habitat may result in local reductions in foraging habitats. Similarly, edge-associated species including red-tailed and sharp-

Text Box 4.5.2



How will elk habitat be affected?

Elk feed in cleared areas but seek cover in forested areas. The proposed alternatives would generally increase cover habitat while decreasing foraging habitat. This effect would be in proportion to the amount of additional LTFC to be designated under each alternative. While foraging habitat may decrease locally in certain areas (particularly under Alternative F), this decrease is not expected to be sufficient in scale to reduce overall health, population growth, or distribution of elk herds.

Photo: WDFW

shinned hawks and great horned owls could potentially decline locally where additional LTFC is designated. Finally, the alternatives would have mixed and primarily localized effects on neo-tropical migratory birds, with a moderate increase in species associated with structurally complex and interior forests (for example, Townsend’s warbler) and moderate decreases in species associated with ecosystem initiation stage forests (for example, willow flycatcher). However, similar to other species discussed, there would be no significant impacts at the scale of the analysis area (1.377 million acres of DNR-managed lands).

Table 4.5.1. ESA-Listed Species and Potential for Adverse Impacts

Species	Federal status	Potential for adverse impacts from marbled murrelet conservation alternatives
Columbian white-tailed deer (<i>Odocoileus virginianus leucurus</i>)	E	None. Habitats associated with the Columbian white-tailed deer are protected by the 1997 HCP riparian and wetland strategies. This species is peripheral to DNR-managed forestlands.
Gray wolf (<i>Canis lupus</i>)	E	None. Habitats associated with the gray wolf are protected by the HCP gray wolf conservation efforts.
Grizzly bear (<i>Ursus arctos horribilis</i>)	T	None. The combination of 1997 HCP riparian, wetland, and uncommon habitats and northern spotted owl conservation strategies protects grizzly bear habitat. This species is a rare occurrence on DNR-managed forestlands.
Mazama pocket gopher (<i>Thomomys mazama subspecies</i>)	T	None. Mazama pocket gophers occupy prairie-like habitat—areas that are relatively open, with short-statured vegetation and few woody plants. This type of habitat and this species is peripheral to DNR-managed forestlands.
Northern spotted owl (<i>Strix occidentalis caurina</i>)	T	None. Habitats associated with the northern spotted owl are protected by the 1997 HCP northern spotted owl strategy.
Oregon silverspot butterfly (<i>Speyeria zerene hippolyta</i>)	T	None. Habitats associated with the Oregon silverspot butterfly are protected by the 1997 HCP Oregon silverspot butterfly conservation efforts. This species is peripheral to DNR-managed forestlands.
Oregon spotted frog (<i>Rana pretiosa</i>)	T	None. Habitats associated with the Oregon spotted frog are protected by the 1997 HCP riparian and wetland strategies.
Snowy plover (<i>Charadrius alexandrinus nivosus</i>)	T	None. Snowy plovers nest primarily on coastal beaches, dunes, and beaches at creek and river mouths. These habitats are protected with the 1997 HCP riparian and wetland strategies. This species is peripheral to DNR-managed forestlands.
Streaked horned lark (<i>Eremophila alpestris strigata</i>)	T	None. Streaked horned larks nest on the ground in sparsely vegetated sites dominated by grasses and forbs and occasionally on beaches or estuaries. Where these habitats occur near DNR-managed lands, they are protected with the 1997 HCP riparian and wetland strategies. This species is peripheral to DNR-managed forestlands.
Taylor’s checkerspot butterfly (<i>Euphydryas editha taylori</i>)	E	None. Habitats (primarily balds and open grasslands) associated with the Taylor’s checkerspot butterfly are protected by the 1997 HCP uncommon habitats strategy.
Western yellow-billed cuckoo (<i>Coccyzus americanus</i>)	T	None. Habitats associated with the western yellow-billed cuckoo are protected by the 1997 HCP riparian and wetland strategies.

Northern spotted owl

There are no changes proposed to the northern spotted owl goals and objectives. The designated nesting, roosting, and foraging (NRF) and dispersal areas will not change in location or habitat targets. The DNR will continue to manage for achievement of 1997 HCP habitat thresholds within these areas as well as within each of the landscapes in the OESF. Alternative F, though, differs in that it will treat mapped, low-quality northern spotted owl habitat as LTFC (47,000 acres) within the designated NRF and dispersal areas and within each of the landscapes in the OESF (refer to Text Box 4.5.1 as an example).⁴ In this LTFC designation, the DNR will still be able to perform silvicultural treatments—such as variable density thinning—to enhance future spotted owl and marbled murrelet habitat. Because many NRF and dispersal management areas are currently below their habitat target, this addition of LTFC is not expected to change the general management approach over what would otherwise occur. In addition, LTFC designated outside current spotted owl management areas, for example in the Straits and South Coast planning units, would provide additional blocks of potential owl habitat.

Inclusion of spotted owl habitat in LTFC will not have a direct, negative effect on spotted owl habitat. Stands that provide habitat will continue to do so. Likewise, stands that do not yet provide spotted owl habitat but are naturally developing toward habitat conditions will continue to do so, providing benefits to the spotted owl.

Silvicultural treatments in designated owl conservation areas (NRF, dispersal, and OESF) will continue according to the HCP strategies except where special habitat areas overlap these areas because commercial thinning is not allowed in special habitat areas.

⁴ Low-quality northern spotted owl habitat is the same as Young Forest Habitat in the OESF.

Table 4.5.4. Summary of Potential Impacts to Wildlife

Key questions	Criteria	Measures	Potential impacts
Do areas proposed for marbled murrelet conservation under the alternatives potentially impact federally listed species or other wildlife species?	<p>1997 HCP conservation objectives</p> <p>Habitat diversity is not lost. Both ecosystem initiation and structurally complex stand development stages (the two stages used most by wildlife) are available in sufficient quantities to support associated species within the analysis area.</p> <p>An adequate mix of habitat types is maintained under the alternatives, including early seral-stage forests and edge habitats, to support wildlife diversity</p> <p>Landscapes are not dominated by competitive exclusion stage forests with low wildlife diversity.</p>	<p>Total LTFC</p> <p>Acres of marbled murrelet conservation overlapping spotted owl conservation</p> <p>Acres of interior forest; Acres of edge forest</p> <p>Acres of DNR-managed lands affected (for context and scale of effects)</p>	<p>None/beneficial</p> <p>Wildlife diversity is likely to increase over time with all alternatives.</p> <p>Some local losses of diversity associated with fewer acres of ecosystem initiation stage stands, particularly under Alternative F. However, at the scale of the analysis area, such habitats would remain sufficiently abundant to maintain biodiversity on DNR-managed lands.</p> <p>Localized changes in habitat conditions may temporarily affect some sensitive species, but overall amount of habitat available for sensitive species would remain stable or increase on DNR-managed lands.</p> <p>Foraging habitat for deer and elk may be locally reduced where larger blocks of LTFC would be added. This is primarily true of Alternative F. However, foraging habitat would continue to be present at the scale of the analysis area.</p>

4.6 Marbled Murrelet

This section describes the potential effects of the alternatives on marbled murrelet nesting habitat and population.

Analysis questions

- *How do the alternatives affect marbled murrelet nesting habitat, and how are changes to nesting habitat quantity and quality expected to affect the marbled murrelet population?*
- *Do the alternatives provide habitat in important geographic locations for marbled murrelet conservation? These include southwest Washington and areas close to marine waters, including along the Strait of Juan de Fuca and in the North Puget planning unit.*

Evaluation criteria

As described in Section 3.6, both the marine and inland habitats of the marbled murrelet play key roles in the life cycle of the species. The proposal addresses management activities on forested state trust lands, not the marine environment, and therefore no impacts are anticipated to the marine environment. This analysis will focus on how inland nesting habitat is affected by the alternatives and whether anticipated changes to that habitat will impact the marbled murrelet population.

Scale of analysis

This analysis considers all DNR-managed lands within the analysis area, with data summarized at the HCP planning-unit level where important for comparisons among the alternatives. Comparative marbled murrelet habitat and population data from other conservation zones (refer to Section 3.6) is also considered in order to understand relative impacts of the alternatives.

How impacts are measured

The analysis will consider:

- Habitat quantity, including anticipated loss of potential habitat and gains in habitat through the life of the HCP
- Habitat quality, including P-stage and edge effects
- Disturbance impacts to habitat from forest use and management activities
- Amount and quality of habitat in geographically important areas
- Potential impacts to the marbled murrelet population in Washington using a population viability analysis model

Summary of direct, indirect, and cumulative impacts

As a forest manager, DNR's activities cause direct and indirect impacts to marbled murrelets. Timber harvest and thinning can remove current or potential future habitat and increase deleterious edge effects at nearby habitat. Roads and trails built for access to and through DNR-managed lands can cause direct impacts by removing habitat and also increase disturbance effects by creating forest edges. Other disturbance effects including audio-visual disturbance, predator attraction, and impulsive noise can cause both direct and indirect impacts to nesting birds. Cumulatively, these impacts can result in reduced habitat quantity and quality. The alternatives propose to conserve existing habitat and add new habitat areas to existing conserved forestlands, which will result in new and higher-quality habitat developing over time.

This section compares the relative impacts of the action alternatives and how these impacts ultimately affect the marbled murrelet populations.

Direct impacts: Habitat loss and gain

Ongoing forest management within the analysis area, outside of marbled murrelet-specific conservation areas, will result in short-term losses to mostly low-quality potential habitat, followed by long-term gains in both low- and high-quality habitat within LTFC.

PROTECTION OF OCCUPIED SITES

All of the alternatives protect occupied sites, which are patches of habitat where evidence of marbled murrelet use has been observed. The action alternatives assume site occupancy based on the occupied sites identified in the Science Team Report, resulting in approximately 16,000 more acres of occupied sites than would be assumed under the no action alternative. Timber harvest would be prohibited in these areas, as would most of the forest management and land use activities known to disturb nesting marbled murrelets. However, there will be isolated cases where some limited forest management activities may occur within an occupied site, such as a road construction or individual tree removal. All alternatives except Alternative B add buffers to these occupied sites. Alternatives C through F use special habitat areas, emphasis areas, or MMMA that would further increase the security habitat around some occupied sites in strategic locations.

Table 4.6.1. Comparison of Occupied Site Protection Strategies Among Alternatives

Occupied site protection	Alt. A (no action)	Alt. B	Alt. C	Alt. D	Alt. E	Alt. F
Increase acres of occupied sites	No	Yes	Yes	Yes	Yes	Yes
Applies occupied site buffers	Yes	No	Yes	Yes	Yes	Yes
Additional security acres for occupied sites	No	No	Yes—special habitat areas and emphasis areas	Yes—special habitat areas	Yes—special habitat areas and emphasis areas	Yes—MMMAs
Applies conservation measures to protect occupied sites from disturbance	No	Yes	Yes	Yes	Yes	Yes

The use of buffers and other protective measures to occupied sites reduces the risk to marbled murrelet habitat from predation and other disturbances. Since marbled murrelets frequently re-use their nesting areas (Nelson 1997), enhancing the protection of occupied sites is a strategy that would likely reduce the risk of birds having to move nest locations.

POTENTIAL HABITAT LOSS FROM HARVEST

Outside of long-term forest cover, some P-stage habitat for the marbled murrelet will be harvested under the proposed action. As a “reasonable worst case” scenario, the analysis assumed that all harvest of this habitat would occur in the first decade of the planning period. For analysis, habitat is described as either low quality (P-stage value 0.25–0.36) or high quality (P-stage value 0.47–0.89). Table 4.6.2 estimates the acres of low-quality and high-quality P-stage habitat that will be harvested in the first decade, outside of long-term forest cover.

Table 4.6.2. Estimated Acres of Habitat Released for Harvest in Analysis Area

	HCP Unit	Alt. A (no action)	Alt. B	Alt. C	Alt. D	Alt. E	Alt. F
Low-quality P-stage habitat loss to harvest (P-stage value 0.25–0.36)	OESF	6,104	8,532	6,363	7,486	6,123	3,398
	Straits	3,503	5,407	4,880	4,439	4,438	4,881
	North Puget	12,990	13,564	12,717	12,488	12,316	8,823
	South Puget and Yakima	3,997	4,250	4,212	4,214	4,212	1,569
	Columbia	2,921	4,963	3,103	3,103	3,103	1,086
	South Coast	1,920	4,102	3,333	3,332	3,333	2,660
Subtotal		31,435	40,818	34,608	35,062	33,525	22,417
High-quality P-stage habitat loss to harvest (P-stage value 0.47–0.89)	OESF	2,007	4,472	0	3,779	0	945
	Straits	579	751	0	488	0	667
	North Puget	1,417	1,804	0	1,556	0	789
	South Puget and Yakima	948	1,180	0	1,124	0	495
	Columbia	40	233	0	94	0	70
	South Coast	15	173	0	164	0	57
Subtotal		5,006	8,613	0	7,205	0	3,023
Total acres		36,441	49,431	34,608	42,267	33,525	25,440

Most harvest outside of LTFC in the first decade is expected to be in low-quality habitat. Of the total habitat taken under each alternative, 83–100 percent is low quality. The most overall harvest is under Alternative B. Differences in where marbled murrelet conservation areas have been proposed result in the no high-quality habitat being removed under Alternatives C and E.

POTENTIAL HABITAT GAINS

Throughout LTFC, P-stage habitat will increase in amount and quality over time. This habitat gain would occur under the no action alternative as the interim strategy continues to be implemented. By the final decades of the HCP, initial habitat loss outside LTFC will be outpaced by gains in habitat within LTFC, where the regulatory framework exists to maintain these forests in long-term forest cover. Gains are expected under every alternative (refer to Table 4.6.3 and Figure 4.6.1).

Table 4.6.3 Estimated Acres of Habitat in the Final Decade of the Planning Period in LTFC, by HCP Planning Unit and Alternative

	HCP Unit	Alt. A (no action)	Alt. B	Alt. C	Alt. D	Alt. E	Alt. F
Final decade potential low-quality P-stage habitat	OESF	3,322	3,154	3,375	3,168	3,375	3,458
	Straits	25,368	19,991	21,274	21,754	21,755	21,273
	North Puget	49,008	48,423	49,737	49,727	49,998	58,820
	South Puget and Yakima	31,383	31,168	31,240	31,237	31,240	40,543
	Columbia	7,840	7,729	8,763	8,763	8,763	8,818
	South Coast	31,742	31,286	31,572	31,572	31,572	32,234
Total low-quality habitat		148,662	141,750	145,962	146,221	146,703	165,145
Final decade potential high-quality P-stage habitat	OESF	63,694	58,893	65,974	60,857	66,284	69,084
	Straits	8,484	9,032	10,020	9,955	10,458	9,337
	North Puget	69,175	68,137	70,980	69,432	71,283	76,929
	South Puget and Yakima	11,073	10,632	11,902	10,761	11,902	14,662
	Columbia	11,772	9,337	11,860	11,762	11,860	14,070
	South Coast	20,824	18,869	21,372	20,823	21,372	22,434
Total high-quality habitat		185,021	174,900	192,109	183,590	193,158	206,516
Combined totals		333,684	316,650	338,071	329,811	339,861	371,661

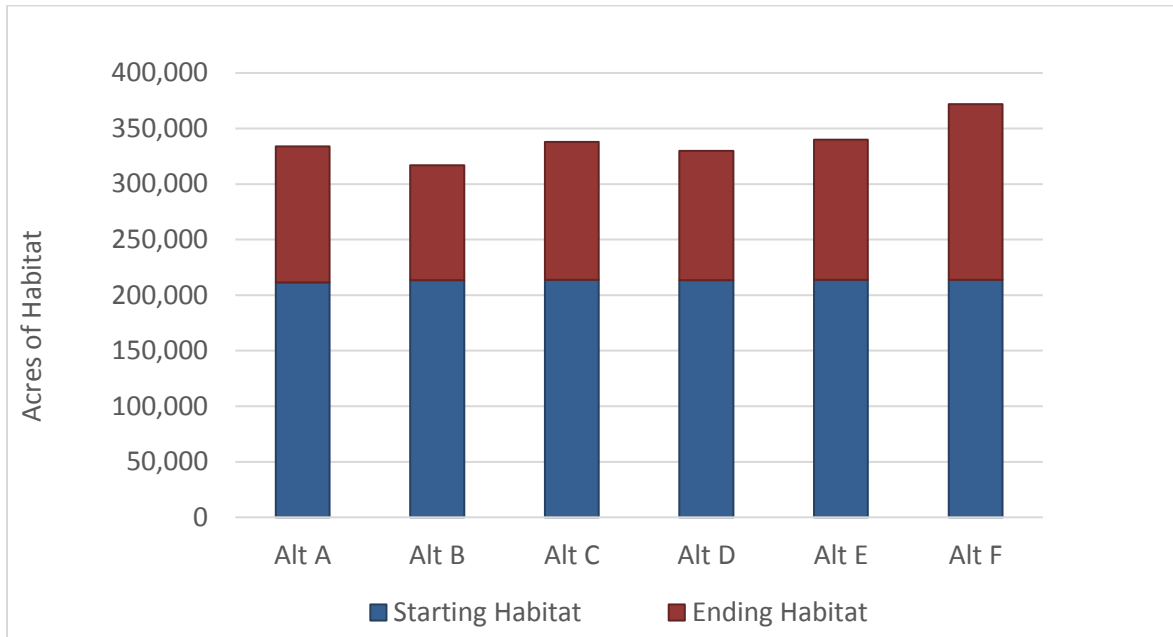
Focus on Southwest Washington

USFWS has identified DNR-managed lands in southwest Washington as important for marbled murrelet recovery because of the lack of federal lands in this landscape to provide for marbled murrelet conservation (USFWS 1997). Much of the existing nesting habitat and most known marbled murrelet occupied sites in southwest Washington are located on DNR-managed lands. The South Coast and Columbia HCP planning units cover this area. The Joint Agencies have identified a range of conservation options for these lands to maintain and improve the distribution of murrelet habitat in this important landscape. The no action alternative would protect approximately 81 percent of all known P-stage habitat in South Coast and 59 percent in Columbia. Alternatives C through E would protect more of this habitat, approximately 85 percent in South Coast and 75 percent in Columbia. Alternative F protects the most P-stage habitat, protecting approximately 85 percent in South Coast and 91 percent in Columbia, while Alternative B protects less: 65 percent in South Coast and 34 percent in Columbia (significantly less than the no action alternative).

NET HABITAT BY END OF PLANNING PERIOD

Effects of the proposed harvest of 25,000 to 49,000 acres of habitat outside LTFC during the first decade, coupled with predicted habitat development in LTFC during the 5-decade planning period, result in a net increase of habitat acreage for every alternative, including the no action alternative (Alternative A) (Refer to Figure 4.6.1).

Figure 4.6.1. Growth of Habitat Through Time, by Alternative



Acres not adjusted for quality; includes stringers.

Accounting for habitat quality

Although every alternative shows a net gain of habitat acres through the life of the HCP, the *quality* of this habitat is influenced primarily by P-stage and edge effects. Other factors, including whether the habitat is in an interior forest condition, the geographic location of habitat, and the timing of habitat development also factor into overall habitat quality.

P-STAGE AND HABITAT QUALITY

Acres of habitat lost or gained are modified by their P-stage values, which reflects the quality of that habitat based on its probability to be used for nesting (refer to Appendix F). An acre of the lowest quality habitat (P-stage value 0.25) is therefore “worth” only 0.25 acres in terms of its habitat quality. Multiplying the acres of habitat projected to grow within the planning period by their P-stage value creates a more accurate picture of the mitigation value of these acres as compared with the non-adjusted acres reported in the previous section. Both adjusted and non-adjusted acres are reported in this analysis for purposes of comparing the alternatives. P-stage is combined with other adjustment factors (refer to the following section).

INTERIOR FOREST HABITAT

Larger patches of interior forest located away from forest edges are more likely to help protect nesting marbled murrelets from the effects of predation, changes to microclimate, and other types of disturbance events and activities. Interior forest is not subject to edge effects. Chapter 2 provided summary data on the relative interior and edge conditions expected in long-term forest cover under each alternatives. This section further analyzes the differences among the alternatives relative to the protection and development of interior forest habitat.

Patterns of habitat development differ by alternative within HCP planning units and among planning units. After initial harvest of habitat in the first decade of the planning period, new habitat is expected to grow and develop. Development of habitat in areas of interior forest may be the most important for developing functional nesting habitat for the marbled murrelet over time. For example, Alternatives C, D, and E, include 100-meter buffers around all occupied sites, which will effectively increase the area of interior habitat associated with the occupied sites and minimize potential for edge effects in occupied sites from future management. Figure 4.6.2 shows how interior forest habitat is expected to develop.

Figure 4.6.2. Estimated Growth of Interior Forest Habitat Among HCP Planning Units



Alternatives C through F, all of which variously incorporate marbled murrelet conservation areas beyond existing occupied sites, provide greater proportions of interior habitat than Alternative B. Alternatives C through F also present a variety of approaches to reduce edge effects on murrelet habitat by strategically configuring some areas of LTFC and result in a somewhat greater proportion of interior habitat than Alternative A, the no action alternative.

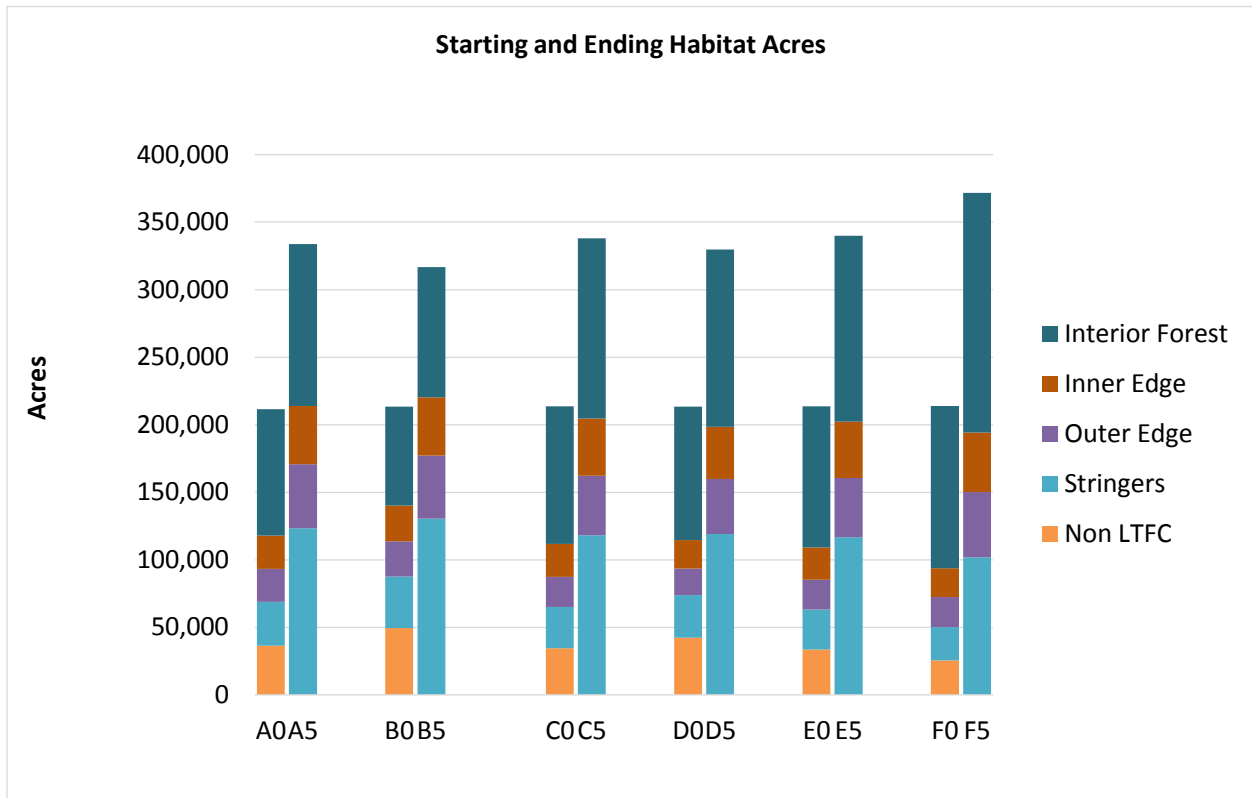
In the short term, loss of mostly low-quality habitat outside of long-term forest cover will occur under any alternative, including the no action alternative. This habitat loss is not in areas of known nest sites or occupied habitat. Within the first 2 decades, growth of new habitat and development of higher-quality habitat outpaces this initial habitat loss.

EDGE EFFECTS

Habitat that is not in interior forest is considered edge habitat (including habitat located in stringers). Habitat in an edge condition is subjected to a number of edge effects, including changes to microclimate, increased risk of predation, increased windthrow, and other types of disturbances (refer to Section 3.6 and Appendix I). Because the amount and composition of marbled murrelet-specific conservation areas differs among alternatives, there are different amounts of edge habitat.

Figure 4.6.3 compares the acres of habitat in different interior and edge conditions based on current (Decade 0) conditions versus projected edge conditions for all alternatives at the end of the planning period (Decade 5). Stringer habitat is also presented (refer to Figure 4.6.3).

Figure 4.6.3. Starting (Decade 0) and Ending (Decade 5) Habitat, by Alternative and Edge Position



Acres not adjusted for quality. “Non-LTFC” refers to P-stage habitat outside LTFC.

Under all alternatives, existing edges within long-term forest cover soften and disappear over time as younger forests within LTFC mature. Limitations on timber harvest and related activities (such as road construction) mean that the creation of new edges in habitat will also diminish significantly through time in LTFC under all alternatives.

Roads

While existing forest edges in LTFC will soften and abate over time as forests mature, many roads through LTFC will be maintained under all alternatives because they are part of a greater transportation network. These roads will have chronic edge effects on habitat in LTFC. The additional negative edge impacts of roads are anticipated to have minor impacts in overall habitat quality. Roads in habitat are assumed to create negative edge effects on habitat but to a lesser degree than caused by adjacent harvested and replanted stands. About 5 percent of habitat is estimated to be affected by road edges through the planning period.

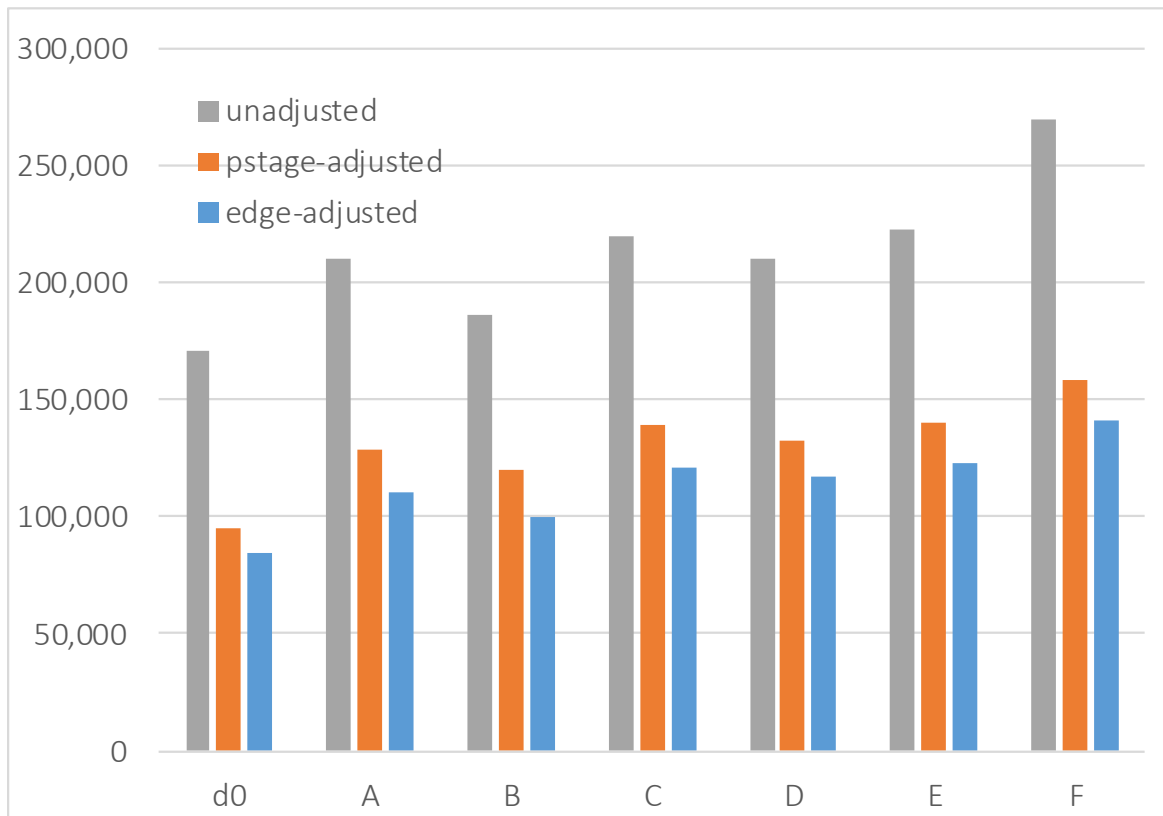
Stringers

All alternatives also project a relatively high amount of potential habitat in a stringer condition. These habitat stringers are primarily managed for riparian conservation and will never develop interior habitat because of their configuration. While habitat in stringers may provide some isolated nesting opportunities, they are assumed to have no value as nesting habitat in this analysis. Therefore, habitat located in stringers is excluded for the purposes of calculating impacts and mitigation.

HOW P-STAGE AND EDGE INFLUENCE HABITAT QUALITY

Stand-level habitat quality (P-stage) has a significantly greater effect on habitat quality than edge conditions. Figure 4.6.4 compares the gains in larger blocks of habitat (i.e., excluding stringers) as adjusted for P-stage value alone (by multiplying the habitat acreage by its P-stage value) and then further adjusted for edge condition. In Decade 5, the average P-stage-adjusted acreage is 62 percent of the average unadjusted habitat acreage, while edge adjustments further reduce that to 54 percent (Figure 4.6.4). While edge effects will negatively impact habitat quality in all alternatives, there is little difference in the level of edge influence among Alternatives C through F.

Figure 4.6.4. Comparing the Influence of P-stage and Edge Effects: Current (Decade 0) Murrelet Habitat Across all DNR-Managed Lands (Excluding Stringers) Compared With Estimated Future (Decade 5) Murrelet Habitat, by Alternative



HOW LOCATION INFLUENCES HABITAT QUALITY

Another factor influencing habitat quality among the alternatives is geographic location. The action alternatives place proportionately less habitat conservation in South Puget and portions of other planning units where distance from high-quality marine habitat and extensive development limits the marbled murrelet conservation potential of state forests. Conversely, proportionately more conservation is proposed for the OESF, Straits, and South Coast planning units, where the highest levels of marbled murrelet use of state forests occur. For example, some areas of OESF are in close proximity to important marine foraging areas such as the Strait of Juan de Fuca. Intermediate levels of conservation occur in the Columbia and North Puget planning units, with emphasis on conservation in areas closest to marine waters.

Certain geographically discrete areas of DNR-managed forests provide only marginal value for murrelet conservation because they are further than 3.1 miles (5 kilometers) from occupied sites and occur in areas with little habitat (refer to Appendix H, Figure 7). Within these “marginal landscapes,” habitat value is further reduced to 25 percent of its value based on P-stage and edge effects. Effectively, none of the current or potential future habitat in North Puget, OESF, and Straits occurs in marginal landscapes, but approximately 10 and 12 percent of habitat is expected to be located within the marginal landscape in the South Coast and South Puget planning units, respectively, by Decade 5.

TIMING OF HABITAT LOSS AND DEVELOPMENT

Habitat that exists today currently provides nesting opportunities to murrelets and is therefore more valuable than habitat that will be developed further into the future (as forests mature). If an impact to that habitat happens today, the offsetting mitigation (the same value of habitat becoming available to the murrelet) may not happen for several decades. The analytical framework takes this into account by adjusting the value of mitigation through time, which is expressed by decade to the end of the HCP.

The decadal adjustment factor is based on how much habitat develops in a particular decade, as well as which decade that habitat is realized. For example, the total habitat that develops in long-term forest cover from the present into the first decade receives full mitigation credit to offset harvest in the managed forest within that first decade; all of the acres are counted. However, the total habitat that develops between the first and second decades receives only 80 percent of the total credit. This is because the habitat that grows during this decade will contribute to murrelet conservation for less time in 4 out of the 5 total decades (80 percent of decades). Growth occurring between the second and third decades receives 60 percent credit (3 out of 5 decades of growth), and mitigation credits are calculated in this way through the end of the HCP (refer to Appendix I).

Putting it all together: Quality of habitat gained and lost through time

The overall losses and gains in habitat quantity can be modified by all of the factors affecting habitat quality as listed previously: P-stage, edge, location, and the timing of the growth of new habitat. These factors are described in further detail in Appendix H. Habitat with little value (stringers) is excluded outright, and habitat in edge condition or located far from at-sea populations or occupied sites are assumed to have a reduced quality.

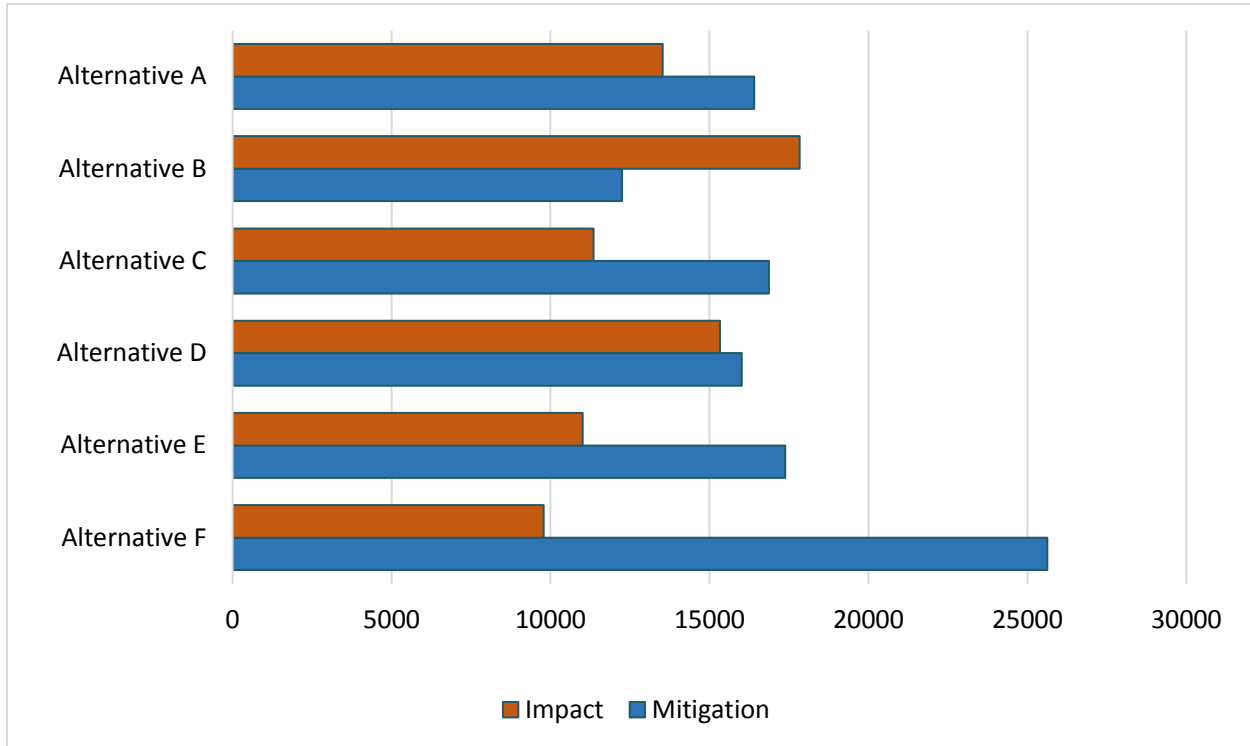
The result of these modifications can be reflected as a comparison of “impact” (habitat loss) to “mitigation” (habitat gain). As shown in Figure 4.6.5, Alternative F has the highest ratio of mitigation to impact at around 2.5:1. Alternatives A, C, and E all show significantly more acres gained than lost over the planning period, while Alternative D shows only slightly more gain than loss. Only Alternative B results in impact exceeding mitigation.

Under every action alternative, mitigation credit is assigned to marbled murrelet habitat that currently exists or develops within LTFC through the life of the HCP. Mitigation acres can be estimated and compared against potential impacts, which is the loss of P-stage habitat outside LTFC. Appendix I provides a detailed description of how the Joint Agencies will estimate potential impact and mitigation acres under the proposed action.

It is important to recognize that while specific outcomes are presented, in this case in impact and mitigation acres, there are uncertainties associated with these estimates. These uncertainties include the realization that habitat selection by marbled murrelets is complex and poorly understood and that forest growth and future habitat development may be influenced by many factors (such as climate change or natural disturbance) as described in Appendix E. The projections of future habitat development presented here are estimates which may or may not be realized over time. In addition, there are potential impacts to the species that are not clearly understood. Debate remains in the scientific community on how certain impacts (such as noise disturbance) may or may not affect the species.

The Joint Agencies worked together on developing the P-stage model and the analytical framework for the purposes of developing and analyzing the alternatives. These models serve as a tool to facilitate our relative understanding of impacts and mitigation for the different alternatives. The population model is also relevant for further interpretation of potential impacts. A summary of impacts (e.g., mostly habitat loss) and mitigation acres (habitat development over time) as measured by adjusted acres expected under each alternative is provided in Figure 4.6.5.

Figure 4.6.5. Adjusted Acres of Habitat Loss (Impact) and Gain (Mitigation) by the End of the Planning Period, by Alternative and Adjusted for Quality



Gains and losses are not equally distributed among HCP planning units. Table 4.6.4 shows the net acres in each HCP planning unit when adjustments are made for habitat quality (P-stage, edge effects, and time).

Table 4.6.4. Acres of Mitigation Minus Impact, by HCP Planning Unit and Alternative

HCP unit	Mitigation minus impact (quality- and time-adjusted acres)					
	Alt. A (no action)	Alt. B	Alt. C	Alt. D	Alt. E	Alt. F
OESF	-37	-3,926	387	-2,801	554	1,616
Straits	48	-1,151	-395	-277	22	-809
North Puget	1,146	536	2,531	1,618	2,799	6,868
South Puget and Yakima	-30	-283	369	-199	369	3,234
Columbia	-70	-1,317	408	473	408	1,810
South Coast	1,185	285	1,529	1,343	1,529	3,402
Total (net)	2,242	-5,856	4,829	157	5,681	16,121

Positive values occur where mitigation exceeds impact, negative values where impact exceeds mitigation.

Changes in acres are strongly related to the condition of these planning units at the beginning of the planning period. North Puget begins the planning period with a greater inventory of low-quality habitat and older non-habitat and therefore shows a significant increase in habitat quality through time. For planning units that begin with a relatively high proportion of protected, high-quality habitat (including OESF and Straits), negative acres can result for alternatives that shift the conservation focus from these areas to other HCP planning units. North Puget and the South Coast, where conserved high-quality habitat is currently scarce, show gains in habitat under any alternative.

Effect on marbled murrelet populations

The preceding analysis measures the amount and quality of habitat conserved or developed over the planning period. However, the amount and timing of habitat loss and development may not directly relate to population growth or decline. Uncertainties about marbled murrelet survival, reproduction rates, dispersal, and other environmental influences may affect how the population responds to increased habitat.

To help understand how marbled murrelet populations might respond to the variations in habitat presented in each alternative, the Joint Agencies engaged Dr. Zach Peery of the University of Wisconsin, an expert population ecologist and marbled murrelet biologist, to develop a model that could estimate the effects of the alternatives on marbled murrelet populations and incorporate the habitat estimates and analytical framework described in preceding sections and in supporting documents.

Dr. Peery's team built a population viability analysis model to compare the effects of the alternative proposals for habitat harvest and development on the marbled murrelet population in Washington. The model used demographic information obtained in intensive field studies and available in published reports. It was based on reasonable understanding and interpretation of murrelet ecology and nesting habitat relationships as well as detailed assessments of forest conditions in Washington, especially on DNR-managed lands.

As is common in population viability analyses, a number of simplifying assumptions regarding murrelet demography, dispersal, and breeding biology were required. Also in common with most population viability analyses, model predictions of risk and population size are best viewed in a relative sense. The uncertainties underlying the model do not support absolute predictions of ending population size (for example, the exact number of murrelets at a given point in time). Instead, the model outputs are best used as relative comparisons of risk and potential for recovery among the management alternatives. Model predictions must be considered in light of uncertainty about the effects of stressors in the marine environment and future changes in climate as too little is known about these non-forest influences to incorporate them into the model structure. For a detailed presentation of modeling methods, results, and discussion, including assumptions and limitations, refer to Appendix C.

Two different scenarios encompass the principal hypotheses regarding uncertainty over the environmental factors that influence the murrelet population decline. A "risk analysis" scenario was based on the assumption that both nesting habitat loss and other chronic environmental stressors such as marine conditions are responsible for the murrelet population decline observed in Washington. It used relatively pessimistic demographic rates that result in a declining murrelet population with less ability to use nesting

habitat as it develops. An “enhancement analysis” assumed that loss of nesting habitat is primarily responsible for the population decline and uses more optimistic demographic rates that result in a murrelet population with greater capacity to use nesting habitat as it develops.

To focus on relative differences between the alternatives, murrelets in Washington were assumed to belong to two simplified subpopulations (DNR and non-DNR), with habitat conditions artificially held constant on non-DNR lands. Simulations of the Washington population assumed that the two subpopulations were connected by dispersal while simulations of the DNR population alone assumed no dispersal. The models simulated murrelet populations over 50 years in response to the current and projected future habitat conditions proposed under each alternative. All simulations begin with a population assumed to be approximately 40 percent greater than the carrying capacity (K) of existing habitat in order to simulate the observed rate of decline. Researchers conducted 10,000 simulations with biologically appropriate levels of random variation in survival and reproductive rates for each alternative to produce two informative outputs: average ending population size and the proportion of model runs that fell below specified fractions of the initial population size as a measure of “quasi-extinction risk.”

Detailed results can be found in the report (Peery and Jones 2016, Appendix C); results are briefly summarized here.

RISK ANALYSIS

When the Washington population was evaluated, few differences could be seen in projected population size and the probability of extinction. During the 50-year model period, all alternatives had low probability (5.4–6.0 percent) of quasi-extinction (dropping below one-eighth of the starting population). Similarly under all alternatives, after an initial annual decline of approximately 5 percent (related to assuming the population was 40 percent over carrying capacity or “ K ”), populations continued a steady decline of approximately 1.5 percent per year for the remainder of the modeling period (ending populations ranged from 1,039 to 1,092 murrelets).

When the model focused on just the theoretical DNR population with no dispersal, differences among alternatives in population response and the risk of quasi-extinction were more pronounced. Alternative F resulted in the greatest number of female murrelets (175) and lowest quasi-extinction probability (11 percent), whereas Alternative B resulted in the lowest population size (95 female murrelets) and highest quasi-extinction probability (42 percent). However, all alternatives showed a pattern of steeper initial population decline followed by continued steady decline of approximately 1.5 percent at levels appropriate to the K provided by each alternative.

ENHANCEMENT ANALYSIS

Similar to the risk analysis, little difference among alternatives was apparent at the statewide scale. For the Washington population, probability of quasi-extinction (dropping to one-eighth of the initial population) was zero or nearly zero for all alternatives. While murrelet numbers initially declined in the first few decades because the population was assumed to be over K , the population stabilized for the remainder of the planning period for all alternatives. Alternative F was projected to support the largest ending population (2,663 female murrelets) and Alternative B the smallest (2,368 female murrelets).

The hypothetical population limited to DNR-managed lands had very low probabilities of quasi-extinction under all alternatives (0.01–0.1 percent). All alternatives began with declining populations (during the first 2 decades) followed by gradual increases in response to increasing habitat for the remainder of the modeling period. Alternative F resulted in an ending population of 590 female murrelets, while B resulted in 328 female murrelets. Table 4.6.5 shows the mean ending female population sizes by alternative.

Table 4.6.5. Enhancement Analysis for Simulated DNR Sub-Population, by Alternative

Year	Projected mean population sizes after 10,000 simulations (number of female marbled murrelets)					
	Alternative A (no action)	Alternative B	Alternative C	Alternative D	Alternative E	Alternative F
0	542	542	542	542	542	542
10	393	355	420	397	423	467
20	343	276	392	354	401	466
30	350	277	408	368	419	496
40	375	302	445	402	455	541
50	406	328	482	436	491	590

COMPARING MODELED POPULATION RESPONSES AMONG THE ALTERNATIVES

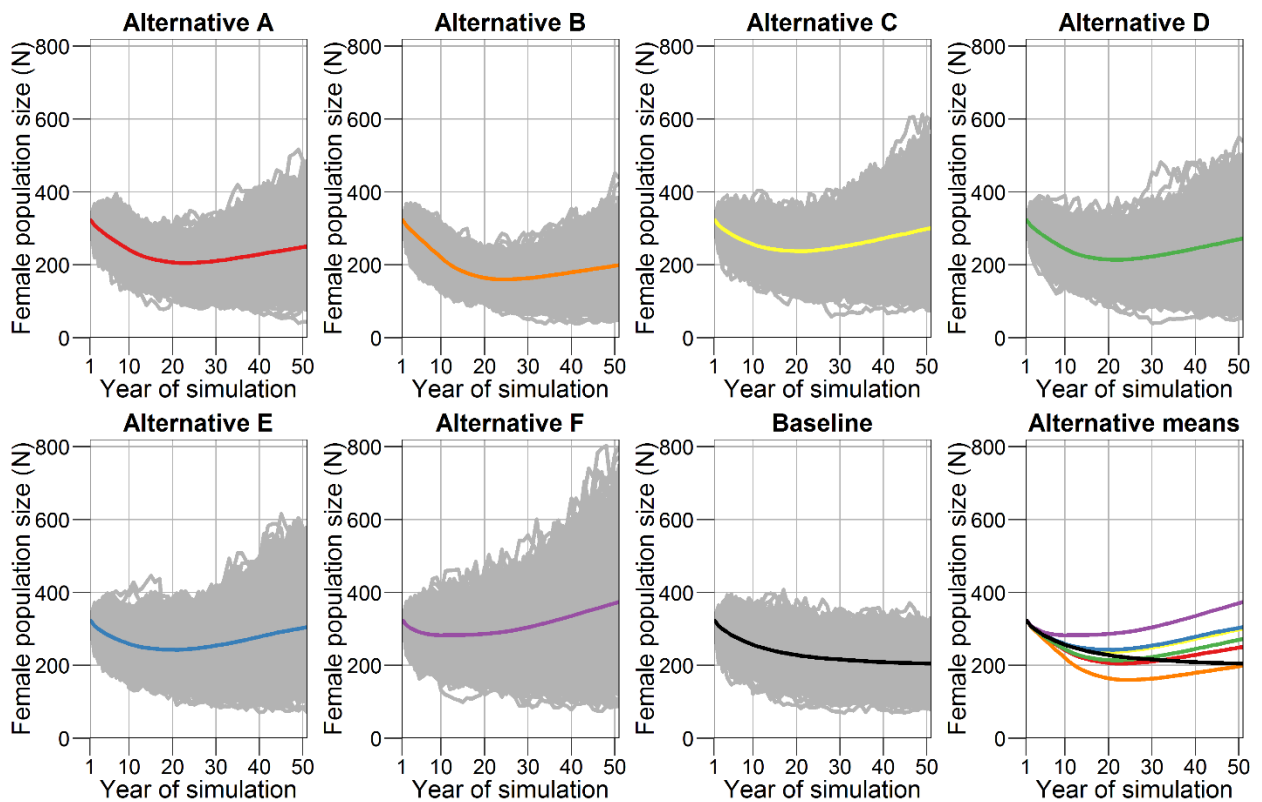
Model results for the Washington population of marbled murrelets showed no substantial difference in population size or quasi-extinction risk among the action alternatives (Appendix C).

For the DNR sub-population, Alternative B resulted in the lowest ending populations and the highest risk of quasi-extinction. Alternative F resulted in the highest population by the end of the planning period and lowest risk of quasi-extinction. Under the risk scenario, the simulated populations continued to decline even though *K*, which was directly related to adjusted habitat acreage, increased under all alternatives. However the enhancement scenario suggested a different pattern with gradual population increases reversing the initial declines in response to increased habitat on DNR lands. Refer to Figure 4.6.6.

In a separate sensitivity analysis, the modelers found the most influential factor in murrelet population growth was the amount of high-quality nesting habitat (P-stage values of 0.89 and higher). The populations were found to be less sensitive to edge conditions and the overall amount of nesting habitat which mostly reflected the abundance of low-quality habitat (P-stage values of 0.25 and 0.36).

Figure 4.6.6. Simulated Population Responses, by Alternative for the DNR Sub-Population Under the Enhancement Analysis (Copied from Peery and Jones 2016, refer to Appendix C)

The colored lines on each graph reflect the average of all 10,000 simulations, which are plotted in gray. Baseline as used in this figure is not the same as the no action alternative. Baseline represents a static habitat scenario where the raw amount of murrelet nesting habitat that presently exists on DNR lands remains constant over the 50-year modeling period. The baseline scenario offers a useful benchmark by which to compare scenarios with changing habitat conditions.



Conclusions: Changes in habitat and population response

All alternatives increase the acreage and quality of marbled murrelet habitat over the analysis period.

These projected increases are likely positive impacts on the DNR sub-population of birds, even when considered against the ongoing 4.4 percent population decline. If nesting habitat is the primary limitation on murrelet population growth, all alternatives result in a reversal of the population decline, with Alternative F resulting in the earliest reversal and greatest population increase. However, under the “risk” scenario, the population continues to decline because this scenario assumes a greater influence from

chronic environmental stressors outside the forest. Key comparisons of the alternatives are summarized in Table 4.6.6.

Table 4.6.6 Comparison of Alternatives Based on Key Measures

Measure	Alternatives					
	A (no action)	B	C	D	E	F
Acres of habitat loss in first decade (not adjusted for quality)	36,000	49,000	35,000	42,000	34,000	25,000
Total unadjusted habitat acres (Decade 5)	333,700	316,600	338,000	329,800	339,900	371,700
Total adjusted habitat acres (Decade 5)	161,400	158,700	169,500	164,400	170,300	181,500
Adjusted acres of interior habitat by Decade 5 (percent change)	82,800 (21%)	67,300 (-1%)	93,700 (37%)	91,900 (35%)	95,800 (40%)	114,200 (67%)
Average P-stage, Decade 5	0.61	0.65	0.63	0.63	0.63	0.59
Decade to habitat recovery ⁵	2	3	2	2	2	0
Ending female population for DNR sub-population (risk/enhancement)	74 / 251	54 / 199	90 / 301	78 / 272	91 / 305	107 / 374
Probability of the DNR sub-population falling below one-eighth of the starting population ⁶ (risk/enhancement)	22% / 0%	41% / 0%	11% / 0%	20% / 0%	10% / 0%	6% / 0%

Alternative B reflects the most harvest of marbled murrelet habitat in the first decade. It takes 3 decades for overall acres of habitat in LTFC to exceed this loss. Alternative B has the highest ending P-stage value, but this is due to including more occupied site acres (P-stage 1) relative to other P-stage categories. The population model shows that Alternative B has, by far, the smallest simulated population by the end of the analysis period, as well as the greatest quasi-extinction risk among the alternatives to marbled murrelet populations.

Alternatives C, D, and E are similar in the overall amount of acres conserved and the quality of those acres. Although Alternative D proposes the most initial harvest of habitat outside LTFC among these three alternatives, the overall value of the habitat retained and percentage of new interior habitat grown is higher than in the no action alternative.

⁵ Decade to habitat recovery refers to the time it takes for habitat growth in LTFC to compensate for the habitat loss in the first decade as measured in adjusted acres.

⁶ A 5 percent decline per year equates to a decline to one-eighth of the starting population in 40 years.

Alternatives C and E conserve isolated stands with P-stage 0.47 and higher, thus raising their overall habitat quality as compared to Alternative D. Alternatives C and E differ only slightly in the population responses. Alternative D lies in the middle of the range of the simulated population. An important distinction for Alternative D is that the loss of higher-quality habitat results in results in approximately 10 percent fewer murrelets in the modeled marbled murrelet population than in Alternatives C or E.

The greater area of LTFC and lesser harvest proposed in Alternative F results in a projected net habitat increase after the first decade, the most gain over time in interior habitat, the highest modeled population gains, and the lowest risk of quasi-extinction. Although this alternative conserves the most acres of potential habitat, the average habitat value in the final decade of the planning period is slightly lower than the other alternatives because more lower-quality habitat develops in the conservation areas. Alternative F conserves the most habitat, even when adjusting for edge effects.

Indirect effects on habitat: Disturbance

Marbled murrelets use DNR-managed forests for breeding and other essential behaviors from April 1 through September 23 in Washington. During this time, they can be exposed to audio-visual stressors from a variety of land use activities. Harvest and other forest management and use have indirect impacts on habitat quality by increasing the risk of disturbance to nesting marbled murrelets and chicks. Some of these stressors are related to habitat conditions, predator composition, and use in edges (described in preceding sections), and others are related to noise and visual disturbances from forest use and management activities. Sources of disturbance impacts are diverse and include road construction, maintenance, and use; timber harvest and recreational activities; aircraft; and rock pit operations and more.

A disturbance event is considered significant when an activity causes a murrelet to delay or avoid nest establishment, flush away from an active nest site, or abort a feeding attempt during incubation or brooding of nestlings. Indirect effects of campgrounds and day-use areas include locally increased populations of nest predators. Such events are considered significant because they have the potential to result in reduced nesting attempts, nest success, fitness, and/or survival of juveniles and adults, thus impacting the population (USFWS 2012).

The effect of many of these disturbances caused by new or expanded land use activities throughout the planning period are reduced by the conservation measures described in Chapter 2. There are also existing and ongoing disturbance effects that DNR evaluated to ensure that mitigation (the growth of new habitat) would be adequate to offset these negative influences over time.

Quantitative estimates of disturbance can be developed by determining the birds' likely response given the proximity, timing, duration, and intensity of stressors and converting that information into acres of quality-adjusted habitat exposed to stressors during the breeding season (Appendix I). However, uncertainties over the nature of murrelet responses to the range of potential disturbances, the location of murrelet nests, and the timing and location of potentially disturbing activities do not allow quantitative estimates of disturbance impacts similar to the estimates of habitat quality and quantity used to evaluate the impacts of harvest and development of murrelet habitat. Thus, while the spatial and temporal overlap of potentially disturbing activities with current and future murrelet habitat can be estimated, the impacts of potential disturbance to that acreage cannot be directly compared or tallied with habitat acreage.

Potentially disturbing activities were classified into six groups with similar characteristics, their average spatial and temporal distributions were estimated based on contemporary practices, and their spatial footprints were derived according to the appropriate distances. These disturbance footprints were intersected with the current marbled murrelet habitat map to estimate the areas potentially subject to those various disturbances. The estimates reported in Table 4.6.7 are based on the assumption that disturbance patterns will be approximately constant over the HCP term and that habitat conserved and developed under each alternative is exposed to disturbance approximately in proportion to its abundance. The estimates of annual habitat disturbance are based on the amount of habitat (Appendix I) estimated for the middle of the HCP term averaged across all alternatives. Cumulative disturbance can be estimated by multiplying acres disturbed annually by 51.

Table 4.6.7. Average Estimated Acreage of Murrelet Habitat Disturbed Annually During the Nesting Season, by Activity Group

Activity group	Stressor	Distance	Duration	Response/impact	Average habitat disturbed annually during nesting season (adjusted acres)
Group 1 (includes green collecting, pre-commercial thinning, non-motorized trail use, minor road maintenance)	Ground-based noise and visual disturbance	≤100 meters	< 1 day	No significant response based on duration; minimal to no impacts	9,200
Group 2 (includes firewood collection, road reconstruction, major road and trail maintenance, communications facilities)	Ground-based noise and visual disturbance	≤100 meters	< 7 days	Aborted feedings, adults flushing; disruption of normal behaviors	310
Group 3 (campground use and maintenance)	Ground-based noise and visual disturbance Predator attraction	≤100 meters	< 1 month	Increased predation risk, aborted feedings, adults flushing; potential injury and/or mortality	142

Activity group	Stressor	Distance	Duration	Response/impact	Average habitat disturbed annually during nesting season (adjusted acres)
Group 4 (includes timber harvest, motorized trail use, new road and bridge construction)	Ground-based noise and visual disturbance	≤100 meters	>7 days, < 1 month	Aborted feedings, adults flushing; disruption of normal behaviors	1,630
Group 5 (sand and gravel extraction, blasting)	Ground-based noise and visual disturbance	≤ 400 meters (0.25 mile)	>7 days, < 1 month	Hearing damage from blast noise (within 100 m), aborted feedings, adults flushing; injury; disruption of normal behaviors	52
Group 6 (aerial herbicide application)	Aircraft Noise	≤100 meters	< 7 days	Aborted feedings, adults flushing; disruption of normal behaviors	50

The most common and widespread types of disturbance, Group 1 activities (short duration, low intensity) are estimated to occur over 9,200 adjusted habitat acres annually but are not expected to have adverse effects. Group 2 and Group 4 activities are transient, widely distributed ground-based disturbances with similar expected murrelet response, which is disruption of normal behaviors that is estimated to occur over 1,900 acres annually. Groups 3 and 5 are ground-based disturbances from discrete facilities; together, they are expected to result in disruption of normal behaviors from noise and visual disturbance over 200 acres annually. In addition, Group 3 activities are expected to result in potential injury and/or mortality to murrelets in the form of increased nest predation in 143 acres annually, and blasting (Group 5) within 100 meters of nesting murrelets could also result in injury and/or mortality to about 5 acres annually. Group 6, aircraft noise, is expected to result in disruption of normal behaviors over 50 acres annually. Some of the disturbance estimated in one category will overlap in space and time with disturbance estimated in another category, so estimates of acres impacted may reflect cumulative impacts.

Estimates of acres of habitat gained and lost under the alternatives do not take into account the disturbance acres because those impacts do not result in habitat removal. Instead, the frequency, intensity, and amount of acres impacted from these disturbances informed conservation measures proposed under the action alternatives. These measures are designed to reduce the risk of these impacts and are more fully described in Chapter 2, Section 2.2. Table 4.6.8 summarizes how the conservation measures are expected to affect to marbled murrelets.

Table 4.6.8. Summary of Resulting Effects of Key Proposed Conservation Measures on Disturbance

Conservation measure	Potential disturbance impacts addressed	Resulting effect
Limiting harvest and thinning activities	Aborted feedings, adults flushing; potential disruption of nesting behaviors	Seasonal restrictions avoid activities during the nesting season, including reducing audio-visual disturbance from heavy equipment use, road construction, and related noise.
Seasonally restricting forest health treatment activities	Aborted feedings, adults flushing; potential disruption of nesting behaviors	Reduced risk to marbled murrelet specific conservation areas from audio-visual disturbances during peak activity periods for nest visits. Occupied sites are further protected from smoke from prescribed burns.
Limiting road construction	Aborted feedings, adults flushing; potential disruption of nesting behaviors	Alternatives B, E, and F: Creation of edge and audio-visual disturbance may occur as a result of some road construction through occupied sites, although consultation will likely minimize this risk. Habitat located outside occupied sites is subject to ongoing disturbance impacts from road construction. Alternatives C and D: Occupied sites, buffers, and special habitat areas will not receive new impacts from roads. Risk of road impacts may increase if more road miles must be built to avoid conservation areas.
Daily timing restrictions on road maintenance, decommissioning, or abandonment	Aborted feedings, adults flushing; potential disruption of nesting behaviors	Reduced risk to nesting birds in occupied sites from audio-visual disturbances during critical feeding hours. Other marbled murrelet conservation areas and low-quality habitat throughout the analysis area may experience audio-visual disturbance from these activities.
Limiting installation and placement of harvest-related infrastructure (tailholds, guyline corridors, etc.)	Habitat removal, aborted feedings, adults flushing; potential disruption of nesting behaviors	Reduced risk to platform trees from equipment. Reduces audio-visual disturbance to all marbled murrelet conservation areas. Reduces risk of habitat removal in occupied sites.
Limiting salvage and recovery activities during the nesting season	Aborted feedings, adults flushing; potential disruption of nesting behaviors	Reduced risk to nesting habitat in marbled murrelet conservation areas from audio-visual disturbance during critical feeding hours. Increases the potential recovery of high-quality habitat if it is damaged. Activities in low-quality habitat outside conservation areas are not restricted, which could result in some site-specific audio-visual impacts from recovery and salvage operations but may also allow more enhancement of low-quality habitat.
Restricting both location and timing of blasting	Hearing damage from blast noise (within 100 m), aborted feedings, adults flushing; potential injury or disruption of nesting behaviors	Reduced or eliminated impulsive noise impacts to nesting and potentially nesting murrelets within conservation areas. Murrelets nesting outside of these areas may be subject to disturbance from blasting. Alternatives C and D propose the strictest blasting limitations.

Conservation measure	Potential disturbance impacts addressed	Resulting effect
Limiting rock crushing and pile driving during nesting season	Hearing damage from impulsive noise, aborted feedings, adults flushing; potential harm or disruption of nesting behaviors	Reduced or eliminated impulsive noise impacts to nesting and potentially nesting murrelets during peak nest activity periods.
Limiting aerial activities during nesting season	Aborted feedings, adults flushing; potential disruption of nesting behaviors	Audio-visual disturbances from low-flying aircraft on nesting murrelets will be reduced in marbled murrelet conservation areas. Birds nesting outside these areas will be subject to these impacts.
Limiting the location of new or expanded recreation facilities and trails	Increased predation risk, aborted feedings, adults flushing; potential harm	Alternatives C and D: Risk of habitat removal, direct harm from predators, and increased audio-visual disturbances will be significantly reduced in marbled murrelet conservation areas, except isolated patches of high-quality habitat. Outside of conservation areas, disturbance from maintenance activities will be eliminated during critical nest visiting and feeding hours. Alternatives B, E, and F: Risk of disturbance will be reduced during critical nest visiting and feeding times. This restriction does not address the creation or use of undesignated trails or areas of recreational activities.
Restricting and mitigating the use of easements, rights-of-way, leases, and contracts where DNR has authority to do so	Aborted feedings, adults flushing; potential disruption of nesting behaviors	Reduced risk of audio-visual disturbances for maintenance activities and construction of new facilities during peak nest activity periods in conservation areas.

Potential changes to long-term forest cover through time

In addition to the direct impacts to marbled murrelet habitat from harvest and related activities and the indirect effects from ongoing land use activities within and adjacent to marbled murrelet habitat, long-term forest cover may be affected through time by disturbances and activities outside of the Joint Agencies’ control. These impacts could come from landslide events, wind and fire events, or undesignated or illegal land use activities. These impacts could also come from new rights-of-way or easements required to provide utilities or road infrastructure or for legally required access to inholdings.

These impacts are anticipated to be generally minor at the scale of all LTFC and insignificant within marbled murrelet-specific conservation areas. For example, only between 4 and 6percent of the land proposed as marbled murrelet conservation areas and not already deferred for other conservation reasons is identified as having high landslide hazard potential using DNR data (refer to Section 3.1 for a description of these data). This does not mean that 4 to 6 percent of these areas will fail during the

planning period. Activities that can trigger landslides will be restricted in these areas (for example, road building and harvest). However, there remains a small risk of habitat loss due to natural landslide events. Similarly, rare weather events such as catastrophic windstorms, while not exacerbated by the proposed alternatives (refer to Section 4.2, Climate) could result in some loss of long-term forest cover. Although potentially locally significant, these losses are not expected to be significant at the statewide scale during the planning period.

Those alternatives with a higher amount of mitigation than expected take (refer to Figure 4.6.5) would provide additional capacity to “absorb” or account for these impacts. Alternative F is the most resilient because it conserves the greatest amount of acreage across a wide geography, while Alternative B is least resilient because it conserves the least acreage and is the most geographically restricted.

Summary of impacts

The marbled murrelet population is declining in Washington. Habitat growth on DNR-managed land appears to have the potential to decrease the rate of this decline under some alternatives. The alternatives offer different approaches to habitat protection and habitat growth that, when analyzed and compared, illustrate some key differences in habitat amount and quality and estimated population response.

Table 4.6.9. Summary of Potential Impacts to Marbled Murrelets

Key question	Criteria	Measures	Potential impacts		
How do the alternatives affect marbled murrelet nesting habitat, and how are changes to nesting habitat quantity and quality expected to affect the marbled murrelet population?	Compliance with ESA and HCP	Amount and quality of habitat gained and lost	<p>All alternatives result in more habitat gained than lost over time, with improved habitat quality and softened edge effects. In the short term, loss of mostly low-quality habitat outside of long-term forest cover will occur under any alternative, including the no action alternative. Within the first 2 decades, growth of new habitat and development of higher-quality habitat outpaces this initial habitat loss.</p> <p>When adjusted for quality, Alternative B is the only alternative with impacted acres exceeding acres of mitigation. Alternative D has the closest balance of impact to mitigation when factoring in habitat quality. Alternative F has significantly more mitigation acres than impact acres.</p> <p>Alternative F conserves the most additional habitat overall and has the most increase in interior habitat over time. Alternatives C through E also have substantial increases in interior habitat, while Alternative B has a slight reduction.</p>		
	Need, purpose, and objectives			Level of disturbance from forest management and land use activities	Disturbance impacts will be ongoing in LTFC but will be minimized inside occupied sites, buffers, and special habitat areas. Risk of disturbance within marbled murrelet conservation areas is minimized to the highest degree under Alternatives C and D. However, given the relatively small number of acres involved for most disturbance categories, this is a minor benefit.
				Relative comparisons of population projections over time, including risks of quasi-extinction	<p>Alternative B has the highest risk of quasi-extinction.</p> <p>If nesting habitat is the primary limitation on murrelet population growth, all alternatives result in a reduced rate of population decline, and Alternative F shows the earliest reversal and greatest overall increase in population.</p>

Key question	Criteria	Measures	Potential impacts
<p>Do the alternatives provide habitat in important geographic locations for marbled murrelet conservation?</p> <p>These include southwest Washington and areas close to marine waters, including along the Strait of Juan de Fuca and in the North Puget planning unit.</p>	<p>Compliance with ESA and 1997 HCP</p> <p>Need, purpose, and objectives</p>	<p>Relative comparison of habitat conserved in important landscapes identified by Recovery Plan and or <i>Recovery Implementation Team Report</i></p> <p>Relative comparisons of future habitat development in strategic locations</p>	<p>Southwest Washington: The no action alternative would protect approximately 81% of all known P-stage habitat in South Coast and 59% in Columbia. Alternatives C through E would protect more of this habitat, approximately 85% in South Coast and 75% in Columbia. Alternative F protects the most P-stage habitat in southwest Washington, protecting approximately 85% in South Coast and 91% in Columbia. Alternative B protects less: 65% in South Coast and 34% in Columbia (significantly less than the no action alternative).</p> <p>Close to marine waters: Alternatives C, D, and E provide more murrelet conservation near the Strait of Juan de Fuca compared with the other alternatives. Alternatives C and E provide additional habitat in OESF (including the Clallam Block) and Straits. Alternatives C through F emphasize murrelet conservation in important areas west of National Forestlands in North Puget (closer proximity to marine waters), and Alternative F provides additional habitat in North Puget.</p> <p>Alternative F provides the most overall future habitat development in important areas.</p>

Minimization and mitigation for adverse impacts

All alternatives use areas of long-term forest cover as the primary conservation strategy to provide both minimization and mitigation for the impacts summarized in Table 4.6.9. These impacts include loss of habitat, ongoing edge effects, and ongoing disturbance. These impacts are mitigated by:

- 1) Conservation and development of marbled murrelet habitat in LTFC
- 2) Conservation of habitat in strategic locations on DNR-managed forestlands
- 3) Conservation measures designed to minimize the impacts of edges and disturbance (refer to Chapter 2 and Table 4.6.11).

4.7 Recreation

This section describes the potential effects of the alternatives on DNR recreation facilities and users in the analysis area.

Analysis question

- *How are recreational opportunities on DNR-managed lands affected by the action alternatives?*

Evaluation criteria

Impacts are evaluated against the quality and quantity of recreational opportunities available, as governed by DNR recreation planning policies and the multiple use concept.

Scale of analysis

The alternatives are analyzed at both the analysis area scale and at a “landscape block” level. The proposed conservation measures most directly affect recreation in landscape blocks where marbled murrelet conservation areas and designated recreation facilities and/or trails overlap.

How impacts are measured

Direct, indirect, and cumulative impacts are measured qualitatively, considering use-level trends through the life of the HCP and where designated recreation intersects with proposed marbled murrelet conservation areas.

Summary of direct, indirect, and cumulative impacts

Under the interim marbled murrelet strategy, Alternative A, existing HCP provisions and DNR policies for recreation planning will continue to be followed. Alternatives B through F include specific conservation measures that would impact new or expanded recreation in marbled murrelet conservation areas (refer to Chapter 2).

All of the action alternatives have the potential to clarify the geographical information that will be used in recreation planning. This is a positive impact in terms of adding certainty to where and what recreational opportunities will be allowed on DNR-managed lands with marbled murrelet habitat.

There are no significant adverse impacts identified at the scale of the analysis area. However, DNR may need to shift the focus of recreation within some landscape blocks where there are marbled murrelet conservation areas in order to accommodate a growing demand for recreation on state trust lands.

Direct impacts to recreational opportunities

There would be no anticipated direct impacts to recreation in the popular DNR-managed landscapes of Capitol Forest, Tiger Mountain State Forest, Raging River State Forest, Green Mountain State Forest, Tahuya State Forest, and Elbe Hills State Forest. These recreational landscapes do not have marbled murrelet conservation areas designated under Alternatives B through F; therefore, the conservation measures will not directly affect these areas when managing and developing recreation. These landscapes could be indirectly affected by the conservation measures if restrictions on recreation within marbled murrelet conservation areas shift more recreation to these landscapes (refer to the subsequent subsection, Indirect impacts).

For landscape blocks with existing designated recreation areas that are located within proposed marbled murrelet conservation areas, expansions of these facilities or development of new facilities will be limited. As demand for recreation continues to increase, so will public use of these existing areas and potential interest in expanding these areas.

Twelve (12) landscape blocks within the analysis area have existing recreational facilities that are located within proposed marbled murrelet-specific conservation areas. Some conservation measures proposed under the alternatives would limit new or expanded recreation within these areas while current uses would remain, as highlighted in Table 4.7.1.

Table 4.7.1. Existing Recreation in Landscape Blocks With Marbled Murrelet Conservation Areas

HCP planning unit	Landscape block	Type of facility impacted	Known areas with potential limitations on expansion
North Puget	Walker Valley	Motorized trails	Alternative F: A MMMA encompasses the northeast portion of the trail system.
Columbia	Elochoman	Motorized trails	Alternative F: MMMA encompasses a trailhead and ORV trail.
South Coast	Radar/Bear	Campgrounds	Alternative D: Two campgrounds are within special habitat areas. Alternative F: Two campgrounds are within a MMMA.
Straits	Port Angeles	Motorized trails	All alternatives have occupied sites and/or buffers that overlap a section of motorized trail.
Straits	North Crescent	Motorized trails	All alternatives have occupied sites and/or buffers that overlap a section of motorized trail.
Straits	North Crescent	Campground	All alternatives have occupied sites and/or buffers that encompass a campground.
OESF	Coppermine	Campground	Alternatives B through F have occupied sites and/or buffers that encompass a campground.

IMPACTS ON NEW OR EXPANDED RECREATIONAL OPPORTUNITIES: ALTERNATIVES C AND D

Alternatives C and D would restrict recreational development within occupied sites, buffers (including the 0.5-mile enhanced buffer in emphasis areas), and special habitat areas. This means that the areas limited for recreation will be more clearly defined with specific geographic areas, which could bring more certainty to planning new and expanded recreational opportunities.

However, potential impacts to strictly limiting new and expanded recreation opportunities in these areas include:

- Increased use of existing facilities and trails, requiring increased enforcement and maintenance.
- Increased volume of use within the landscape block, with the possibility of people going off trails or building trails without permission from the department, requiring increased enforcement and environmental mitigation.
- Development of other areas more suitable for recreational development, where available.
- Decreased recreation in this landscape block.

These potential impacts are not exhaustive. If there is sufficient public interest to expand recreational opportunities near existing designated recreation, DNR will need resources to identify suitable areas for recreational development that are consistent with the intentions and actions of the marbled murrelet conservation strategy and also meet the other land management and environmental obligations of the department.

Another potential impact of Alternatives C and D involves the requirement to consult USFWS to abandon or decommission non-designated trails in marbled murrelet conservation areas. Under the interim strategy, there is no specific requirement for consultation if the department needed to abandon, decommission, and potentially restore non-designated trails anywhere in the state to alleviate safety, environmental, or natural resource concerns. The additional step of consulting with USFWS when needing to abandon a trail in a marbled murrelet conservation area does add some uncertainty to outcomes. However, DNR and USFWS have a long history of working together to efficiently resolve implementation issues, and there is no reason to believe that would change.

IMPACTS ON NEW OR EXPANDED RECREATIONAL OPPORTUNITIES: ALTERNATIVES B, E, AND F

The conservation measure proposed for Alternatives B, E, and F provides DNR the flexibility to assess and potentially develop recreation opportunities within marbled murrelet conservation areas if there are no identified impacts to the marbled murrelet or if impacts can be mitigated through consultation with USFWS. The difference between these provisions and the no action alternative is that there would be a potential for recreational development in occupied sites and buffers, the 0.5-mile buffer in emphasis areas, and special habitat areas. If DNR wanted to pursue recreational activities in one of these places, they would conduct an impacts analysis. If impacts were identified, they would consult with USFWS. Where no impacts to the marbled murrelet are identified, DNR would not have to consult with the USFWS, and new or expanded recreation could move forward in these areas.

Where impacts are identified, DNR may choose not to pursue new or expanded recreation development, or may consult with USFWS. Because this is done on a site-specific basis, is not possible to describe what potential outcomes could entail. However, DNR and USFWS have a long history of working together to efficiently resolve implementation issues, and there is no reason to believe that would change.

IMPACTS TO MAINTENANCE ACTIVITIES (ALL ACTION ALTERNATIVES)

Daily timing restrictions for maintenance activities will likely have a low to minimal impact to recreation opportunities. The nesting season coincides with the most popular season for recreation on many landscapes as well as the optimal timing for many maintenance activities. Staff would have to take care to schedule maintenance work in marbled murrelet conservation areas outside of the daily timing restrictions, but it could likely be accomplished with reasonable accommodation. There are some maintenance activities that could reasonably occur outside of the nesting season.

Indirect impacts

An indirect effect of limiting new or expanded recreation development in some areas is that it may increase recreational pressure in other landscape blocks. It could create public pressure to develop recreational opportunities in landscapes that have not historically had designated recreation or in areas that are less environmentally suitable for recreation. There is also the potential for increased recreational use on landscapes with developed recreation, leading to increased need for management, maintenance, enforcement, and potentially expansion of designated opportunities.

Limiting recreational trail and facility development in one portion of a landscape might result in increased recreational use of open forest roads, public pressure to expand into other areas, and the development of trails without department permission. This could lead to higher resource needs for management, maintenance, decommissioning, restoration, and enforcement.

DISPERSED RECREATION

It is possible that restricting designated recreational development and expansion in landscapes with marbled murrelet conservation areas could indirectly impact dispersed recreation. Access for dispersed recreation happens from both designated facilities as well as from county roads, forest roads, and adjacent lands. Impacts could range from decreased access to displacing dispersed recreation to other forested blocks that may or may not be suitable for dispersed recreation activities. Unsuitable or concentrated dispersed use of an area can lead to impacts that require management, mitigation actions, enforcement, and the potential need to actively manage an area. Any expansion in recreation management requires additional staff and financial resources.

Cumulative impacts

The state's population is projected to grow by several million over the next 3 to 4 decades. The Washington State Recreation and Conservation Office completed an assessment of supply of outdoor recreation facilities and opportunities in Washington (RCO 2013). Their findings suggest that the current supply of recreation is not completely meeting public demand, and meeting that demand is further

challenged by the pressures of population growth and urbanization in Washington. This is likely to intensify over the next several decades as public land available for recreation becomes more restricted. This increased pressure may result in additional use of existing facilities and trails, public interest to develop new facilities and new trails (both motorized and non-motorized), and an increase in trails being created without the DNR's permission in both landscapes with and without marbled murrelet conservation areas. Landscapes with marbled murrelet conservation areas may see public pressure for recreation where there is not currently much demand for recreation. This may result in management and enforcement issues to limit recreational use of an area and stay consistent with the HCP conservation strategies.

Increases in recreational volumes or expanded recreational development can create conflicts with adjacent landowners, trust income-generating activities, or environmental responsibilities. There are a variety of stakeholders that have interests in how DNR manages the lands, including, but not limited to, the trust beneficiaries, the environmental community, the Tribes, adjacent landowners, and the recreating public. In the future, if recreation on DNR-managed trust lands starts to significantly impact the basic activities necessary to fulfill trust obligations, recreational use will need to be evaluated for how to manage, eliminate, or compensate the trusts.

Table 4.7.2. Summary of Potential Impacts to Recreation

Key questions	Criteria	Measure	Potential impacts
How are recreational opportunities on DNR-managed lands affected by the alternatives?	Recreational opportunities are provided consistent with the Multiple Use Concept and other department policies Impending recreation plans	Use levels through life of HCP (trends) Designated recreation that intersects with marbled murrelet conservation areas	No impact to existing and dispersed uses. Clearly defined marbled murrelet conservation areas could provide more certainty to recreation planning. Restrictions on development in marbled murrelet conservation areas could shift recreation use to other areas or result in undesignated uses. Recreation planning can take into account potential restrictions on development, but this may affect some local user groups.

4.8 Forest Roads

This section describes the potential effects of the alternatives on DNR's network of forest roads in the analysis area, with a focus on whether changes to road use or management would affect other elements of the environment.

Analysis question

- *Do the action alternatives affect the location, amount, or use of forest roads to the extent that impacts to elements of the environment are significantly increased?*

Evaluation criteria

The location of proposed marbled murrelet conservation areas and the proposed conservation measures for these areas are compared against existing rules and policies governing forest roads to evaluate potential impacts.

Scale of analysis

The alternatives are analyzed at the analysis area scale. The action alternatives, including proposed conservation measures, provide uniformity for road work and management among the HCP planning units.

How impacts are measured

Impacts are evaluated qualitatively by estimating how the alternatives affect DNR road management and road work operations and determining if these effects significantly increase impacts to natural resources. Decisions for locating and managing roads happen on a site-specific basis, for example when evaluating an area for a timber sale, and these areas have yet to be determined. Therefore, the identification of specific impacts tied directly to the alternatives are based on stated assumptions about how the alternatives may affect roads, their location, management, and how those changes may in turn affect the risk to natural resources.

Summary of direct, indirect, and cumulative impacts

Numerous forest management policies and regulations address the potential environmental impacts from roads (refer to Section 3.8). The conservation measures would impose restrictions on the timing and location of some road-associated activities; however, these restrictions are similar to those currently implemented under the no action alternative. Proposed restrictions on road construction and blasting

could have some indirect, localized effects on natural resources. While overall road density is not expected to increase significantly as a result of the alternatives, in some cases, additional road miles may be needed to avoid marbled murrelet habitat and conservation areas. Across the analysis area, it is unlikely that these changes would increase the risk of environmental impacts because of the existing regulations, policies, and guidelines designed to minimize these risks.

Some alternatives could have moderate impacts on road management activities, access to harvestable stands, and recreation use and access. Differences in impacts among the alternatives are highlighted below.

Effects from restrictions on road location and road work

The alternatives designate habitat that must be either avoided completely when locating roads or be subject to a review process that could result in locating roads away from habitat or conservation areas. These measures could result in the need for additional road miles, which could increase the number of stream crossings, or result in the need to construct roads in areas that may pose higher environmental risk. Longer roads in potentially less desirable locations (from a road construction standpoint) may have less impact overall than building through marbled murrelet conservation areas.

Conversely, roads proposed to be built within special habitat areas, occupied sites and buffers, and 0.5-mile buffers on occupied sites within emphasis areas may have less impact than building elsewhere. If the objective is to conduct activities that have the least impact for specific natural resources, the consultation process outlined for Alternatives B, E, and F may allow more flexibility to choose among the best locations with the fewest impacts. All road construction decisions would be evaluated on a case-by-case basis, and existing regulations and designed standards would be applied.

NEW CONSTRUCTION AND RECONSTRUCTION: ALTERNATIVES C AND D

Alternatives C and D prohibit new road construction or reconstruction through special habitat areas, occupied sites, and their buffers, including the 0.5-mile buffer around occupied sites within emphasis areas, unless otherwise required by state or federal laws or emergency.

From a road management perspective, these measures provide certainty to the process of assessing road location options, particularly in the North and South Puget planning units. However, these limitations could result in constructing longer roads to avoid certain areas. This could elevate risks to water quality and/or involve additional stream crossings or elevate risks to other natural resources. The existing regulatory framework would continue to provide environmental protections on a site-by-site basis. Access to operable lands may also be affected, which can have an effect on timber production.

Road reconstruction under Alternatives C and D is more restrictive than the no action alternative. This means that the long-term use of an existing road may be limited if the physical conditions of that road would deteriorate to the point of needing reconstruction. The physical work for road reconstruction is not significantly different from maintenance activities (work is conducted within the existing footprint). The proposed conservation measure that limits reconstruction could mean that DNR would see the elimination

of road-decommissioning⁷ activities in these areas because there would be no way to reopen the road again. This means that roads within special habitat areas, occupied sites and buffers, and the 0.5-mile buffer within emphasis areas may need to be abandoned, not decommissioned.

The indirect impacts of limiting road reconstruction include potentially cutting off access to operable stands, requiring more new road construction, or requiring more maintenance of existing roads. As with road construction, the limitation on reconstruction has the potential to increase impacts to other natural resources. However, existing regulations remain in place to minimize these impacts.

NEW CONSTRUCTION AND RECONSTRUCTION: ALTERNATIVES B, E, AND F

Options for road construction and reconstruction under Alternatives B, E, and F provide more flexibility within marbled murrelet conservation areas than under Alternatives C and D for siting new roads, conducting road work on existing roads, and reconstructing decommissioned roads. There are uncertainties with how site-specific decisions will be made under a consultation process between the USFWS and DNR, but these agencies have a history of working together to implement the HCP efficiently, and there is no reason to believe that would change.

Alternatives B, E, and F affect road reconstruction to a slightly lesser extent than Alternative C and D because reconstruction is not prohibited outright within marbled murrelet conservation areas. Under Alternatives B, E, and F, road reconstruction conservation measures are similar to the no action alternative in the OESF (see Table 3.8.3) but are more restrictive in the other HCP planning units.

Alternatives B, E, and F potentially allow more road construction through habitat than Alternatives C and D, which would not only remove potential habitat but could also affect the quality of existing habitat by creating more edges. Forest edges created from harvesting and roads impact the security of marbled murrelet habitat by compromising the shape and amount of interior forest patches within LTFC and introducing predators.⁸ Only about 5 percent of habitat is currently impacted by the road edge effect.⁹ Due to the individual analysis needed for each road location, site-specific impacts to natural resources cannot be determined at this time. The existing regulatory framework would continue to provide environmental protections designed to minimize risks.

ROAD MAINTENANCE, DECOMMISSIONING, AND ABANDONMENT (ALL ACTION ALTERNATIVES)

There are no significant differences in terms of road maintenance, decommissioning, and abandonment between the no action alternative and the action alternatives. This type of road work is best conducted during the summer construction season, which aligns with the nesting season. Working in wet conditions increases the risk of sediment delivery, reduces the ability to compact road fill or surfacing adequately, and increases damage on existing roads from equipment due to weak soil conditions. Allowing work to

⁷ Road decommissioning reduces the need to maintain roads between long periods of timber harvest inactivity. This reduces the long-term maintenance costs of the road and decreases impacts from hauling and other traffic, sediment delivery, and flooding.

⁸ Appendix G: Long-term Forest Cover Focus Paper

⁹ Refer to Section 3.6 and Appendix H: Potential Impacts and Mitigation Focus Paper.

occur during the nesting season but within the daily timing restrictions, as proposed under all the action alternatives, is not expected to increase risk to natural resources.

STREAM CROSSINGS (ALL ACTION ALTERNATIVES)

All action alternatives would add approximately 16,000 acres of occupied sites to the conservation strategy compared to the no action alternative. This increases the number of culverts that would be located within occupied sites and buffers (increasing from 212 to 287 culverts); the number of bridges increases from 39 to 52. Maintenance and replacement work on these structures may be required. Stream crossing replacements are required by the need for fish passage, increased hydraulic capacity, emergency replacement due to failure, or scheduled replacement due to age and deterioration; all of these actions fall under the state or federal law or emergency exemptions provided in the conservation measures. New stream crossing locations would need to follow the guidance for new road construction or road reconstruction under the alternatives. Therefore, the conservation measures of the action alternatives would not increase risk to natural resources.

ROCK PIT DEVELOPMENT AND EXPANSION (ALL ACTION ALTERNATIVES)

Where new construction is prohibited under the interim strategy, rock pits would be also be prohibited. Alternatives C and D do not change this basic limitation, but they expand the areas where this prohibition would occur. Therefore, more valuable rock sources could go undeveloped, creating the need for hauling longer distances to other existing rock pits, developing new rock pits in non-restricted areas, or purchasing material from commercial sources. This could result in increased haul trips on forest roads, increasing wear and tear and exacerbating potential environmental impacts. More flexibility is provided under Alternatives B, E, and F, but restrictions on new pit development in the highest priority habitat is still anticipated.

Rock pits can include relatively large areas, and expanding existing rock pits in marbled murrelet conservations areas may have less adverse effects to some natural resources than constructing a new rock pit outside conservation areas. As with new road construction, the risk to natural resources would be reviewed on a case-by-case basis. The existing regulatory framework would continue to provide environmental protections.

Noise-generating activities

CHANGE IN TIMING OF NESTING SEASON (ALL ACTION ALTERNATIVES)

The action alternatives all expand the nesting season currently followed under the interim strategy (April 1 through August 31) to April 1 through September 23. This would restrict more of the summer construction season and the majority of the hydraulic work window. Shifting road work to outside the summer construction season could affect road stability, resource protection, and project scheduling; however, this may not be necessary because most road work can be accomplished outside the peak activity periods, following morning and evening daily timing restrictions as proposed by the conservation

measures. If activities are allowed with daily timing restrictions, there is no increased risk to natural resources.

BLASTING RESTRICTIONS

Compared to the no action alternative, the number of rock pits within occupied sites goes up from six to eight, and the number of rock pits within 0.25 mile of an occupied site increases from 27 to 38. (Again, this is due to the action alternatives using an expanded set of occupied sites, as described in Chapter 2 and Appendix E.) Conservation measures for the action alternatives apply to rock pits located in special habitat areas and within 0.5 mile of an occupied site in an emphasis area.

Table 4.8.1. Number of Rock Pits Affected by Blasting Conservation Measures

Area of blasting restriction	Alt. A	Alt. B	Alt. C	Alt. D	Alt. E	Alt. F
Occupied sites	6	8	8	8	8	8
Within 0.25 miles of occupied sites	27	38	38	38	38	38
Special habitat areas/MMMAs	0	0	8	22	22	55
0.5-mile buffer in emphasis areas	0	0	8	0	8	0
Total	33	46	62	68	76	101

Alternatives C and D

During the nesting season, blasting associated with rock pits or road building would be prohibited in or within .25 miles of occupied sites, buffers, and special habitat areas. Blasting is prohibited within .5 miles of an occupied site within an emphasis area. The number of rock pits out of production for manufacture, expansion, or development during the nesting season (when most road work occurs) would increase from 33 to 62 (Alternative C) or 68 (Alternative D) between the no action alternative and the action alternatives.

Blasting restrictions would hamper the production of aggregate from these identified rock pits. Work within rock pits is typically accomplished during the summer construction season when conditions are better than the wetter fall through spring months. Similar to the prohibitions for new rock pit development and expansion, restrictions on blasting activities would create the need for longer haul distances to other existing rock pits or purchase of material from commercial sources.

Impacts on natural resources due to rock blasting would be reviewed on a case-by-case basis and cannot be determined at this time. Creating new rock pits outside of conservation areas could pose more risk to some natural resources than blasting in existing rock pits due to impacts from hauling rock further and impulsive noise effects on other species.

Alternatives B, E, and F

During the nesting season, blasting could potentially occur in or near marbled murrelet conservation areas, based on consultation between DNR and USFWS to avoid, minimize, and mitigate impacts to nesting birds. Consultation for blasting within the existing footprint of a rock pit would only determine if blasting could be accomplished with daily timing restrictions. If blasting is allowed through consultation, there is no increased impact on natural resources. If not, the same impacts under Alternatives C and D would be expected.

CRUSHING RESTRICTIONS (ALL ACTION ALTERNATIVES)

The conservation measures propose to restrict rock crushing within 110 meters (≤ 120 yards) of occupied sites. Within these areas, rock crushing must take place outside the nesting season when feasible; if rock crushing must take place within the nesting season, daily timing restrictions are imposed. Rock crushing typically occurs during the summer construction season, so restricting rock-crushing activities during the nesting season will be challenging, but not impossible, depending on weather. The timing restrictions would not be difficult to follow. The proposed distance buffer for this noise-generating activity is smaller than that applied under the interim strategy (0.25 mile), but the area to which the buffer applies would increase. Because crushing operations are allowed with timing restrictions if working outside the nesting season is unfeasible, the action alternatives would not increase risk to natural resources.

PILE DRIVING (ALL ACTION ALTERNATIVES)

As with rock crushing, pile driving is restricted within 110 meters (≤ 120 yards) of occupied sites. This is also a decrease in distance from the interim strategy (0.25 mile). Within these areas, pile driving must take place outside the nesting season when feasible; if pile driving must take place within the nesting season, daily timing restrictions shall be followed. Pile driving is typically associated with bridge construction. Because the nesting season is during the hydraulic work window, conducting this activity outside the nesting season would be unlikely, but following daily timing restrictions would be easy to implement. Because pile-driving operations are allowed with timing restrictions if working outside the nesting season is unfeasible, the action alternatives would not increase risk to natural resources.

Indirect and cumulative potential impacts on road management

Increasing acres of marbled murrelet conservation may make timber harvesting and road planning more difficult and expensive. Smaller harvestable stands may not have the timber volume to support extraction and could cause more road construction to connect these small harvestable patches into a viable timber sale. This is common in eastside forests where more road is built to reach enough volume to produce income from a timber sale. Even though timber harvesting is still possible, any extra road length or road work affects how much revenue the timber sale is able to produce. The cumulative impacts of road work restrictions; mobilization of harvesting equipment; restrictions on guylines, tailholds, landings, and yarding corridors; and location of marbled murrelet conservation areas could put some additional forestland out of production.

INDIRECT EFFECTS ON ROAD ABANDONMENT

Historically and under the no action alternative, road abandonment has been driven by environmental concerns and protection of resources. The choice to abandon roads is also guided by management decisions concerning use, road density, and costs, but not to the extent of resource protection. Costs, however, are typically driven by environmental concerns. For example, a road will be abandoned if the cost to eliminate fish barrier culverts outweighs the costs and benefits of replacement and reconstruction of the road. Most of the road abandonment activities on DNR-managed lands have been accomplished during road maintenance and abandonment planning (RMAPs) as required by forest practices rules. Taking more land out of timber production results in reassessing the road network and abandoning the roads that are no longer needed to manage land.

POTENTIAL FOR AN INCREASE IN ROAD MILES

At the scale of the analysis area, overall road miles are not likely to change significantly under any alternative. Road density may remain stable or decrease within the high-priority habitat but could either remain stable or increase in non-marbled murrelet conservation areas where road construction is not as restricted. The use of abandonment is expected to continue in the future to keep the forest road system mileage in check.

For a particular landscape or watershed, an increase or decrease in road density as a result of added marbled murrelet conservation could be significant. Because new road locations are assessed on an individual basis, the actual impact to the environment is not evaluated at this time.

NON-TIMBER USE AND ACCESS

Roads are the main access points for public recreation. Road abandonment or restrictions on new road construction or recreational use within marbled murrelet conservation areas could limit access to established recreation sites or areas used for dispersed recreation. Access to non-timber forest products may also be more limited, which could have indirect impacts to local economies. (Refer to Chapter 4.11, Socioeconomics.) Increases in unauthorized road use or undesignated trail building could result if significant restrictions are put in place on roads in areas of high recreational use. Access to other types of facilities (for example, private inholdings, leased lands, or utility corridors) could also be affected by limitations on road construction or reconstruction.

Summary

Table 4.8.2 provides a summary of potential impacts to forest roads and associated natural resources that are potentially impacted by these roads. Specific adverse impacts are difficult to pinpoint because road management decisions are largely made on a site-specific basis. No changes are proposed to the rules, policies, and procedures that are in place to minimize and mitigate environmental impacts from road construction and management. The conservation measures do propose restrictions on the location of roads and associated rock pits and the timing of road work. This could result in indirect effects to other natural resources. Strictly limiting road construction in some areas could also cause access problems for operable forest stands and for recreation.

Table 4.8.2. Summary of Potential Impacts to Forest Roads

Key questions	Criteria	Measure	Potential impacts
<p>Do the action alternatives affect the location, amount, or use of forest roads to the extent that impacts to elements of the environment are significantly increased?</p>	<p>Forest practices rules</p> <p><i>Policy for Sustainable Forests</i></p> <p>1997 Habitat Conservation Plan</p>	<p>Required road work (construction, reconstruction, maintenance, decommissioning, and abandonment)</p> <p>Miles and density of roads</p> <p>Number of rock pits and stream crossings</p> <p>Timing of activities for environmental protection and optimal construction</p>	<p>Localized increases in road miles may occur, but road density in the analysis area is unlikely to increase as a result of the alternatives. Increased road abandonment in conservation areas would also likely occur.</p> <p>Alternatives C and D: Additional road miles may be needed to avoid construction in marbled murrelet conservation areas. Potential impacts to aquatic resources and wildlife would be minimized through existing regulations, policies, and design guidelines.</p> <p>Alternatives B, E, and F: New road development through marbled murrelet conservation areas could remove habitat, create new edge effects, and reduce the quality of the habitat.</p> <p>The consultation process outlined for Alternatives B, E, and F allows more flexibility than Alternatives C and D to choose among the best locations with the fewest impacts.</p> <p>Indirect impacts could also occur to recreation and other user access; there is a potential for increased unauthorized use. Restrictions on road reconstruction can cause decreased use of road decommissioning as a management tool and increased construction of duplicate access roads, increasing the road density adjacent to the marbled murrelet conservation areas.</p> <p>Rock pit development could be shifted to outside conservation areas, with some localized impacts to other noise-sensitive species and wildlife habitat.</p>

Potential mitigation for adverse impacts

ROAD RECONSTRUCTION

The conservation measures for road reconstruction could be adjusted to apply only to increases in the size of the road prism. For reconstruction that does not increase the existing road prism, a conservation measure similar to road maintenance would be adequate (following daily timing restrictions in proximity to habitat). Reconstruction required to widen the road prism could be treated like new construction and be prohibited in marbled murrelet conservation areas under Alternatives C and D or restricted under Alternatives B, E, and F.

BLASTING

Adjusting the restrictions on blasting to allow rock production within the existing footprint of a rock pit, following daily timing restrictions, could reduce the need to develop new pits in other sensitive areas. Other rock pit activities such as stripping, ripping, and loading are not covered under the long-term conservation strategy. These activities all include the use of heavy equipment, and guidelines to address these activities could help minimize risks of disturbance to nesting birds.

4.9 Public Services and Utilities

This section describes the potential effects of the alternatives on DNR-managed lands used for providing public services such as energy production and communication.

Analysis questions

- *Would the alternatives affect siting, management, maintenance, or in-kind replacement of existing communication and energy-related uses?*
- *Would the alternatives reduce high-potential opportunities for DNR to sell additional rights-of-way and leases for new or expanded communications and energy-related uses?*

Evaluation criteria

The criteria for communications and energy-related uses is that safety and reliability of existing facilities are maintained, state trust revenues are retained, and that opportunities for development of high-potential future uses are not irretrievably lost.

The specific performance standards for meeting these criteria are as follows:

- Consistency between long-term murrelet conservation measures (as defined in the alternatives) and existing uses of or contractual agreements for communication and energy-related leases.
- Continuation of access to existing rights-of-way or communication sites.
- Sustained ability to maintain, repair, and replace existing transmission lines or communication facilities as needed to ensure reliability and safety.
- Ability to develop new or expanded transmissions lines, telecommunication sites, and high-potential energy resources are consistent with murrelet conservation measures.

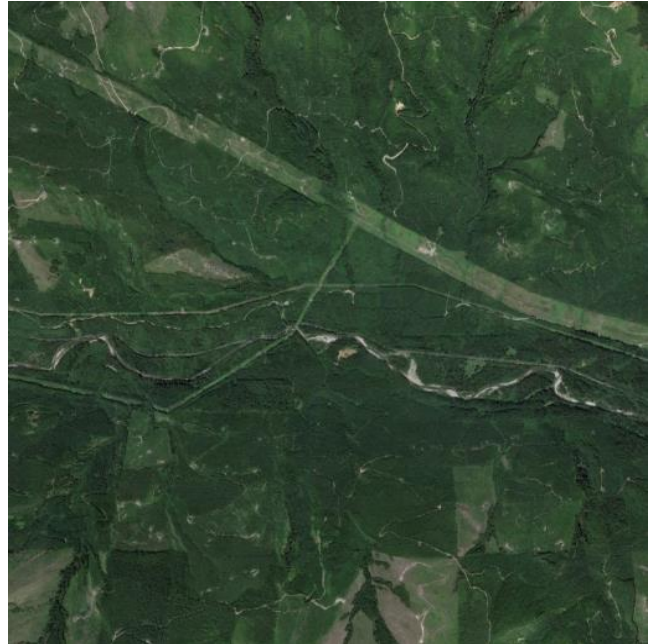
Scale of analysis

General effects of the alternatives on utilities, communications, and energy-related facilities are considered for the analysis area as a whole. Where existing major facilities or potential future uses are located adjacent to specific marbled murrelet conservation areas, effects are noted at the HCP planning unit scale.

How impacts are measured

Potential adverse impacts on communication and energy-related infrastructure and uses are expressed with the following measures:

- Location and extent of marbled murrelet conservation areas adjacent to existing and high-potential future communications and energy-related uses, including transmission lines and oil and gas leases.
- Adequacy of the 1997 HCP to address effects on marbled murrelet habitat from high-potential new uses and from management, maintenance, replacement, or expansion of existing uses.



BPA transmission line corridor (upper left to center right) crossing state trust lands in the Green River area, northwest of Enumclaw (South Puget planning unit)

In addition, the analysis considers qualitatively the status and trends of leases and easements with the amount of marbled murrelet conservation and the conservation measures proposed for each alternative as a general indicator of potential constraints on DNR sales of leases and rights-of-way.

Summary of direct, indirect, and cumulative impacts

Effects of alternatives on utility rights-of-way

EXISTING RIGHTS-OF-WAY

Increasing marbled murrelet conservation areas on state trust lands could potentially restrict the timing of maintenance and repair activities within existing rights-of-way. Restrictions are most likely where marbled murrelet conservation areas would be established adjacent to existing rights-of-way.

In such areas, transmission line maintenance work—such as vegetation clearing and helicopter-based inspections or transport of materials—would need to follow aerial activity distance thresholds and daily timing restrictions during the nesting season.

DNR does not currently have all utility corridors mapped, so a complete analysis of where proposed marbled murrelet conservation areas are located near existing corridors could not be done. The agency does have updated data on BPA transmission line corridors, which cover approximately 118 miles of DNR-managed lands in the analysis area. Table 4.9.1 illustrates the portion of BPA rights-of-way that are currently located near proposed marbled murrelet conservation areas.

Table 4.9.1. Approximate Mileage of BPA Rights-of-Way Within 0.5 Mile of a Marbled Murrelet Conservation Area

	Alternative A	Alternative B	Alternative C	Alternative D	Alternative E	Alternative F
Miles	20.9	20.2	52.4	28.9	52.7	34.5
Portion of Total miles of BPA rights-of-way in analysis area	18%	17%	44%	24%	44%	29%

Most of these corridors do not travel directly through marbled murrelet conservation areas. The most notable overlap of corridors and proposed conservation is located in the following areas:

- The North Puget planning unit near Goldbar (U.S. Route 2)
- South Puget planning unit in the Green River Watershed (near Enumclaw)
- South Coast planning unit east of the Long Beach Peninsula

Only the area in the South Coast planning unit would have additional marbled murrelet conservation areas designated on both sides of an existing BPA corridor under two alternatives. Alternative D designates the lands adjacent to this corridor as special habitat area, and Alternative F designates these lands as MMMA.

Based on this sample, and considering the conservation measures proposed, additional marbled conservation is not likely to substantially interfere with the ability of utility companies or other easement-holders to maintain system operations, reliability, and safety within the analysis area.

REPLACEMENT PROJECTS AND NEW RIGHTS-OF-WAY

All transmission line structures (for example, steel towers or H-frame wood poles) at some point require replacement. Replacement projects generally involve replacing individual structures, sometimes involving additional clearing in the right-of-way to accommodate larger structures.

New transmission projects may also be planned to meet new or increased energy demands. New projects often occur within and adjacent to existing rights-of-way. Therefore, potential future constraints on transmission line expansion are most likely to occur in areas where marbled murrelet conservation areas would be established adjacent to an existing transmission corridor.

In addition, replacement projects may require that existing road networks be expanded. Alternatives C and D would restrict new road construction within marbled murrelet conservation areas, which could cause conflicts for accessing facilities. Alternatives B, E, and F provide more potential flexibility to construct roads using a consultation process between the Joint Agencies.



The Radar Ridge communication site in Pacific County (South Coast planning unit). Photo: DNR

Effects of alternatives on leases for communications and energy-related facilities

COMMUNICATION SITES

Effects of the action alternatives on existing communication sites within the analysis area are limited to distance thresholds for helicopter-based inspections, maintenance, or repairs. Between 18 and 21 existing sites are currently located within proposed marbled murrelet conservation areas. Proposed conservation measures could affect the timing of maintenance and repair activities at these sites. Review and consultation with DNR and USFWS may be necessary to avoid disturbance impacts from these activities if they must be conducted during the nesting season.

New leases for communication sites will be limited in occupied sites, special habitat areas, and 0.5-mile buffers within emphasis areas under the proposed conservation measures for all action alternatives. Consultation between DNR and USFWS will be necessary to avoid habitat impacts in these areas. Specific sites anticipated for new leases cannot be known at this time. Given the amount of land still available for new leases within the analysis area and the availability of existing sites to co-locate new services, this is not anticipated to be a major impact to public communication services.



Chinook helicopter transports a replacement structure to a remote portion of transmission line. Photo: BPA

GEOHERMAL ENERGY PRODUCTION AND OIL AND GAS LEASES

No planned or other reasonably foreseeable geothermal energy sites or oil and gas leases are located within existing or potential new marbled murrelet conservation areas. While Alternatives C, D, E, and F would all increase restrictions on geothermal and oil and gas leases over existing levels, there are no proven or high-potential energy resources that would be irretrievably lost due to any of the alternatives.

Cumulative effects

Additional restrictions on DNR-managed lands due to additional marbled murrelet conservation areas that would occur under Alternatives C through F (particularly Alternative F) would add to the extensive set of environmental restrictions that already apply to rights-of-way and leases for communications and energy-related uses. However, due to the relatively small number of acres affected and the existing consultation process used by the Joint Agencies, none of the alternatives are expected to contribute significantly to the cumulative regulatory burden of rights-of-way and leases for communications and energy-related uses.

Table 4.9.2. Summary of Potential Impacts on Public Services and Utilities

Key questions	Criteria	Measure	Potential impacts
Would the alternatives constrain management, maintenance, or in-kind replacement of existing communication and energy-related uses?	<p>Safety and reliability of existing facilities is maintained</p> <p>State trust revenues are retained</p> <p>Consistency with marbled murrelet conservation</p> <p>Access to existing infrastructure is maintained</p> <p>No substantive reduction in ability to maintain, repair, and replace existing transmission lines or communication facilities as needed to ensure reliability and safety</p>	Location and extent of additional marbled murrelet conservation areas (LTFC) adjacent to existing and high-potential future communications and energy-related uses	The addition of LTFC and its conservation measures may complicate ongoing maintenance, repairs, replacement, and expansion of some communications and energy-related facilities. The review and consultation process provided by the conservation measures should be able to address these complications.
Would the alternatives reduce high-potential opportunities for DNR to sell additional rights-of-way and leases for new or expanded communications and energy-related uses?	Opportunities for development of high-potential future uses are not irretrievably lost	Consider status and trends of leases and easements, together with the amount of additional marbled murrelet restrictions for each alternative, as general indicators of potential constraints on DNR sales of leases and rights-of-way.	No recognized high-potential sites are located within proposed marbled murrelet conservation areas. However, habitat that develops under the alternatives may be unavailable for communications and energy-related uses where DNR has discretion or authority over siting.

4.10 Environmental Justice

This section describes the potential effects of the alternatives on low-income or minority populations.

Analysis questions

- *Would the action alternatives result in disproportionately high and adverse impacts on low-income or minority populations?*

Evaluation criteria

The criterion for environmental justice is whether the action alternatives would result in disproportionately high and adverse impacts on low-income or minority populations.

Specific measures for evaluating these criteria are as follows:

- Adverse human health effects—including effects on air quality, water quality, noise pollution, traffic, aesthetics, or quality of life—are not disproportionately high and adverse for low-income or minority populations.
- Adverse economic effects do not reduce the economic viability of low-income or minority communities or populations.

Scale of analysis

Environmental justice issues are considered at the scale of the analysis area for general trends and effects on Hispanic and American Indian communities. The analysis looked for counties that contain both (a) higher than average low-income or minority populations (relative to other counties within the analysis area) and (b) relatively high amounts of state trust forestlands that would be deferred from harvest under one or more of the alternatives.

Effects related employment are related to the analysis conducted in Section 4.11, Socioeconomics. Issues related to traditional tribal access and uses of state trust lands are addressed in Section 4.12, Cultural Resources.

How impacts are measured

The potential for adverse human health effects is measured qualitatively based on the degree to which resources related to human health would be affected, including air and water quality, noise, and the visual environment.

The magnitude of effects is measured by acres of marbled murrelet-specific conservation. The context of local and regional economies is measured with a qualitative review of the literature to determine (a)

general occupational and employment conditions and trends for low-income and minority workers, and (b) the degree to which forest-related work contributes to those conditions and trends.

Impacts related to reduced trust payments and potential indirect effects on low-income and minority communities are based on the analysis presented in Section 4.11, Socioeconomics.

Summary of direct, indirect, and cumulative impacts

Adverse human health effects

The alternatives evaluate varying amounts of marbled murrelet conservation. None of the alternatives would generate toxic waste; air, water or noise pollution; traffic congestion or hazards; or visual blight or otherwise cause environmental harm or risks to human health to any individuals or communities, including low-income or minority communities.

Adverse economic effects

HARVEST OF FOREST GREENS AND OTHER NON-TIMBER RESOURCES

Low-income or minority collectors of forest greens are not likely to be disproportionately affected under any of the alternatives. None of the alternatives propose further restrictions on the harvest of forest greens and other non-timber resources. The potential reduction in access to forest green harvest sites due to limitations on road and trail building in marbled murrelet conservation areas under Alternatives C, D, E, and F is minor in relation to the amount of available collection sites located throughout private, state, and federal forestlands within the analysis area.

TIMBER-RELATED LABOR

Depending upon the alternative, there will be various amounts of land available for full range of management options (refer to Section 4.11). Some alternatives have more restrictions on timber harvest than others. As described in Section 4.11, Pacific and Wahkiakum counties have the highest potential for reduced timber harvest, and they have low economic diversity, resulting in potential loss of income to low-income and minority populations. For these two counties, all action alternatives, with the exception of Alternative B, would result in higher amount of dedicated acreage for marbled murrelet conservation. Pacific and Wahkiakum counties do not have minority or low-income populations higher than the average among counties in the analysis area. Although minority and low-income populations could be negatively affected, the effect will not vary or result in a disproportionate impact from that on the rest of the population.

In the context of the more than 2 million acres of private, state, and federal forestlands located in these counties, the expected change in timber harvest is relatively small. The volume of timber harvested on DNR-managed lands would be reduced, which means fewer workers would be needed on those lands.

However, thinning would still be allowed throughout LTFC, with the exception of special habitat areas (under Alternatives C, D, and E) and occupied sites. This work would likely provide economic opportunities for members of low-income and minority communities.

INDIRECT IMPACTS: GOVERNMENT SERVICES FOR LOW-INCOME AND MINORITY POPULATIONS

As discussed in Section 4.11, Socioeconomics, all counties that have a reduction in acres available for harvest could experience a reduction in local revenues. Counties whose workforce is closely tied to logging, including Pacific and Wahkiakum, would be most affected by Alternatives C through F. This in turn could affect government services that may be providing support to low-income and minority populations. However, most government services that support low-income and minority populations are provided by state and federal funding rather than local funding, including government services such as Basic Food benefits (food stamps), Supplemental Security Income (SSI), State Family Assistance (SFA), and the Employment Security Department programs.

Collectively, these factors indicate that none of the alternatives is likely to cause disproportionately high and adverse economic effects on low-income or minority communities.

Table 4.10.1. Potential Impacts Related to Environmental Justice

Key questions	Criteria	Measures	Potential impacts
Would the alternatives result in disproportionately high and adverse impacts on low-income or minority populations?	<p>Adverse human health effects—including effects on air quality, water quality, noise pollution, traffic, aesthetics, or quality of life—are not disproportionately high and adverse for low-income or minority populations.</p> <p>Adverse economic effects do not reduce the economic viability of low-income or minority communities or populations.</p>	A qualitative review of the literature to determine general occupational and employment conditions and trends for low-income and minority workers	<p>None. The proposed action is focused on marbled murrelet conservation, and none of the alternatives would generate toxic waste; air, water or noise pollution; or traffic congestion or hazards or otherwise cause environmental harm or risks to human health to any individuals or communities, including low-income or minority communities.</p> <p>The alternatives are expected to reduce total demand for forest sector labor, and this change could be significant for Pacific and Wahkiakum counties. However, the magnitude of such effects is not likely to cause disproportionately high and adverse economic effects on low-income or minority populations.</p>

4.11 Socioeconomics

This section analyzes the potential impacts from the alternatives to social and economic values in the analysis area. The analysis questions cover three broad areas: government revenue, employment, and community values.

Analysis questions

- *How do the action alternatives affect trust revenue over the life of the HCP?*
- *How do the action alternatives affect county and state government revenue from other sources over the life of the HCP?*
- *How do the action alternatives affect county employment levels over the life of the HCP?*
- *How do the action alternatives affect environmental services and non-timber economic activities over the life of the HCP?*

Evaluation criteria

The action alternatives include proposed conservation measures that affect the operation and management of DNR-managed forestlands with marbled murrelet habitat in the analysis area. The alternatives do not provide a harvest schedule, which is a plan for future harvests. Without a harvest schedule, it is not possible to evaluate changes based on changes in the location and yield of timber sales, such as revenue distribution. Potential harvest schedules are being developed as part of an update to the sustainable harvest calculation (currently being drafted). These schedules will evaluate a range of marbled murrelet conservation alternatives as described in this DEIS but will combine these constraints with other considerations in order to establish alternative harvest schedules.

We can, however, evaluate potential revenue impacts in a more generalized way by considering acres available for harvest. Over long time periods such as a harvest rotation, revenue is related to the area available for harvest. The area available for harvest under each alternative is known. This analysis is therefore based on the change of acres available for harvest using a weighted “operable acre” unit (designed for purposes of this DEIS analysis only). Operable acres are weighted by their assumed operability potential. Uplands with general objectives are areas where HCP, *Policy for Sustainable Forests*, and all relevant laws apply. They are weighted equal to their area in acres. Uplands with special objectives are areas where, in addition to general objectives, objectives such as northern spotted owl or hydrologic maturity objectives apply. They are weighted at one-third of their area

Text Box 4.11.1

Can we evaluate exactly how the alternatives impact local revenue?

The marbled murrelet conservation strategy does not include a harvest schedule. Without a harvest schedule, it is not possible to evaluate impacts related to specific changes to location and yield of timber sales, which directly impact revenue distribution.

because harvest area or volume removal is limited. Riparian areas are weighted at 1/33 of their area based on the actual harvest level in these areas over the past ten years.

Scale of analysis

The scale of analysis in this section varies depending on the aspect of interest. Impacts are assessed for counties, trusts, and the Washington State general fund. Impacts are assessed against trust lands in western Washington because of broadly similar operational and financial considerations with the analysis area.

How impacts are measured

Potential impacts to trust revenue, employment, and taxes are evaluated in this analysis. A threshold level of a 25 percent reduction in operable acres for most counties and trusts is used because it is assumed that counties can accommodate changes in revenue potential of this magnitude. This assumption is supported by the *Policy for Sustainable Forests*, which includes a policy that harvest levels not change by more than 25 percent from the preceding decade (DNR 2006, p. 25). This policy was approved by the Board of Natural Resources after SEPA review.

For Pacific and Wahkiakum counties, the threshold is set lower because Daniels 2004 identified these counties as “DNR counties of concern.” Daniels states that these counties “may experience difficulty adapting to changes in DNR forest management strategies.” Small reductions in revenue or employment in these counties is expected to have more impact on these counties than other counties.

The impact of the alternatives is expected to be adverse if the following criteria are met:

- Trust revenue:
 - For each trust except Pacific and Wahkiakum state forest trusts: operable acres available for harvest in western Washington in a trust decrease by more than 25 percent compared to Alternative A. A decrease of this magnitude is expected to result in a similar reduction in the long-term revenue generating capability of the trust lands.
 - Pacific and Wahkiakum state forest trusts: operable acres available for harvest in these trusts is lower than Alternative A based on the threshold established for this analysis.
- Employment:
 - Each county except Pacific and Wahkiakum counties: operable acres in western Washington in a county decrease by more than 25 percent compared to Alternative A.
 - Pacific and Wahkiakum counties: operable acres in these trusts is lower than Alternative A.
 - Western Washington: operable acres in western Washington decrease by more than 25 percent compared to Alternative A.

- Forest tax:
 - Each county except Pacific and Wahkiakum counties: operable acres in western Washington in a county decrease by more than 25 percent compared to Alternative A, and forest tax distributions to the county are equal to at least ten percent of the sales tax distribution.
 - Pacific and Wahkiakum counties: operable acres in these trusts is lower than Alternative A.
 - Western Washington: operable acres in western Washington decrease by more than 25 percent compared to Alternative A.
- Sales and other taxes:
 - There is a high uncertainty regarding the impact of the change in operable acres available for harvest on these tax revenues at the county level and state level.

Impacts less than the thresholds described in the preceding list are expected to be negligible.

Key assumptions

The analysis assumes that each operable acre can generate the same amount of timber volume in the same amount time and that the potential revenue of the timber is the same. In reality, site potential varies across the landscape. Due to the scale of the analysis and the spatial similarity between the alternatives, this difference is expected to be small. Harvest revenue depends on not only site potential, but also species composition, timber quality, management costs, operational difficulty, and availability of markets. For purposes of this generalized analysis, these factors are assumed to be similar between lands conserved under each alternative.

County-level employment change impacts assume that timber harvest volume is closely related to timber-job employment levels within a county. This assumption assumes that workers are not employed outside their home county.

Summary of direct, indirect, and cumulative impacts

Potential impacts to socioeconomics can be summarized under four general categories: trust revenue, tax revenue, employment, and environmental services and non-market values.

Trust revenue

The analysis provided here is designed to compare the proposed alternatives to one another. Assumptions are made about trust revenues in order to make this comparison. These assumptions cannot be carried through to a detailed analysis of local employment impacts or forest tax impacts, but some general conclusions can be reached. Assumptions are stated in the sections that follow. More accurate revenue

estimates will be developed after a harvest schedule is determined (which is being developed under a new sustainable harvest calculation, currently in draft).¹⁰

IMPACTS TO TRUST REVENUE FROM TIMBER HARVEST

One way to assess the different strategies is to calculate the “bare land value”¹¹ of lands conserved or released by the different action alternatives as compared to Alternative A. This calculation assumes that the same prescription is applied to all lands affected by the alternative. The prescription assumes all the lands are higher-productivity sites and each operable acre is planted with Douglas fir, Western red cedar, or Western hemlock and is harvested in a variable retention harvest at age 50. Note that this calculation does not take into account the value of the standing timber on these lands. Not including the value of the standing timber in the bare land value calculations underestimates the impacts to trust revenue. However assumptions about the productivity and rotation length overestimate the impacts if some areas have lower productivity, longer rotations, or lower harvest yields (refer to Appendix M).

Alternative B increases the number of operable acres available for harvest and therefore increases the bare land value of trust compared to Alternative A. Alternatives C, D, E, and F all reduce the operable acres. The impacts to the trust increase in this order: Alternative C, Alternative D, Alternative E, Alternative F (Table 4.11.1).

Table 4.11.1. Change in Management and Bare Land Value From Alternative A

	Alternative B	Alternative C	Alternative D	Alternative E	Alternative F
Bare land value change	\$26 million	-\$12 million	-\$13 million	-\$15 million	-\$61 million

Another way to assess the impact is to look at assumed annual value of timber sales that could have occurred in the conserved acres or that may occur in the released acres (Table 4.11.2). The analysis uses a similar set of assumptions. Specifically, the assumptions are that harvest volumes yield 32 thousand board feet per acre, that the sale price of the timber is \$350 per thousand board feet, and that 1/50 of the operable acres are harvested each year.

¹⁰ A DEIS for the sustainable harvest calculation is expected to be released December 2016.

¹¹ Bare land value (BLV) assesses the present net worth of an infinite number of successive, identical timber harvest rotations. As calculated here, the resulting value does not include any indication of the value of non-timber or non-market values. Revenue sources other than timber harvests could be included in the calculation, if applicable. BLV is calculated as: $BLV = \frac{NFW}{(1+i)^{n-1}}$, where NFW is the net future worth calculated as the sum of the future revenue and costs of one rotation, with both revenue and costs compounded until the end of the rotation, *i* is the annual discount rate, and *n* is the number of years in a rotation. Note that this calculation assumes that the cost, revenue, and rotation length do not change over time.

Table 4.11.2. Change in Estimated Total Value of Timber Sales, by Action Alternative (assuming each operable acre yields 32 MBF per acre, that the sale price of the timber is \$350 per MBF, and that 1/50 of the operable acres are harvested each year)

	Alternative B	Alternative C	Alternative D	Alternative E	Alternative F
Timber sale value change	\$4 million	-\$2 million	-\$2 million	-\$2 million	-\$9 million

CHANGES IN OPERABLE ACRES BY TRUST

For this analysis lands are grouped either by trust (for the federally granted lands) or by benefiting county (for the State Forestlands¹²). Tables 4.11.3 and 4.11.4 show the trusts where the operable acres in western Washington is significantly reduced. The impacts of the action alternatives to trusts and benefiting counties are as follows:

- **Alternative B:** No adverse impacts to any trust or trust and benefiting county combination. For all trust or trust and benefiting county combinations, the area with a full range of management options does not change or it increases compared to Alternative A.
- **Alternatives C through F:** Pacific County State Forest and Wahkiakum County State Forest trusts are adversely impacted.

Table 4.11.3. Change in Operable Acres Available for Harvest in the Federally Granted Trusts

	Trust(s)	Alt. A (no action)	Alt. B	Alt. C	Alt. D	Alt. E	Alt. F
		Operable acres					
Federally granted trusts	Agricultural School Grant	10,436	1%	0%	0%	0%	-6%
	Capitol Building Grant	30,485	5%	-2%	-1%	-3%	-5%
	CEP&RI and CEP&RI transferred	30,485	2%	-2%	-3%	-2%	-4%
	Common School and Escheat	196,942	3%	-2%	-2%	-2%	-6%
	Normal School	10,157	5%	-4%	-4%	-5%	-2%
	Scientific School Grant	23,115	2%	-1%	-1%	-1%	-16%
	University Grant (original and transferred)	12,322	6%	-11%	-18%	-15%	-15%

¹² State Forest Purchase and State Forest Transfer Lands are combined for this analysis.

	Trust(s)	Alt. A (no action)	Alt. B	Alt. C	Alt. D	Alt. E	Alt. F
		Operable acres	% changes in acres available compared to Alternative A				
Other lands	Community College Forest Reserve	2,401	0%	0%	0%	0%	-2%
	Community Forest Trust	0	0%	0%	0%	0%	0%
	Land Bank	0	0%	0%	0%	0%	0%
	Water Pollution Control Division Trust Land	3,820	0%	-2%	0%	-2%	0%
	Other	1,822	0%	0%	0%	0%	-2%

Table 4.11.4. Change in Operable Acres Available for Harvest in the State Forest Trust Lands (Transfer and Purchase), by County

State Forest Trust land	Alt. A (no action)	Alt. B	Alt. C	Alt. D	Alt. E	Alt. F
	Operable acres	% changes in acres available compared to Alternative A				
Clallam County	39,752	10%	2%	3%	0%	6%
Cowlitz County	6,895	0%	0%	0%	0%	0%
Grays Harbor County	21,159	2%	2%	2%	2%	2%
Jefferson County	10,615	3%	2%	2%	2%	2%
King County	7,905	0%	-1%	0%	-1%	-0%
Kitsap County	4,036	0%	0%	0%	0%	0%
Lewis County	21,274	0%	0%	0%	0%	-5%
Mason County	18,004	0%	0%	0%	0%	0%
Pacific County	10,261	9%	-13%	-21%	-13%	-23%

	Alt. A (no action)	Alt. B	Alt. C	Alt. D	Alt. E	Alt. F
State Forest Trust land	Operable acres	% changes in acres available compared to Alternative A				
Pierce County	2,721	0%	0%	0%	0%	-11%
Skagit County	36,173	1%	-1%	0%	-1%	-2%
Snohomish County	33,984	1%	-2%	-1%	-2%	-2%
Thurston County	28,919	1%	1%	1%	1%	1%
Wahkiakum County	5,781	20%	-9%	-12%	-9%	-25%
Whatcom County	13,482	1%	-3%	-2%	-4%	-22%

Tax revenue

FOREST TAX

Changes in harvest levels have direct impacts on the annual forest tax liability of operators on trust lands. Harvest volume is expected to increase under Alternative B relative to Alternative A. Forest tax revenue will increase commensurately, assuming no change in the tax rate or timber value. Under Alternatives C, D and E, forest tax distributions from timber harvests on trust lands are expected to decrease significantly in Pacific and Wahkiakum counties based on the reduction in area available for harvest. The impact of Alternative D is expected to be greater on these counties than the impacts of Alternatives C or E.

Under Alternative F, forest tax distributions are expected to decrease significantly in Pacific and Wahkiakum counties. Pacific and Wahkiakum are more greatly impacted under this alternative than under Alternatives C, D, and E.

All alternatives have a negligible impact on the operable acres in western Washington trust lands subject to the forest tax. Therefore, impacts to the state of Washington general fund are expected to be negligible.

SALES AND OTHER STATE AND LOCAL TAXES

Counties and the state receive revenue from sales and other taxes. The revenue from these taxes depends on factors including the tax rate, population, employment, wages, expenditures made by visitors within the county and availability of retail outlets in a county, among other factors. Reduced harvest levels may reduce tax revenue by reducing employment and expenditures by businesses within a county. The impact of harvest reduction on tax revenue is expected to be greatest in counties where timber harvest is a larger component of the total economic activity in the county.

Pacific and Wahkiakum counties are more reliant on timber harvest than other counties in the analysis area. Alternative B is expected to increase harvest in these counties over the no action alternative and therefore result in increased tax revenue in these counties. Revenue is expected to fall in these counties under the other alternatives, with impacts increasing in the following order from smallest to greatest impact to revenue: Alternative C, E, D, F. However, the degree to which this may occur cannot be determined because the relationship between harvest levels and taxable sales and property values in the counties is not known.

Other counties are more economically diversified and less dependent on timber harvest. Any change in tax revenue due to any of the alternatives is expected to be relatively minimal in these counties compared to their large sales tax revenues. All alternatives have only a small effect relative to sales taxes from all economic activity in the state; therefore, impacts to the State of Washington general fund are expected to be minimal.

Tax revenue from economic activity on DNR-managed forestlands from sources other than timber harvest (for example, recreation) is not expected to change significantly under any action alternative. Any increases in tax revenue related to other land uses on DNR forestlands will likely be insufficient to replace tax revenues lost under Alternatives C through F.

Employment

Potential impacts to employment are measured based on the expected change to operable acres. For all western Washington counties together, the change in operable acres available ranges from an increase of 3 percent under Alternative B to a decrease of 4 percent under Alternative F (Table 4.11.5).

Table 4.11.5. Change in Operable Acres in Western Washington, Compared to Alternative A

	Alternative B	Alternative C	Alternative D	Alternative E	Alternative F
Change in operable acres (percent)	17,404 (3%)	-7,979 (-1%)	-8,680 (-1%)	-10,420 (-2%)	-26,000 (-4%)

The harvest level is expected to increase relative to Alternative A (no action) under Alternative B. Employment may increase commensurately, if only slightly. Harvest levels are expected to fall under Alternatives C through F. Adverse impacts are therefore expected in Pacific and Wahkiakum counties under Alternatives C through F. The impact of Alternative D to Pacific and Wahkiakum counties is expected to be greater on these counties than either Alternative C or E but less than the impact of Alternative F. Declines in employment in these counties could be locally mitigated if the alternative results in more acres of thinning harvest because thinning requires more labor per unit of volume to harvest (Mason and Lippke 2007). The overall acres subject to thinning will, however, be less than what was available for variable retention harvest.

Environmental services and non-market values

CARBON SEQUESTRATION

All the alternatives are expected to increase the amount of carbon sequestered on state trust lands over the life of the HCP (refer to Chapter 4.1, Climate). The action alternatives were ranked in that section from most to least carbon sequestration, in order as Alternative F, E, C, D, and then B. However, the amount sequestered under any of these alternatives is not known, and the value cannot be calculated. As no marbled murrelet conservation strategy alternative proposes the sale of carbon credits, no revenue is expected to be generated for the trusts by carbon sequestration.

OTHER NON-TIMBER LAND USES

It is uncertain how the action alternatives will change how people would value non-timber social, environmental, and economic resources. However, because the action alternatives are designed to support the long-term survival of the marbled murrelet, a neutral or positive valuation is expected.

The analysis of impacts to recreation (refer to Chapter 4.7, Recreation) shows that the action alternatives do not have a measurable negative impact on recreation in the analysis area. For mining and other leases, the action alternatives may reduce land available for new activities, but no immediate impacts to planned leases or easements are known since known locations for these leases are far from occupied sites.

The conservation measures associated with the action alternatives do not preclude collection of non-timber forest products. Small changes to the annual harvest area and area of closed canopy forest are likely to occur under the action alternatives in the analysis area. These changes will not significantly lessen the availability of non-timber forest products collected on trust lands. Therefore, no significant impacts to trust revenue or the public's economic well-being due to effects of any of the marbled murrelet long-term conservation strategy on the collection of non-timber forest products is expected.

Cumulative effects

Alternative B, by increasing the number of operable acres available for harvest as compared with Alternative A, is expected to result in stable or increased harvests levels on all trusts and in all counties in the analysis area, stable or increased revenue for all trust beneficiaries with lands within the analysis area, and stable or increased tax revenue and employment in counties within the analysis area.

Alternatives C through F, by decreasing the number of operable acres available for harvest, are expected to result in stable or decreased harvest levels on most trusts and in all counties in the analysis area, stable or decreased revenue for most trust beneficiaries with lands within the analysis area, and stable or decreased tax revenue and employment in counties within the analysis area. Revenue from State Forest trust lands is distributed in accordance with RCW 79.64.110. DNR generates the revenue and distributes it to the counties in which the land is located. Counties further distribute funds to taxing districts and local services; therefore, reduced revenues expected under these alternatives could impact these services.

Pacific and Wahkiakum counties are adversely impacted by Alternatives C through F. Under these alternatives, these two counties can expect reduced revenue and employment based on the thresholds established for this analysis. Because these counties currently have low socioeconomic resiliency, below average economic diversity, and are more heavily dependent on timber harvest for local government revenue, the economies of these counties are less able to tolerate a reduction in harvest volume than other counties.

Uncertainty

The distribution of marbled murrelet conservation areas results in a highly fragmented landscape of potentially operable (harvestable) acres. This variability may result in constraints on forest management activities that are otherwise authorized because of operational costs or inaccessibility (for example, if a harvestable stand is located on the other side of a large block of marbled murrelet conservation). Depending on the frequency of this occurrence, the potential for decreased revenue under Alternatives C through F could be lower or higher than anticipated here. Likewise, Alternative B may not yield the expected increase in revenue compared to Alternative A.

Table 4.11.1. Summary of Potential Impacts to Socioeconomics

Key questions	Criteria	Measures	Potential impacts
How do the alternatives affect trust revenue over the life of the HCP?	Operable acres available	Change in operable acres—reduction in operable acres by over 25% considered adverse	Overall decreased trust revenue. This impact is adverse for the Pacific County State Forest and Wahkiakum County State Forest trusts under Alternatives C through F. .
How do the alternatives affect county and state government revenue from other sources over the life of the HCP?	Operable acres available	Change in operable acres	Overall decreased trust revenue. This impact is likely adverse for Pacific and Wahkiakum counties under Alternatives C through F.
How do the alternatives affect county employment levels over the life of the HCP?	Operable acres available	Change in operable acres Portion (%) of county in harvest-related employment	Decreased employment is possible in Pacific and Wahkiakum counties under Alternatives C through F.
How do the alternatives affect environmental services and non-timber economic activities over the life of the HCP?	Opportunities available	Change in opportunities	No measurable impacts identified.

Potential mitigation for adverse impacts

The legislature has authorized the transfer or disposition of certain state trust lands encumbered with long-term deferrals due to Endangered Species Act-listed species. Encumbered State Forest Lands in counties with a population of 25,000 or less, which includes Pacific and Wahkiakum counties,¹³ may be transferred into Natural Resource Conservation Areas (Washington Department of Natural Resources 2013, RCW 79.22.060, 79.22.140.). The transfer requires compensation at fair market value without consideration of the endangered species encumbrances. The counties' beneficiaries receive the appraised timber value, less a management fee, at the time of transfer while the land value must be used to purchase replacement State Forest Lands that can generate revenue.

¹³ The State Forest Replacement Lands Program also applies to Skamania and Klickitat counties, which are outside the analysis area.

4.12 Cultural and Historic Resources

This section considers whether any of the alternatives would unintentionally affect cultural resources.

Analysis questions

The primary questions addressed regarding cultural resources are the following:

- *Do cultural and historic sites remain protected under the action alternatives?*
- *How would access to cultural resources be affected by the action alternatives?*
- *How would traditional cultural materials and foods, such as fish, wildlife, and plants, be affected by the action alternatives?*

Evaluation criteria

The primary criterion for cultural and historic resources is that significant sites, access, or materials would not be damaged or destroyed as a result of the alternatives.

Scale of analysis

Effects on cultural resources are considered at the programmatic level for the entire analysis area.

How impacts are measured

Impacts will be measured based on a qualitative review of the potential for actions considered in the alternatives to adversely affect cultural and historic resources.

Summary of direct, indirect, and cumulative impacts

No significant impacts to cultural and historic resources are anticipated under any of the action alternatives. These resources are typically identified by DNR and protected as part of project planning for timber sales and other forest management activities such as construction of recreational trails or communication sites.

Site protection

The primary threat to cultural and historic sites is timber harvest and associated road construction and subsequent public access and uses. All action alternatives include measures restricting timber harvest in LTFC and limiting road construction and new recreational facility development in marbled murrelet conservation areas. Alternatives C through F increase the total amount of LTFC compared with the action alternative. Alternative B, while resulting in fewer total acres of LTFC, adds 16,000 acres of occupied sites where harvest would be prohibited.



Pelton wheel, used to power historic mines in DNR's Northwest region. Photo: DNR

All action alternatives would also make some currently deferred lands available for potential harvest (refer to Chapter 2, Figure 2.4.1). Alternatives C through F would remove LTFC designation from 2,000 to 3,000 acres in the Straits planning unit only, while Alternative B would remove LTFC designation from approximately 27,000 acres in the analysis area (most in OESF). While this could result in more access to currently unidentified or inaccessible cultural and historic sites within these areas, potential impacts would be addressed under the current regulatory framework at the project-specific level. Existing DNR cultural resource protection procedures would be expected to identify and avoid significant adverse impacts from harvesting stands that are currently deferred under the interim strategy.

Access

Ongoing Tribal access and use of DNR lands for collection of traditional cultural materials and food (for example, cedar bark, bear grass, and berries) is not limited under the proposed action alternatives. This type of access is typically coordinated via consultation with regional staff or DNR's tribal liaison office, and this process would be unchanged under a long-term strategy. Where existing roads may be abandoned in proposed marbled murrelet conservation areas, it is possible that some local access issues could occur. It is expected that the existing tribal consultation practices would continue to address site-specific access issues.

Traditional cultural materials and foods

Forest stand conditions would be altered over time within lands designated as LTFC, and these changes are likely to alter the abundance and availability of certain traditional materials. Some, such as cedar wood and bark, may increase within LTFC, while others, such as berries, may decrease within areas of mature and maturing forest. However, while localized changes in habitat conditions may temporarily reduce forage for important species such as deer and elk within LTFC, overall abundance and distribution of culturally important species and other traditional materials would likely remain stable or increase on state trust lands (refer to Section 4.5, Wildlife).

Conclusions

The alternatives are focused on varying levels of LTFC for marbled murrelet conservation purposes, and none of the alternatives would result in direct harm to any cultural resources. Effects that may occur later in time, as projects are implemented under the strategic direction established in the alternative selected, would be addressed through DNR’s existing archaeological assessment work and tribal consultation. The effects identified are not sufficiently significant to contribute to cumulative effects related to cultural and historic resources.

Table 4.12.1. Summary of Potential Impacts to Cultural and Historic Resources

Key questions	Criteria	Measures	Potential impacts
Do cultural and historic sites remain protected by the alternatives?	Significant historic, archaeological, and cultural sites would not be damaged or destroyed.	Qualitative	None. Effects are addressed at the project-specific level (e.g., plans for specific thinning operations).
How would access to cultural resources be affected by the alternatives?	Tribal access to the forest would not be lost.	Qualitative	Some existing roads may be abandoned where they are located within marbled murrelet conservation areas under all action alternatives, which could interfere with access to some areas. In areas where access is currently limited under Alternative A, some new roads may be built under the action alternatives, which could increase public access to tribal use areas and/or physically harm unknown cultural or historic sites. However, road locations are assessed for cultural and historic resource impacts at the project-specific level prior to construction, so there is not expected to be damage to cultural or historic sites.
How would traditional cultural materials and foods, such as fish, wildlife, and plants, be affected by the alternatives?	Supplies of culturally important resources would not be lost.	Qualitative	Changes in habitat conditions over time in LTFC may locally reduce forage habitat for some game species, but overall abundance and distribution of species would remain stable or increase on state trust lands (refer to Section 4.8, Wildlife). Fish resources are not expected to be impacted (refer to Section 4.4, Aquatic Resources).