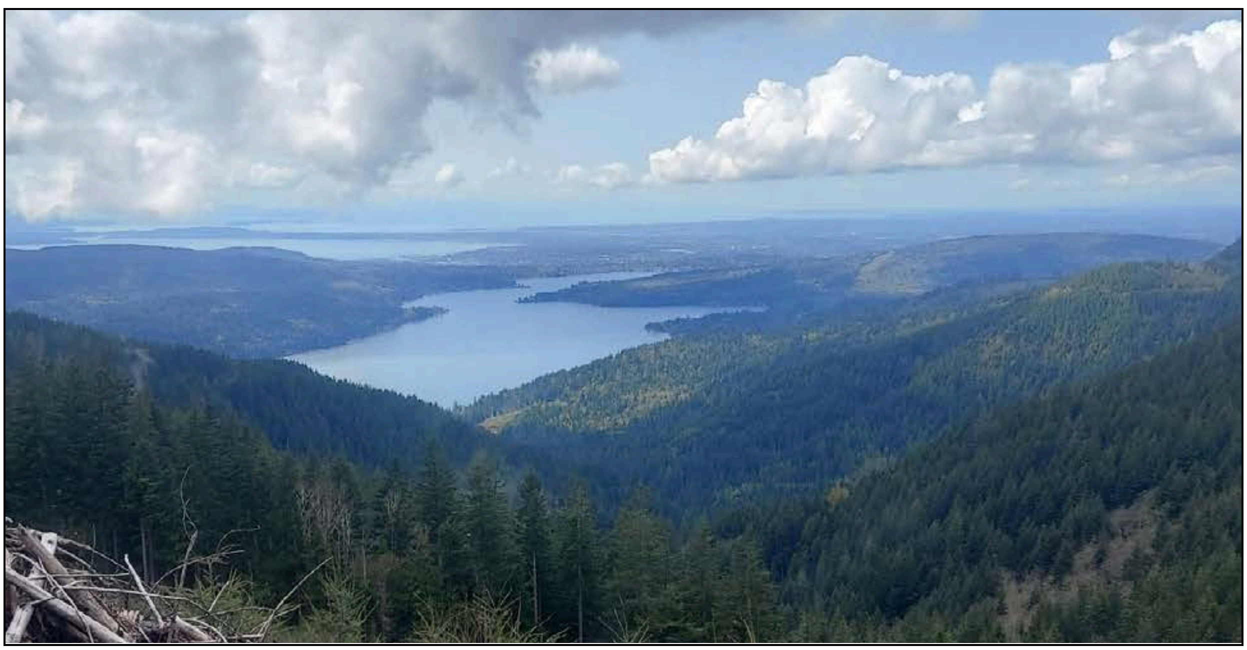
Lake Whatcom Watershed Forest Management Plan

Prepared by Northwest Natural Resource Group

For

City of Bellingham

Whatcom County



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EXECUTIVE SUMMARY

Lake Whatcom has and continues to play an important role in the quality of life for the people and ecosystems surrounding it. The Lake Whatcom watershed was first inhabited and utilized by Coast Salish tribes who continue to maintain deep spiritual, cultural, and subsistence connections to the lands and waters of the region. Today, the watershed is the drinking water source for more than 120,000 people, valuable habitat for plants and animals, a recreational destination for outdoor enthusiasts, and home to more than 19,000 residents.

The Lake Whatcom watershed encompasses more than 36,000 acres of land that is divided between private, city, county, and state ownerships. Land uses include forestry, agriculture, recreation, and residential development. The County acquired over 8,000 acres from the Washington Department of Natural Resources in 2014 through a reconveyance process that specified the land be used for public recreational access (RCW 79.22.300). To date, the City has acquired approximately 3,500 acres through the Lake Whatcom Land Acquisition and Preservation Program, specifically to prevent development and protect forests, safeguarding Lake Whatcom's water quality. In 2024 Whatcom County and the City of Bellingham embarked on a collaborative effort to develop a comprehensive forest management plan to guide the long-term conservation and restoration of 12,205 acres of their combined forestland.

This ecologically-based forest management plan integrates the goals and objectives of the Lake Whatcom Management Program—including protection of water quality, reduction of sedimentation and nutrient loading, and enhancement of watershed resilience—with principles of ecological forest management. The overarching goal is to restore and maintain a complex, uneven-aged forest mosaic that emulates the structure and function of old-growth ecosystems while safeguarding the watershed's hydrological integrity.

Management strategies emphasize the gradual transition of even-aged, second-growth forests into structurally diverse stands characterized by multi-layered canopies, large live trees, abundant coarse woody debris, and variable understory composition. Silvicultural treatments will use tools such as variable-density thinning to accelerate late-successional characteristics while minimizing soil disturbance and surface erosion. Riparian buffers, unstable slopes, and areas of high hydrologic sensitivity will receive special care, prioritizing natural recovery processes to protect water quality and slope stability.

In alignment with the Lake Whatcom Management Program 2025-2029 Work Plan, this strategy also seeks to minimize road-related sediment delivery through upgrading and properly maintaining legacy forest roads and ensuring any new road construction is not hydrologically connected. Active management areas will incorporate Best Management Practices (BMPs) for road maintenance, forest management timing, and equipment operations to prevent turbidity and protect aquatic ecosystems.

Ultimately, this plan envisions the Lake Whatcom watershed as a resilient, self-sustaining forested landscape that supports clean water, diverse habitats, and compatible public uses. By applying principles of ecosystem complexity, legacies, and natural disturbance emulation, management actions will promote forest heterogeneity, enhance carbon storage, and strengthen ecological integrity over time. The result will be a forest that not only meets contemporary resource protection objectives but also provides a living model for sustainable watershed stewardship in the Pacific Northwest.

Plan Overview

Plan Purpose

The purpose of the Lake Whatcom Forest Management Plan is to provide an actionable document that guides management activities and provides recommendations for the long-term management of County and City-owned forestlands within the Lake Whatcom watershed. Implementing the recommendations in this plan is a separate process which will be undertaken by City and County work planning efforts respectively.

This forest management plan:

1. Focuses on actions that positively impact and safeguard water quality and forest health and otherwise supports the goals and objectives of the current Lake Whatcom multi-parameter Total Maximum Daily Load to meet water quality standards, Whatcom County Comprehensive Plan, City of Bellingham Comprehensive Plan, and Lake Whatcom Management Program Work Plan;
2. Presents management strategies and stand-level prescriptions that utilize Best Management Practices to improve forest health, improve water quality and watershed health, increase fire resistance, preserve and protect critical and unique habitats, and reduce the risk of mass wasting/debris torrent events;
3. Addresses issues affecting timely and efficient implementation, including the consideration of budgetary and other resource/capacity needs associated with management activities in order to inform County and City decision-making;
4. Addresses potential issues affecting implementation and/or outcomes including those potentially associated with climate change and adjoining land use practices.

Management Objectives

- **Water Quality -** maintain and improve water quality in Lake Whatcom and the surrounding watershed with particular attention on reducing sediment delivery to the lake.

- **Forest Health and Resiliency -** promote healthy and resilient forests that are adaptable to a changing climate and ensure long-term forest cover in the watershed.

- **Resistance to Wildfires** - improve forest resistance to and recovery from wildfires.

- **Wildlife Habitat -** provide quality wildlife habitat throughout the watershed while preserving and protecting critical and unique habitats.

- **Recreational Access** - ensure management recommendations align with and support recreation goals and access that are appropriate for the County and City respectively.

Desired Future Condition

The desired future condition for the Lake Whatcom watershed is a resilient, late-seral forest landscape that emulates the structure, composition, and ecological function of native old-growth ecosystems. Guided by the principles of ecological forest management, the watershed will consist of a diverse mosaic of forest stands varying in age, species composition, and structural complexity—featuring large, old trees; multi-layered canopies; abundant standing dead wood and downed logs; and rich understory diversity. These conditions will enhance habitat connectivity, promote carbon storage, and sustain essential ecological processes such as nutrient cycling and natural regeneration. Hydrologically, the forest will stabilize soils, regulate streamflows, and protect water quality by minimizing sedimentation and maintaining intact riparian systems. Over time, this restored, late-seral forest condition will provide clean drinking water, ecological resilience, and enduring habitat integrity while supporting compatible public and cultural values within the Lake Whatcom watershed.

Forest Overview

The current forested condition of City and County owned properties in the Lake Whatcom watershed reflects a legacy of intensive historical land use, including extensive logging, road building, and limited reforestation prior to public ownership. Much of the watershed is now dominated by second-growth Douglas-fir and western hemlock stands between 40 and 90 years old, originating from clearcuts that occurred primarily during the mid-20th century. These forests tend to be even-aged, densely stocked, and structurally uniform, with relatively closed canopies, limited understory vegetation, and sparse amounts of coarse woody debris and standing dead wood. Such simplified stand structures provide fewer ecological niches and reduced habitat complexity compared to the late-seral and old-growth forests that historically covered the basin.

The hydrological and geomorphic consequences of this management legacy are also evident. A dense network of legacy logging roads—many of which were constructed before modern Best Management Practices—contributes to surface runoff, sediment delivery, and slope instability. In some areas, impacted soils and altered drainage patterns exacerbate erosion and fine sediment transport to streams and the lake, degrading water quality and aquatic habitats. Riparian zones have been partially degraded by past harvest activities and reduced canopy cover, which has affected stream shading, large woody debris recruitment, and temperature regulation.

Despite these challenges, the watershed's forests are now in a period of ecological recovery under public management by Whatcom County and the City of Bellingham. Active restoration and selective thinning projects are proposed to increase structural complexity, promote mixed-species regeneration, and enhance watershed function. Many stands are showing early signs of developing multi-layered canopies and improved understory complexity. However, the watershed as a whole remains in a transitional condition—ecologically simplified but moving toward greater resilience and complexity through the application of long-term, ecologically based forest management practices.

Management Recommendations

Over the next 30 years, ecologically based forest management in the Lake Whatcom watershed has the potential to restore late-seral forest structure and improve watershed function through a combination of active and passive restoration strategies. Selective and variable-density thinning is the recommended primary silvicultural tool for accelerating the development of complex stand structures in even-aged, second-growth forests. By reducing stem density, these treatments will promote understory regeneration, enhance species and age diversity, and encourage the growth of large-diameter trees characteristic of late-seral conditions. Supplemental tree planting with shade-tolerant and site-appropriate species such as western redcedar and western hemlock will increase compositional diversity and resilience to pests, disease, and climate change. Over time, these interventions will create a more heterogeneous forest canopy, improve wildlife habitat, and strengthen ecosystem functions such as carbon sequestration and clean water.

In tandem with active forest restoration, management recommendations include emphasizing conservation of sensitive areas, including riparian zones, unstable slopes, and wetlands, where natural processes can recover without disturbance. These areas will serve as ecological anchors, promoting natural regeneration, enhancing water filtration, and reducing sediment delivery to streams and the lake. Fire risk mitigation will also play an important role, using targeted thinning, surface fuel reduction, and the retention of moisture-rich species to lower wildfire potential while maintaining ecological integrity. These treatments will be designed to protect the watershed’s drinking water supply and reduce the likelihood of post-fire erosion or runoff impacts.

Best Management Practices (BMPs) for forest road maintenance are recommended for implementation consistently across the watershed to protect hydrologic functions and reduce chronic sedimentation. Over the 30-year period, recommendations include upgrading road systems to improve drainage systems and hydrologically disconnecting road networks from streams. Seasonal restrictions on heavy equipment use, erosion control measures, and ongoing monitoring will ensure that road infrastructure supports both forest management access and long-term watershed protection. Together, these practices will guide the Lake Whatcom watershed toward a resilient, late-seral forest condition that sustains clean water, stable slopes, and diverse ecological communities for future generations.

SECTION 1: INTRODUCTION

Management Context

Plan Purpose

The purpose of the Lake Whatcom Forest Management Plan is to provide an actionable document that guides management activities and provides recommendations for the long-term management of County and City-owned forestlands within the Lake Whatcom watershed. Implementing the recommendations in this plan is a separate process which will be undertaken by City and County work planning efforts respectively.

This forest management plan:

1. Focuses on actions that positively impact and safeguard water quality and forest health and otherwise supports the goals and objectives of the current Lake Whatcom multi-parameter Total Maximum Daily Load to meet water quality standards, Whatcom County Comprehensive Plan, City of Bellingham Comprehensive Plan, and Lake Whatcom Management Program Work Plan;
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Location Overview

This forest management planning effort encompasses over 12,205 acres of forestland split across 19 properties owned by Whatcom County and the City of Bellingham within the Lake Whatcom watershed as identified in the table and map below. City-owned properties were acquired through the Lake Whatcom Land Acquisition and Preservation Program. County-owned properties include properties acquired by the Whatcom County Parks Department including lands reconveyed to the County in 2014 by the Washington State Department of Natural Resources (DNR).

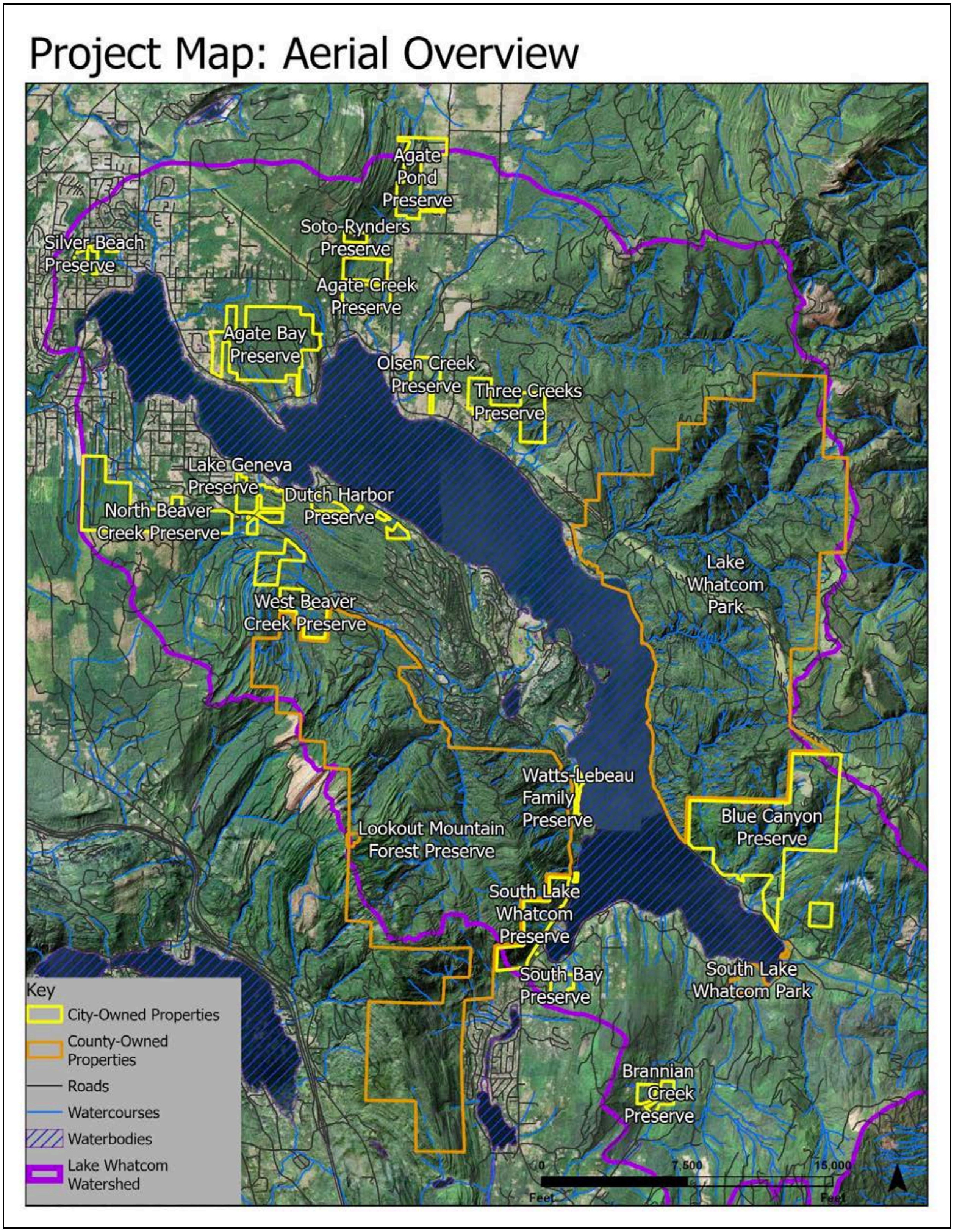
The watershed is located in northwest Washington State, primarily within Whatcom County, and spans from the western slopes of the Cascade foothills to the eastern edges of the City of Bellingham. The lake itself is approximately 10 miles long and divided into three basins. Steep hillsides and ridges surround much of the watershed, and several creeks—such as Austin, Smith, and Olsen creeks—flow into the lake. The region's topography and natural beauty also make it a popular area for outdoor recreation and residential development.

Lake Whatcom itself lies just southeast of the City of Bellingham and serves as the primary drinking water source for more than 120,000 residents. Bellingham, the largest urban center in the county with a population exceeding 90,000, is a growing urban area with a diverse economy and strong environmental and recreational values. The community of Sudden Valley, located along the western shore of Lake Whatcom, is a major residential area within the watershed; other population centers surrounding the watershed include the Geneva, Agate Bay, and Sunnyside neighborhoods.

Table of Properties Included in Current Management Plan

Property	Ownership	Acres
Agate Bay Preserve	City	421
Agate Creek Preserve	City	152
Agate Pond Preserve	City	155
Blue Canyon Preserve	City	823
Brannian Creek Preserve	City	64
Dutch Harbor Preserve	City	67
Lake Geneva Preserve	City	125
Lake Whatcom Park	County	4,660
Lookout Mountain Forest Preserve	County	4,554
North Beaver Creek Preserve	City	370
Olsen Creek Preserve	City	71
Silver Beach Preserve	City	42
Soto-Rynders Preserve	City	20
South Bay Preserve	City	39
South Lake Whatcom Park	County	76
South Lake Whatcom Preserve	City	182
Three Creeks Preserve	City	172
Watts-Lebeau Family Preserve	City	29
West Beaver Creek Preserve	City	183
	County	**9,290**
	City	**2,915**
	Total	**12,205**

Map of Properties Included in Current Management Plan



Management History

Coast Salish peoples, including the Lummi, Nooksack, and Swinomish tribes, have long inhabited this landscape, maintaining deep spiritual, cultural, and subsistence connections to the lands and waters of the region, including what is now known as the Lake Whatcom watershed. Though the arrival of Euro-American settlers in the late 18th century and subsequent development have transformed the region, tribes continue to steward the land and exercise their treaty rights across this landscape.

The lake and its watershed have long been valued not only for their ecological and aesthetic significance, but also for their critical role in supporting human settlement, industry, and recreation. Early non-native settlers began to arrive in the mid to late 1800s, establishing several historic settlements around Lake Whatcom. Early settlers cleared land for homesteads and agricultural uses, particularly along the northern section of the watershed where the topography was flatter, but also on historic floodplains and landslide fans along the lake's edge. A steamboat line began operating on the lake in 1897, and the Bellingham Bay and Eastern Railroad was completed along the northern shore of Lake Whatcom in 1901. Mining was an early industry, with the Blue Canyon Coal Mine established at the south end of the lake in 1891 and operated there for several decades. A mine was also operated around Lake Geneva. Today many of the properties in the watershed have separately owned mineral rights, but no active mining has occurred for over 75 years[1].

In the late 19th and early 20th century, the logging and lumber industry was the primary industry in the watershed, and the Lake Whatcom Logging Company was a major player in the regional timber industry. Founded in 1898, the company owned extensive land throughout the watershed and operated sawmills at both the southern and northern ends of the lake. Short railroad lines were built to move logs and lumber out of the woods and into Bellingham Bay where it was exported across the United States and the larger world. Easily accessible timber was depleted along the lakeshore by the early 1900's and logging operations progressed uphill to find uncut timber. These early operations clear-cut large swaths of the forest, often without replanting or concern for long-term ecological impacts, such as erosion and sedimentation, and eventually removed almost all of the pre-settlement forest from the watershed. Logging continued in the upper reaches of the watershed throughout the 1950s and 60s, but the major boom was over by the 1940s with many of the early sawmills shutting down. As the boom ended, many timber owners defaulted on their property taxes, transferring ownership to Whatcom County, which, like many counties in the state at that time, transferred the lands in trust to the State of Washington's Department of Natural Resources to manage forestry operations and generate revenues on behalf of the county and its junior taxing districts.

After the logging and mining booms ended, land use transitioned to residential and recreational uses, with several summer cabins and resorts built along the lakeshore. As the population of Bellingham and surrounding communities grew, so did the demand for residential development in the watershed. In the 1950s and 1960s, subdivisions began to emerge along the lakeshore, and residential development

[1] Lake Whatcom watershed history summarized from a report prepared for Whatcom County Public Works entitled "The Lake Whatcom Watershed - A Retrospective Resource Directory Companion Report 1850-2007".

eventually spread across the entire northern, western, and southern shores of the lake, with notable population centers developing at Sudden Valley on the lake's west shore and Glenhaven to the south. The lake has long been used as a drinking water source for its many inhabitants, with the Bellingham Bay Water Company establishing an intake on Whatcom Creek in the 1880s. Today Lake Whatcom serves as the primary drinking water source for over 120,000 residents of Bellingham and surrounding communities.

By the 1980s, the cumulative impacts of logging, development, and poor land-use practices prompted growing concern among local governments and environmental advocates about Lake Whatcom's water quality. A large winter storm in 1983 caused an extensive sequence of landslides and debris torrents down the Smith Creek drainage, resulting in extensive property damage and spurring the local community to further consider the impacts of logging in the watershed.

Guided by shared lake protection goals, the City of Bellingham, Whatcom County, and the Lake Whatcom Water and Sewer District passed a joint resolution in 1992 and formed the Lake Whatcom Management Program (LWMP) in 1998 by Interlocal Agreement. The LWMP coordinates lake protection efforts between the City of Bellingham, Whatcom County, and the Lake Whatcom Water and Sewer District, with policy oversight from their legislative bodies and implementation by the LWMP's Interjurisdictional Coordinating Team. In addition, the City established the Lake Whatcom Watershed Advisory Board to coordinate efforts, promote public engagement, and recommend policy changes. Whatcom County also adopted stricter development regulations in the watershed, including the Lake Whatcom Watershed Overlay District, which limits new subdivisions and mandates low-impact development techniques. Stormwater retrofitting projects have been implemented to improve drainage systems in existing neighborhoods, and septic-to-sewer conversions have been prioritized in high-risk areas.

One of the most significant shifts in land management came in the early-1990s to mid-2000s, when researchers, including those from Western Washington University's Institute for Watershed Studies, revealed low dissolved oxygen in Lake Whatcom. Subsequent studies by the Department of Ecology confirmed the link between development and declining water quality, particularly low dissolved oxygen due to excess phosphorus. The Washington Department of Ecology placed Lake Whatcom on its polluted water body list for failing to meet state standards for dissolved oxygen. In response, the City of Bellingham began purchasing forested lands in the watershed to prevent future development and protect existing forest cover. The Lake Whatcom Land Acquisition and Preservation Program, launched by the City of Bellingham in 2001, has since conserved thousands of acres, reducing the extent of impervious surfaces and limiting pollutant runoff.

At the same time, growing concern around forest management activities across the state spurred the creation of additional environmental protections and the 2004 Lake Whatcom Landscape Plan was created to guide forest management activities on state-owned forestlands in the watershed. Because many of these forestlands were originally entrusted to the state by Whatcom County, in 2012 the County began the process of reconveying these lands back to county ownership, taking over title in early 2014 to 8,844 acres of forestland which are now managed by the Whatcom County Parks Department.

The LWMP continues to coordinate lake protection efforts, developing shared work plans every five years to guide and identify work that will be completed to protect the lake. Actions in the LWMP 2025–2029 Work Plan span twelve program areas and include constructing and retrofitting stormwater treatment facilities, enforcing land use regulations, preserving forestland, and supporting residential retrofits to reduce runoff. Forest management was added to the 2025-2029 Work Plan as one of the program areas and the development of forest management plans for County and City-owned forested properties was prioritized, resulting in this current planning effort.

Current Management

Whatcom County and the City of Bellingham have already implemented a range of forest management activities across the forest properties in this management plan. Many of the City-owned properties were previously used for agricultural or residential use and have undergone significant restoration activities to remove old structures, restore forest cover, and fight invasive species. The City has also undertaken forest thinning on a few properties to reduce tree density and promote structural complexity, and has underplanted hardwood-dominated forests with conifer seedlings. The County continues to maintain and operate the main line roads conveyed to them by the state of Washington in 2014, but has not undertaken major forest management or restoration at this time. The County manages recreational access at several developed trailheads throughout the watershed, including Lookout Mountain Forest Preserve, Lake Whatcom Park, and South Lake Whatcom Park.

Management Planning Process

Planning Framework

This forest management planning effort utilized the following framework to develop management recommendations that meet landowner and community objectives.

1. **Define Objectives** - Initial objectives were defined by landowners and informed by community engagement to identify a final set of planning objectives and define a desired future condition for the forested landscape.
2. **Assess Forest Landscape** - The forested landscape was assessed by trained foresters to objectively quantify and characterize current forest conditions.
3. **Evaluate Forest Conditions** - The forest conditions identified during the field assessment were evaluated by trained foresters against the objectives, identifying conditions that were not currently meeting the objectives and preventing the forest from achieving the desired future condition.
4. **Develop Management Recommendations** - Given the results of this evaluation, recommendations were developed by trained foresters and reviewed by landowners to aid the forest in achieving the objectives and reaching the desired future condition.

Management Objectives

Identifying management objectives is a critical part of the planning process. Through consultation with landowners and community members, the following objectives were identified to guide the development of this management plan.

- **Water Quality -** maintain and improve water quality in Lake Whatcom and the surrounding watershed with particular attention on reducing sediment delivery to the lake.
- **Forest Health and Resiliency -** promote healthy and resilient forests that are adaptable to a changing climate and ensure long-term forest cover in the watershed.
- **Resistance to Wildfires** - improve forest resistance to and recovery from wildfires.
- **Wildlife Habitat -** provide quality wildlife habitat throughout the watershed while preserving and protecting critical and unique habitats.
- **Recreational Access** - ensure management recommendations align with and support recreation goals and access that are appropriate for the County and City respectively.

In addition, it is in the intention of this plan to respect, restore and maintain tribal access for natural and cultural resource use in the watershed.

Desired Future Condition

To achieve these objectives, this plan envisions a resilient, diverse, and ecologically functional forest landscape that supports clean water, diverse wildlife habitat, and sustainable human uses. Broadly, this vision is best realized in the restoration of late-successional (aka "old growth") forests similar to those that were once prevalent in the watershed. At the landscape level, old-growth forests are not a static forest type, but a dynamic, evolving assemblage of stands representing multiple stages of successional development. These include young forests recovering from disturbance, mid-aged closed-canopy forests, and mature stands with large trees, standing dead wood, and coarse woody debris. However, it is important to note that the desired future condition is not the past, as a changing climate may not support the same plant assemblages that developed under historic climate conditions. Therefore, historical reference conditions are informative, but do not represent an absolute model for future forest structure.

Applied to the Lake Whatcom watershed, this concept supports a vision of forests that evolve through natural processes and intentional management to mimic historical disturbance regimes. Through ecological thinning, tree planting, riparian restoration, and long-term protection, forests in the watershed can develop the structural complexity associated with older forests. Structurally complex forests include a diverse arrangement of trees of different sizes and species occupying multiple canopy positions as well as a diverse collection of understory vegetation, standing snags, and downed wood. As large legacy trees, multi-layered canopies, and rich understories become more prevalent, ecological resilience is enhanced and the forest supports high levels of biodiversity, including habitats for a variety of birds, mammals, amphibians and insects.

Most importantly, this vision directly supports the watershed's primary function as a drinking water source. Forests with old-growth characteristics protect water quality by stabilizing soils, reducing sediment runoff, and maintaining cool stream temperatures through dense canopy cover. Riparian buffers with late-successional features are especially important for filtering pollutants and providing aquatic habitat.

Achieving old growth conditions is a long-term, adaptive process. It requires managing across entire landscapes and timeframes that span decades or centuries. Forest management within the Lake Whatcom watershed must therefore remain flexible, science-informed, and aligned with both ecological goals and the needs of a growing community.

Monitoring and Adaptive Management

The forest resources evaluated during this planning process, the management objectives articulated by Whatcom County and the City of Bellingham, and the forest management recommendations that have been developed to achieve those objectives, are contemporary to 2025. As forest resources change, objectives evolve, and the results of active forest management are monitored and assessed, this plan will be subject to an adaptive management process that entails systematically assessing ecological, social, and economic outcomes of forest management actions over time. By collecting and analyzing data on key performance indicators, forest managers can identify successes and areas needing improvement. This iterative process allows for timely adjustments to management strategies and objectives, ensuring that the recommendations remain relevant and effective in responding to changing conditions such as climate fluctuations, biodiversity needs, and community input. This proactive approach is intended to foster an evolving range of forest management recommendations that balances ecological integrity with community values and resources.

Community Engagement

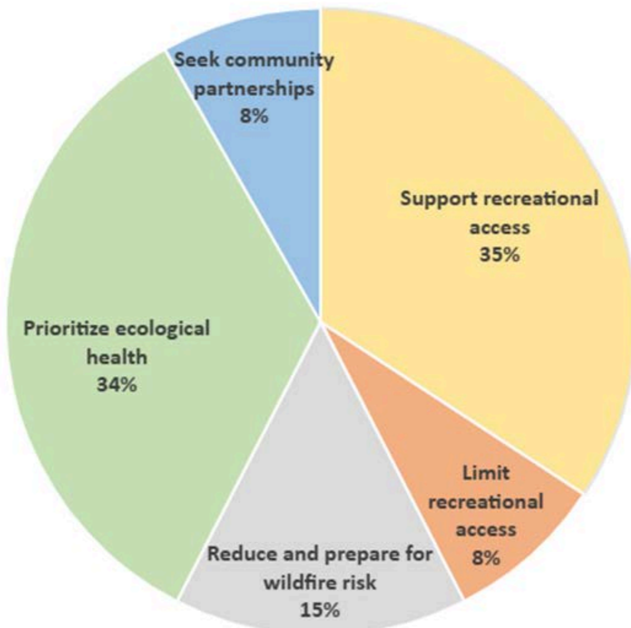
The City and County actively engaged the public throughout the planning process. Plan development began in April 2025 with a series of meetings with tribal partners, stakeholders, and the broader community. The City hosted a dedicated webpage on the "Engage Bellingham" online platform, which provided opportunities for feedback during the early stages of plan development and on the draft plan.

In addition, two public forest tours were held in June and July of 2025. For those unable to attend in person, a video tour was produced and made available on the Engage Bellingham site. Additional details and results of this engagement effort are described in greater detail in Appendix VI.

Phase 1 Community Engagement: Defining Objectives (April-July 2025)

During the first phase of engagement between April and July 2025, when feedback was provided to help inform the plan's goals and recommendations, the planning team received 56 public comments. Comments were categorized by topic and are summarized in the figure below.

Public Comments Summarized by Comment Topic



The most prevalent feedback received during this early public comment process was the desire for protection and expansion of recreational access, particularly calls to balance recreation and environmental uses, increase non-motorized access, increase mountain bike trails, and improve trail maintenance. Maintaining appropriate recreation is a high priority for Whatcom County, and the County developed a community-informed recreational trail plan in 2016 for Lookout Mountain and Lake Whatcom Park which identifies strategies for managing and developing recreational amenities on those properties. Conversely, the City of Bellingham has acquired the properties in this plan for preservation purposes, and recreation is not the primary goal. The City allows limited recreation consistent with the Lake Whatcom Property Acquisition Program land management policy. While recreation is an important topic for the community, managing recreational access and development of trails or other amenities is not within the scope of this forest management planning effort. Instead, this plan seeks to ensure that management recommendations align with and support recreation goals that are appropriate for the County and City respectively. To this end, the interaction between forest management and recreation is explored in the Recreation section in Section 2.

Nearly equally as prevalent of a topic in the comments was the prioritization of ecological health, particularly limiting development in the watershed, protecting water quality, and decreasing extractive uses of the land. Managing the forest to improve ecological health is a core component of this plan's guiding objectives and the resulting management recommendations. This plan includes an assessment of the forest's ecological health and recommendations to maintain or improve its ecological functions. Another important topic raised during the public comment process was the desire to reduce and prepare for wildfire risk in the watershed, particularly the need to improve access for wildfire suppression. Managing the watershed's wildfire risk is a major objective of this management planning effort and particular attention is given to this topic in the sections on Wildfire Susceptibility and Roads and Access in Section 2.

Phase 2 Community Engagement: Draft Plan (November 2025)

In November 2025, a draft of the Lake Whatcom Forest Management Plan was published on Engage Bellingham for public review. A total of 88 people completed a survey designed to evaluate how well the plan's objectives align with community values. The results indicated strong overall support for the plan's direction. On average, 84% of respondents expressed support or strong support across the six plan objectives, while 13% were neutral and only 3% expressed opposition.

As with the first phase of engagement, several themes emerged through the written comments provided in the survey. These comments resulted in revisions to the final plan around the topics of landslides, adaptive management, thinning, species selection, and recreation.

Feedback on the draft plan was also collected from City and County staff and representatives from the Lake Whatcom Policy Group, Whatcom County Parks Advisory Commission, and other stakeholder groups.

Assessment Methodology

The goal of the forest assessment process was to identify broad forest types and forest conditions, collect sufficient information to develop generalized management recommendations, and prioritize areas of the forest for short-term management. As a result, this assessment methodology was designed to ensure that forest types, management units, and management recommendations were correctly identified at a strategic level, with the expectation that more tactical-level planning and additional data collection will be conducted in each management unit prior to executing management decisions in the future.

The forest assessment process employed a spatially-explicit sampling strategy that leveraged remotely-sensed forest data in order to improve efficiency of physical field data collection. Foresters were then deployed to the forest to sample representative stand conditions and extrapolate collected data across areas of similarity. Lidar-derived canopy-height information, visible and near-infrared aerial imagery, as well as the DNR's remotely sensed forest inventory (RSFRIS) were combined together into a high-contrast imagery layer that was used to identify potential forest types, delineate stand boundaries, and identify areas for additional investigation.

Summarized stand-level inventory data from the early 1990s was available for properties previously owned by the WA DNR (Lookout Mountain Forest Preserve and Lake Whatcom Park), and a limited number of forest appraisals were available for city-owned properties (North Beaver Preserve, West Beaver Preserve, Blue Canyon Preserve, Brannian Creek Preserve) purchased within the last decade. The historic data was generally too old or too simplified to use directly in the field assessment, but did provide a starting hypothesis for forest type and management unit delineations across the watershed.

During the forest assessment conducted between May and September 2025, 424 field plots were installed across the watershed. Plot locations were chosen to be representative of the local forest type and given a sampling weight that corresponded to the observed spatial distribution of that forest type within a management unit. A range of forest metrics were collected at each plot, including: trees per acre, basal area per acre, diameter, and height by species and canopy position. Additionally, qualitative information was collected both at plots, and between plots, including: forest health, wildlife habitat, understory species, habitat quality, and forest structure and development stage.

During this assessment forest roads were also evaluated to determine their status and suitability for management activities as well as to identify any potential maintenance or design issues that could lead to future road failures. Forest roads were identified using publicly available forest road inventory data from the DNR, lidar imagery, and historic Road Maintenance and Abandonment Planning (RMAP) documents. All active roads were walked or driven in their entirety. Water crossings, drainage control structures, and road surfaces were inspected throughout the active road system to identify potential issues. In addition, a sample of abandoned roads were spot-checked to confirm their current status and the conclusions of previous RMAP investigations.

Following the forest assessment process, forest cover was delineated into broad forest types for which general management recommendations were developed. More information on these forest types and general recommendations follow later in this plan. Using remotely sensed data, historic inventory units, and field inventory data properties were further delineated into forest management units (FMUs) that shared similar forest characteristics and management recommendations. General forest type management recommendations are adapted to the realities of each FMU and summarized in more detail in the specific property sections that follow.

Geographic and Temporal Scale

Geographically, this planning effort organizes management recommendations across four scales: watershed, forest stands, property, and forest management unit. First, in Section 2 the plan provides an assessment of landscape-scale conditions and provides management recommendations for watershed-wide issues such as forest health, wildfire, roads, and more. Forest cover is then divided into discrete Forest Stand Types, which are assessed and given management recommendations in Section 3. The watershed is then further divided into discrete “properties” in Section 4, where localized forest conditions and dynamics are described in more detail. Finally, forest cover within each property is segregated into unique forest management units (FMUs) that define changes in forest composition and share management recommendations.

This management plan also provides a 30-year timeline of management recommendations organized in 5-year increments. Effective forest management planning requires making decisions today based on assumptions about how the forest will evolve, markets perform, and management constraints change. While future conditions must be considered in the context of today's decision making, it is unrealistic to schedule future management actions with precision, as many factors may occur in the intervening years (e.g. storms, disease, changing public opinion, etc.) which can affect the appropriateness of the management recommendations proposed today. As such this management plan should be revised at least every 10 years in order to keep these recommendations up to date.

Ecological Forest Management

Overview

Ecological forest management (EFM) recognizes that forests are complex ecosystems whose natural processes are capable of providing multiple ecosystem services that are important for both human and natural communities. These services include clean water, flood mitigation wildlife habitat, carbon storage, valuable forest products, and recreational and cultural opportunities, to name a few. At its core, EFM attempts to balance landowner objectives with the conservation and enhancement of ecosystem services. To achieve this goal, management actions are designed to mimic ecosystem processes endemic to a particular site in order to produce forests that are resilient and adaptable to the current and future climatic conditions of that site. Silviculturally, EFM leads to an increase in forest heterogeneity, biological diversity, and the overall productivity of forest ecosystems.

EFM principles align closely with Whatcom County and the City of Bellingham's objectives for the Lake Whatcom watershed. Unlike production forestry that seeks to maximize a single value - timber, EFM seeks to integrate and manage a broad range of objectives. Because of the challenge of managing multiple objectives simultaneously, EFM typically employs management tools that differ from conventional forest management. Instead of large-scale clearcutting, for instance, EFM typically employs thinning and small-scale patch cuts to reduce competition and increase ecosystem complexity. Instead of homogeneous plantations, EFM utilizes natural regeneration and underplanting to improve species diversity and increase the number of tree cohorts occurring within a forest. These practices promote more complex forest structures, resulting in improved water quantity and quality, improved resiliency to natural disturbances and changing climate conditions, increased resistance to wildfire, and enhanced wildlife habitat.

Stand Dynamics

All forests are part of a dynamic, cyclical process of growth and disruption. Though these cycles can extend longer than several human lifespans combined, over sufficient time and across a landscape, the forces of disturbance and succession produce repeatable patterns of forest development. Understanding these forest dynamics allows the forest manager to utilize natural stand development processes to produce desired forest outcomes. A brief primer on stand dynamics is included below, focusing on forest succession and disturbance regimes common to the forests of the western slopes of the Cascade Mountains[2].

Disturbance Regimes

Disturbances are events which significantly change forest structure and composition, changing the forest's development trajectory. In western Washington, the most common natural disturbances are windthrow and wildfire, but avalanches, landslides, insect infestations, and fungal diseases are all potential disturbance agents. These events can be widespread, removing almost all existing forest canopy over a large area, known as stand-replacing, or more localized, forming canopy gaps or killing off individual trees. Because of differences in climate, topography, and environmental conditions, different forests vary in the type, frequency, and scale of these disturbance events, known as disturbance regimes.

Windthrow is the most prevalent disturbance type in forests close to the ocean, where stand-replacing windstorms are common and moist conditions preclude most wildfires. Inland of the coast, wildfire becomes the dominant disturbance regime, with its frequency dependent on local climate. On wetter sites, wildfires occur infrequently, but when they do, they can be large, severe, and stand-replacing. Insect infestations and diseases target specific tree species and, while not generally considered stand-replacing, these small-scale disturbances are major agents of stand diversification and help create more complex forest structure.

Though not a natural disturbance regime, logging is a major disturbance event common to local forests. From stand-replacing clearcut logging to more localized thinning and gap cuts, the method, scale, and intensity of logging can result in various levels of disturbance impacts. Notably, unlike natural disturbance regimes, most logging methods remove cut trees, resulting in a paucity of large-diameter snags and downed logs in most of the region's forests today.

Forest Succession

A forest canopy broadly consists of three parts: understory, midstory, and overstory. Forest succession is the process by which different plant species interact with and replace each other in these three forest canopy positions over time. This produces distinct ecological communities, or seral stages, that develop over time in the forest. A simplified version of this process is described below.

Disturbance

All forests begin their development from an initial disturbance event which heavily modifies the existing forest or outright replaces it, known as a stand-replacing event. Frequently the disturbance will leave behind components of the old forest — surviving older trees or large snags — known as legacy structures.

[2] Discussion on stand dynamics paraphrased from the Washington Department of Natural Resource's guide on "Identifying Mature and Old Forests in Western Washington" by Robert Van Pelt.

Pre-Forest - Stand Initiation (Early-Seral)

After the disturbance, a new generation of trees and vegetation is initiated. Depending on site-conditions, this may occur quickly or take decades, but eventually a pioneer cohort of trees will establish. Notably, the lack of an overstory canopy results in abundant natural sunlight and a vigorously growing understory of grasses, shrubs, and small trees. Certain plant and animal species are only present during this early-seral stage of development.

Young Forest - Canopy Closure and Competitive Stem Exclusion (Mid-Seral)

Trees continue to grow and eventually their crowns touch (Canopy Closure), shading the understory and removing all but the most shade-tolerant vegetation. As trees grow, they differentiate themselves, with faster-growing trees taking up dominant canopy positions and slower-growing trees falling back into intermediate or suppressed canopy positions. Depending on initial stand densities, the forest will now begin to thin itself (Stem Exclusion) and many of the suppressed trees will die, filling the forest with small-diameter snags and downed logs on the forest floor. A midstory is not typically present.

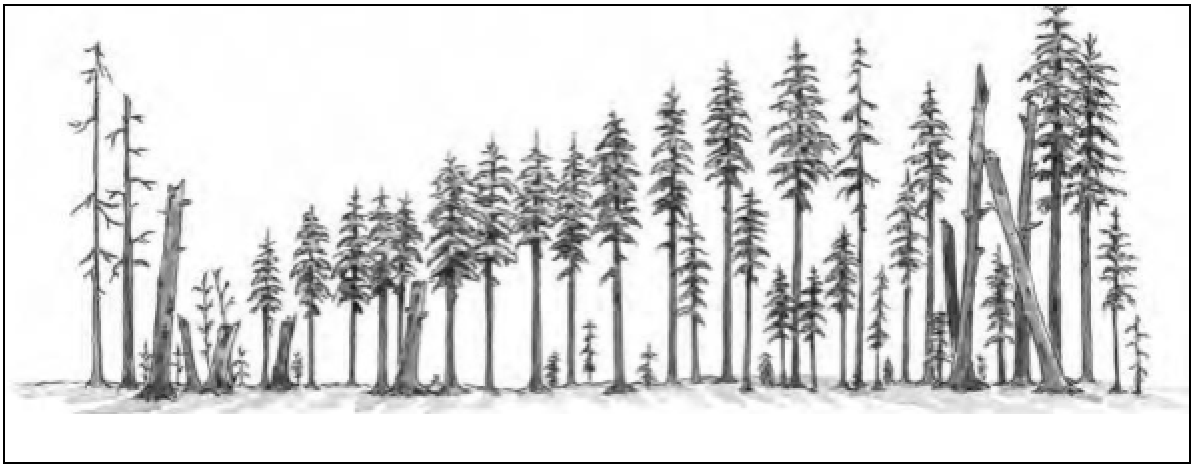
Mature Forest - Understory Reinitiation and Maturation (Mid-Seral)

Density-dependent mortality eventually reduces the forest to a sustainable stocking density, and mortality slows. At this stage the midstory will only consist of any shade-tolerant trees left behind during the competitive exclusion phase. More light now reaches the understory, re-initiating a new cohort of vegetation and shade-tolerant tree seedlings (Mature-I). The competition-based mortality process that was dominant until now switches to individual agents, such as fungi, wind, and insects which create gaps in the canopy, reduce tree density, and change growing conditions. Understory trees eventually grow into midstory positions and overstory trees may develop adventitious branches to take advantage of new light conditions (Mature-II).

Old Forest - Increased Heterogeneity and Pioneer Cohort Loss (Late-Seral)

Localized disturbance agents continue creating gaps in the previously uniform overstory canopy, which over time results in a more diverse mosaic of stand conditions and the development of late-seral habitat characteristics. As members of the original cohort of trees begin to die, they create large-diameter standing snags and woody debris on the forest floor, and are eventually replaced by vigorous midstory trees. Over time, the initial pioneer tree cohort will give way to a mixture of species, including shade-tolerant trees that can regenerate underneath the shade of their canopies. The forest settles into a dynamic equilibrium until interrupted by another stand-replacing disturbance, and the process repeats.

Simple Model of Forest Development Following Stand-Replacing Wildfire



Development Pathways

Forest development is not always a clear linear path as described above, and development pathways may vary considerably by disturbance regime. As an example, a windstorm typically removes only the overstory, enabling more shade-tolerant trees in midstory and understory positions to quickly succeed into upper canopy positions. Conversely, because wildfire can disturb a combination of soil, understory vegetation, seedlings, and mid-canopy trees, but often spares the largest trees with the thickest bark, most post-wildfire regeneration comes from the seeds of these surviving trees. Sometimes the disturbance event is only partially stand-replacing and the new cohort of trees must grow up underneath an existing canopy.

In addition, site conditions, such as soil moisture and seed availability, play a large role in determining forest development. Sometimes, a wildfire may burn at such high severity that the nearest living seed source is far away and the forest takes many years to establish any tree cover. At other times, plenty of seed may be present but hot, dry conditions restrict natural regeneration and the site becomes dominated by shrubs. Even where regeneration does occur, it can occur at such low density that the forest skips initial successional stages of competitive exclusion and understory suppression. Likewise, a site may become initially dominated by wind-dispersed hardwood seeds, such as red alder and cottonwood, which will persist for many decades before succeeding to longer-lived species.

Management Tools

Ecological forest management includes a broad “toolbox” of management tools that can be used to mimic and guide natural ecological processes. Broadly all these tools fall into two general categories: 1) methods of cutting, thinning, or otherwise removing trees and 2) methods for planting and developing new cohorts of trees. These techniques are explained in more detail below under Thinning and Planting Considerations. The main strategies are briefly summarized below:

- **Thinning From Below**. Thinning non-dominant trees to spur diameter and branch growth of dominant trees, which are important components of old-growth habitat

- **Thinning From Above**. Thinning dominant trees to release non-dominant and underrepresented trees in the understory, thereby adjusting species compositions and size distribution.
- **Variable Density Thinning**. Thinning to varying densities to create a spatially-variable patchwork of densities, including unthinned “skips”, moderately thinned, and heavily thinned areas, that promotes complex forest structure by promoting tree growth at different rates.
- **Variable Retention Harvest**. A limited regeneration cut with large retention of legacy trees to better mimic natural disturbance regimes and to provide a more resilient habitat for new seedlings. Typically used after many thinning entries and/or to rehabilitate an older stand that was not previously thinned.
- **Individual Tree Selection**. Where intensive thinning is not necessary or desired, individual tree selection thinning may be used to adjust the species composition and structure of a forest.
- **Gap Creation** Cutting gaps of at least 0.5-1.0 acres to support the growth of shade-intolerant tree and shrub species and increase spatial variability.
- **Underplanting**. After sufficient reduction in canopy density through thinning, adjust species composition by underplanting desired species into the understory. Given the existing overstory density, planting densities are typically lower, and the planted species must be sufficiently shade-tolerant
- **Open Planting**. After gaps or openings in the overstory have been created, or where they occur naturally, it is possible to plant a wide range of species, including less shade-tolerant species. Given the lower tree density in the gap or opening, planting densities are typically higher than with underplanting.
- **Site Preparation and Vegetation Management.** Competing vegetation often precludes the successful establishment of new plantings and requires that planting sites are prepared before planting. Plantings must then be maintained and competing vegetation removed until the trees are tall enough to compete successfully on their own.
- **Retention and Recruit Woody Structures**. Retain existing dead wood structures, including stumps, downed logs, and snag of all species and diameters. Recruit new woody structures through girdling living trees to create snags, felling and leaving trees as downed logs, or using logging slash to create simulated wood structures.
- **Protection of Understory Vegetation**. Minimizing disturbance of understory plants--in particular, older and taller shrubs--and leave some sensitive areas undisturbed, such as unique plant or wildlife habitats, sensitive aquatic areas, or special topographical features.

These techniques can be adapted to most stand types, using biological criteria, in tandem with a manager’s objectives, to determine which trees should be cut in a forest and which trees should be retained, recruited through natural regeneration, or planted.

Stocking Guidelines

Stand stocking can be measured in several ways, such as trees per acre (TPA), basal area per acre (BAA), stand density index (SDI), or relative density (RD) which are helpful to identify overstocked stands and guide management recommendations. Trees per acre tells us how many trees are present in the stand, but doesn't identify the size of those trees. Basal area attempts to incorporate information on the size of trees, effectively measuring the cross-sectional area of trees which is correlated with tree size and dominance, but doesn't identify if that basal area is spread across lots of small trees or lumped into a few large diameter trees. The stand density index transforms the current TPA and average diameters into a theoretically equivalent number of 10-inch diameter at breast height (DBH) trees, allowing for equal comparison of density among stands of different sizes. Since tree species have different levels of shade tolerance and can tolerate different levels of competition, stands with different species compositions can support more or less trees before competition induced mortality begins. Relative density attempts to account for these differences and assesses how close the stand is to this theoretical maximum carry capacity in a standard, comparable way.

Relative density is measured on a scale from 0 (no competition) to 100 (maximum competition) with growth rates varying in between. Trees grow with little competition until canopy closure occurs around RD 15 and the stand grows enthusiastically up to RD 35. From RD 35 to 55, growth slows slightly under competitive pressure and live crowns lift significantly as lower branches die, but trees remain healthy and robust. Above RD 55, trees begin to succumb from competition induced mortality and become extremely tall and skinny. Above RD 75, trees are often extremely skinny, stressed, and unstable suffering from high mortality rates and often holding such limited live crowns that they struggle to respond to improvements in their growing conditions. Stands with RD levels above 55 are considered overstocked and candidates for thinning interventions to reduce density. While useful for measuring competition in younger and more homogenous stands, accurately measuring competition with relative density becomes challenging in older, more structurally diverse stands with multiple canopy classes, and other metrics, such as the proportion of TPA or BAA by canopy class and stand development stage, are better suited to guide stocking decisions.

Management Sequence

Ecological forest management uses the tools, guidelines, and stand dynamics described above to actively shift stand composition and structure to better achieve management objectives. In some cases, a single management intervention (e.g. a one-time thinning) may be sufficient to put a forest on the pathway to fulfill the management objectives, while in others, multiple entries are needed to shape a stand to better meet management objectives, which may include the ongoing production of valuable forest products.

The exact management sequence varies considerably by forest type and objective, but broadly includes periodic thinning entries in order to reduce competition between trees, adjust species composition, and introduce spatial heterogeneity. In time, reducing canopy density will support natural tree regeneration in the forest's understory and the recruitment of new cohorts of trees into the stand. Manual planting may be used, especially in highly homogenous or hardwood-dominated stands, to quickly increase the desired species composition and density. Depending on objectives, additional thinning entries may continue to occur, with small gaps created to increase heterogeneity and create opportunities for less shade-tolerant trees to prosper.

Through monitoring and an adaptive management process the forest management recommendations in this plan will evolve over time to reflect lessons learned and changes to forest resources or objectives.

Thinning Considerations

Given the productive nature of the soils and climate across most of the Pacific Northwest, forests grow rapidly and — depending on initial densities — can quickly become overstocked. Periodic thinning entries may be required to minimize competition, adjust species composition, and introduce additional complexity into the forest. When stands are young and small, this thinning is typically pre-commercial, meaning the trees are too small to have merchantable value and are therefore left in the woods to decompose. However, as stands grow larger, commercial thinning can be used, meaning cut trees are removed and sold to nearby sawmills. Commercial thinning sometimes requires several entries before final target densities are reached. Considerations common to all thinning recommendations in this plan are discussed below.

Pre-commercial Thinning

Overstocked stands with small-diameter trees (under 10” DBH) are good candidates for pre-commercial thinning to reduce density and shift species composition. Though these thinnings don’t yield any revenue, the small-diameter trees can be cut easily and at relatively low cost. Thinning should be *from below*, focusing on removing suppressed and damaged trees as well as trees considered unsuitable for site conditions, in order to release and retain the most vigorous, dominant, and highest-quality trees of each species that are suitable for the site.

Commercial Thinning

Overstocked stands with larger diameter trees (over 10” DBH) that are readily accessible by road, occur on slopes less than 40 percent, or occur on steeper slopes where cable logging will not impact slope stability or surface water should be prioritized for commercial thinning. Importantly, it is generally unsafe to leave large quantities of large-diameter dead conifer trees in the stand, as the larger trees take longer to decompose and may stimulate insect outbreaks, such as Douglas fir or silver fir beetles, which can harm residual living trees. Since larger diameter trees cost more to fell, these thinning entries can be expensive, but since the trees are large enough to sell, a commercial thinning can typically pay for itself. Thinning can be either from below in order to produce additional diameter growth and monetary value, or variable density in order to focus on introducing spatial complexity as well as achieving diameter growth.

Variable density thinning is a good tool to use in most larger diameter stands. It is primarily thinning from below, but designed to create a spatially-variable patchwork of densities, including unthinned “skips”, moderately thinned, and heavily thinned areas that promotes complex forest structure by improving tree growth at different rates. Thinning should first focus on removing suppressed and damaged trees as well as trees considered unsuitable for site conditions in order to release and retain the most vigorous, dominant, and highest-quality trees of each species that are suitable for the site. Some dominant trees should also be selected for removal where they will release vigorous understory trees, thereby increasing the vertical heterogeneity of the forest canopy.

Non-Commercial Thinning

Stands that are currently inaccessible by road, occur on sensitive sites such as unstable slopes or in riparian areas, should be evaluated for non-commercial thinning. In these situations, hand crews fell trees, but the dead material is left in the forest to decay. In addition to felling, crews can girdle trees, effectively killing them while leaving the trees standing in order to produce high-quality snags for wildlife. Not only is working with trees this size expensive, but leaving dead material in the stand increases the risk of fire and insect pest infestations. The exact target densities and sequence of entries will vary from site to site, primarily driven by initial stocking and target species susceptibility to insect outbreaks. As an example, in Douglas-fir dominated stands over 10 inches DBH, cutting and leaving 3 TPA or less annually will prevent an outbreak of Douglas-fir beetle. Cutting more than this will lead to a beetle outbreak which will kill on average an additional six live trees for every 10 cut trees over the next 2 to 4 years. Without an additional source of dead, large-diameter material, the outbreak will eventually subside. Thus, any non-commercial thinning entry must either avoid triggering a beetle outbreak through a long series of light, periodic entries or accept the likely eventuality of a post-thinning outbreak and reduce thinning intensities to account for future insect-driven mortality. Given the high costs and uncertainties around managing insect outbreaks, this technique is not widely recommended and should be used sparingly.

All Thinning Treatments

Site-specific factors drive the selection of preferentially retained species during thinning, but the broad goal is to increase species diversity by retaining and recruiting a wide range of conifers and hardwoods. Notably, retained species should be suitable to site conditions and drought-tolerant species should be favored on sites with low soil moisture.

Thinning prescriptions should be developed in a manner that protects riparian habitat, understory vegetation, and existing habitat structures such as standing snags and downed logs. Thinning and commercial logging is also an opportunity to recruit additional habitat structures into the stand. As an example, equipment operators can often create snags by topping trees as high as possible and non-merchantable portions of logs can be used to create habitat piles and constructed logs.

When implementing thinning prescriptions, a combination of tree marking, where trees to be cut are marked with paint or flagging, and frequent compliance checks will help ensure contractors enact prescriptions as designed and issues are corrected promptly. Trained foresters should be used to mark trees for removal prior to executing commercial thinning treatments. Although tree marking increases costs, it also increases transparency and accountability. In addition, staff should conduct compliance audits regularly to ensure that thinning treatments are implemented in a manner that will meet management objectives.

After thinning, monitor stand conditions over the 5-10 years following a thinning, in order to assess the stand's response and adapt future management accordingly. Sometimes there is more post-thinning mortality than anticipated, some species respond better to the new growing conditions than others, and in some cases new regeneration of seedlings may even begin to occur.

Slash, such as limbs and treetops, produced during thinning has the potential to increase short-term fuel-loading and thus wildfire risk. Fine woody debris under four inches in diameter is the most flammable, so slash mitigation efforts should focus on this category of slash, leaving larger-diameter wood to slowly decay. Slash from commercial thinning should either remain where it falls or — if gathered to the landing as it is in many common logging systems — it needs to be spread back out into the forest. After thinning, slash under four inches in diameter should be processed to bring it within 18 inches to 24 inches of the soil. Driving over slash with logging equipment is a quick way to incorporate this woody material into the soil, thus increasing its decomposition rate and reducing the period over which it will elevate wildfire risk. Slash produced during pre- or non-commercial thinning remains where it was cut, but requires manual processing, known as lop and scatter, to get the material below 24 inches, which increases costs but reduces fire risk.

Depending on initial stand conditions, repeated thinning entries may be necessary to achieve management objectives. In this case, the return interval should be no shorter than 10 years, allowing sufficient time for stand conditions to stabilize and preventing excessive understory damage and soil compaction. For fast growing stands, such as site class II or better, a 10-year waiting period should give just enough time for trees to increase in diameter and ensure that the second thinning produces additional economic value to pay for the cost of labor. Under average growing conditions, such as site class III, more economic value will be captured by waiting roughly 15 years, and up to 20 years on even slower growing sites. Management objectives and operational constraints can also influence the return interval, but ultimately thinning should occur before overstocking and competition stress begins to increase once again.

Planting Considerations

Planting may be necessary in many stands including those that are: understocked, lacking species diversity, lacking multiple canopy layers, or lacking longer-lived conifer species. Open planting entails planting a wide mix of species into a relatively open area, while underplanting entails planting primarily shade-tolerant species under an existing canopy. In either case, a diversity of species should be selected for planting that are suitable to the site conditions. See Appendix III for a list of species tolerances to drought and shade.

Successful planting starts with preparing a site to receive new trees. This can be a broadcast preparation, such as pre-emergent herbicide, manual or mechanical scarification, or controlled burning across large areas. Less intensive site preparation can also occur at the level of the individual planting site by removing competing brush within a three-foot radius circle of a planting spot.

After sites are prepped, trees can be planted in western Washington anytime from late fall to early spring as long as the ground is not frozen. This ensures seedlings have a chance to root before temperatures increase in late spring and summer. Trees are typically planted in a grid, but more random arrangements are possible to increase spatial heterogeneity, though this adds additional effort for post-planting monitoring and maintenance.

Planting densities vary considerably given site conditions and management objectives. Planting at a high density is a common technique to mitigate against potential mortality. When objectives include timber production, high-density planting also ensures there is sufficient stocking for future commercial thinning entries to reduce density and produce timber. For more restoration focused objectives, planting densities may only overplant by 25 from final target density to account for potential mortality.

After planting, seedling survival should be monitored and competing vegetation controlled around all newly planted seedlings for the first 5 years, or until the seedlings have reached a free-to-grow height above the surrounding brush. If seedling survival exceeds density targets, then pre-commercial thinning can be used to easily adjust density. If mortality exceeds expectations, then it may be necessary to plant again, adapting the planting plan as necessary to ensure success.

Operational Considerations

Regulatory Restrictions

The Washington State Department of Natural Resources (DNR) regulates timber harvest and other forest management activities on all private and state-owned forestlands in Washington State through the Forest Practices Act. This includes all activities related to growing, harvesting, or processing timber. Some activities, such as harvesting or salvaging timber; constructing forest roads; installing or replacing culverts or bridges, or working across fish-bearing streams or shorelines, may require submission of a Forest Practices Application/Notification to the DNR before work can proceed.

In addition, properties reconveyed to Whatcom County from the DNR are also encumbered by the DNR's Habitat Conservation Plan (HCP) regulations that were in place at the time of reconveyance. These restrictions broadly match general Forest Practices Act regulations with minor differences around water type classifications and riparian and wetland buffer distances and management. Whatcom County ordinances may require forest management activities within 200 feet of Lake Whatcom to obtain a shoreline exemption permit.

Though this plan considers these regulatory restrictions when developing management recommendations, additional surveying and documentation is required at the time of activity in order to submit a Forest Practices Application and is outside the scope of this management plan.

Implementation Constraints

There are several significant constraints to implementing the management recommendations in this plan, namely: planning and operating costs, steep and inaccessible topography, and a limited forest road network. This plan provides management recommendations at a strategic level that are designed to give forest managers the necessary guidance to prioritize management actions. However, this plan does not provide prescriptive operational details, as these must necessarily be developed prior to conducting a management action in order to take site specific considerations into account. Additional information must be collected at the time of implementation that may adjust or restrict activities. Major factors that might influence the final implementation of the management recommendations in this plan include: thinning or logging costs, available funding and staff capacity, road access and road improvement or building costs, riparian features, and unstable slopes.

Some forest management operations in the Lake Whatcom watershed require significant financial investment due to the complex and sensitive nature of the environment, requiring careful planning and implementation to protect water quality and ecosystem health. These operations often involve extensive planning, monitoring, and the use of specialized equipment to minimize sedimentation and runoff that could harm the lake's water quality. Additionally, the watershed encompasses diverse land uses, including residential, commercial, and recreational areas, necessitating coordination with multiple stakeholders and compliance with federal, state, county and local regulations.

Designing the layout of thinning operations is beyond the scope of this plan. However, this plan does identify properties and management units that are less suitable for commercial logging due to prohibitive costs or concern for environmental impacts. For example, slopes that exceed 40-50 percent may not be accessible to conventional ground-based logging equipment, requiring the use of specialized logging equipment that yards logs by cable, greatly increasing the cost of operations. In addition, the cliff and bench topography common to many properties in the Lake Whatcom watershed introduce additional logging challenges, presenting short impassable barriers that require longer ground-yarding routes, tethered logging systems, or complicated cable-yarding systems with interim supports.

The potential for slope instability in the watershed is discussed later in this document and it is critical that forest management follows existing rules limiting forest operations on unstable landforms. This management plan utilizes remotely mapped topographic, hazard zone, and historical landslide data to gauge the likelihood that unstable slopes will be found within a proposed management area. The presence of a mapped hazard zone or past landslide does not preclude management, but indicates that further investigation is required. Positively identifying and avoiding these landforms requires field investigation at the time of operation before forest practice applications will be approved by the DNR.

The challenges of road building and maintenance are discussed later in this document, however, a lack of adequate road access can limit the amount of land that can be accessed by heavy machinery and the creation of roads necessary to implement an activity can increase operational costs and environmental impacts. Regulatory restrictions on activities that can occur within certain distances of wetlands and streams can restrict operations and further increase the cost of road building. For this management planning effort existing documentation of stream and wetland locations and types have been used. However, during the course of future planning activities additional water features will likely be identified, and existing water type designations may require further review.

SECTION 2: FOREST ASSESSMENT & MANAGEMENT RECOMMENDATIONS

Topoclimate

Overview

A forest's natural ecology is driven by regional climatic factors which are modified by local topography to create site-specific *topoclimates* which influence species composition, forest productivity, and disturbance regimes. Precipitation and temperature patterns in this region are greatly influenced by proximity to the Pacific Ocean and regional topography, leading to a regional climate that is broadly temperate, characterized by mild, wet winters, and dry, warm summers. Within a forest, differences in local topography can influence growing conditions. Sites with southern aspects receive more solar radiation and are typically hotter and drier than sites on northern aspects. Sites on steep slopes and situated on landforms with little uphill catchment areas, such as ridgetops or plateaus, frequently drain quickly and have less capacity to retain soil moisture. Local landforms also influence the impact of natural disturbance regimes, with ridgetops bearing the brunt of wind-related disturbances, while drier and steeper areas are more likely to burn in a wildfire than wetter and flatter areas.

Plant growth slows down as temperatures and sunlight decrease in winter, and can dramatically slow without sufficient soil moisture. Forests growing in colder and darker locations, such as higher elevations, northerly latitudes, or northerly aspects, typically grow slower and support different vegetation than sites in warmer topoclimates. Likewise, a forest occurring in areas with more precipitation, or on sites that retain more moisture, such as northern aspects and valley bottoms, will grow faster and support different vegetation than a forest growing in drier topoclimates.

In the Pacific Northwest, the timing of temperature and precipitation is one of the critical factors determining forest productivity and species composition. Though winter brings an excess of water, plants make little use of it during the cold, dark days. Similarly, while summer brings warm temperatures and long sunny days, trees only profit from these conditions when sufficient water is available. How different plant species manage these environmental conditions ultimately determines which vegetation will survive, thrive, and come to dominate a site.

Assessment

The forests in the Lake Whatcom watershed are split between two broad ecoregions. The properties on the north, south, and west sides of the lake are in the Puget lowland ecoregion, generally characterized by a mild mid-latitude maritime climate, marked by warm dry summers and mild wet winters. Temperature averages between 72 degrees in the summer and 32 degrees in the winter. The mean annual precipitation ranges from 35-65 inches and the frost-free period ranges from 145-200 days. The east side of the lake is in the north Cascades ecoregion, generally characterized by a mild to severe mid-latitude climate, varying by elevation, with mostly dry warm summers and relatively mild to cool very wet winters. Temperatures range from 76 degrees in the summer to 30 degrees in the winter. The mean annual precipitation ranges from 60-90 inches and the frost-free period ranges from 120-200 days. The prevailing wind is generally from the southwest in the summer and the northeast in the winter.

The forests within the Lake Whatcom watershed experience a topoclimate shaped by the surrounding ridges, nearby ocean influences, and proximity to the North Cascade Mountains. The lake is encircled by steep ridges that strongly influence local wind patterns, precipitation distribution, and sunlight exposure. Lake Whatcom is at an elevation of about 300 feet. The properties in this plan have an elevation that ranges from the shores of Lake Whatcom at 300 feet to Lookout Mountain on the southwest side at 2,700 feet and Stewart Mountain on the east side at 3,000 feet. Slopes facing west and southwest tend to receive more precipitation as moist air is lifted from Bellingham Bay and the Strait of Juan de Fuca, while leeward slopes can be slightly drier and warmer. Elevation differences across the watershed also affect temperature, with upper slopes experiencing cooler temperatures and more frequent snowfall than low areas near the lake, but generally do not hold persistent snow packs throughout the winter. During the winter, these forests are particularly vulnerable to intense winter storms. Storm fronts moving inland from the Pacific are funneled through the Strait of Juan de Fuca and are squeezed over the ridges surrounding Lake Whatcom, leading to intense winter storms that can deliver large volumes of precipitation in short time spans.

Climate Change Impacts

Several climatic shifts are expected over the coming decades in response to anthropogenic global warming, well within the lifetime of the trees now growing on site. Summers are expected to become hotter and drier, with reduced summertime precipitation, increased temperatures, including more frequent extreme heat waves, and more frequent periods of drought. Wintertime low temperatures are expected to increase and storm intensity is projected to increase, with rainfall and snowmelt concentrated into shorter time periods. Site-specific factors will exacerbate or mitigate these changes, with low-elevation, south-facing, or drought-prone soils experiencing the greatest impacts of warmer and drier conditions.

The greatest risk to Pacific Northwest forest ecosystems, and individual species, is the potential for climate change to exacerbate existing stressors and reduce forest productivity. Reductions in available soil moisture, particularly during the hot summer months, can have negative consequences on tree growth, stand density, survival of drought-sensitive species, seedling establishment and survival, capability of trees to resist pathogens and insects, increased risk of wildlife, and potential for invasive species to spread further. Climate change is altering how forests burn, and forests are increasingly at risk of large-scale, high-severity wildfire events.

Vegetation Zones

Overview

Forest vegetation zones represent recurring groups of terrestrial plant communities that are found in similar climatic and physical environments and are influenced by similar disturbance regimes. Using this information, ecologists are able to identify the likely forest composition, structure, and landscape pattern of succession that would have existed across the vegetation zone prior to Euro-American settlement, known as the historical reference condition. While vegetation zones are generalizations, they provide an important starting point for understanding how current and future vegetation will respond to management interventions, natural disturbance regimes, and changing climatic patterns. This report uses the Ecological Systems classification system, widely employed by federal and state agencies for biodiversity conservation and management planning.

Assessment

Using vegetation zone maps for North America, the following Ecological Systems were identified as likely to be present in this forested landscape prior to Euro-American settlement.

Vegetation Zone Summary Table

Vegetation Zone	Acres	Relative Prevalence
North Pacific Hypermaritime Western Red-cedar-Western Hemlock Forest	5,100	42%
North Pacific Maritime Mesic-Wet Douglas-fir-Western Hemlock Forest	4,205	34%
North Pacific Mesic Western Hemlock-Silver Fir Forest	982	8%
North Pacific Maritime Dry-Mesic Douglas-fir-Western Hemlock Forest	743	6%
North Pacific Seasonal Sitka Spruce Forest	572	5%
North Pacific Lowland Riparian Forest and Shrubland	396	3%
North Pacific Broadleaf Landslide Forest and Shrubland	136	1%

The table above identifies relative prevalence of these zones within the assessment area and are described in more detail below.

North Pacific Hypermaritime Western Redcedar and Western Hemlock Forest

The most prevalent vegetation zone in this assessment area, the North Pacific Hyper Maritime Western Redcedar and Western Hemlock Forest is part of the coastal temperate rainforests of North America extending from western Washington north into the southern half of southeastern Alaska, typically never more than 15 miles from saltwater. It occurs on low, gentle terrain, typically below 2000 feet of elevation, inland of the immediate fog zone and downslope of the rain-on-snow zone. The hypermaritime climate is characterized by cool summers, persistent fog, and very wet winters without a significant snowpack. Annual precipitation ranges from 100-150 inches, mostly as heavy winter rain. Soils are often nutrient-poor, acidic, and poorly drained, with a thick organic layer overlying mineral soil or bedrock.

The overstory is dominated by western red-cedar and western hemlock. Pacific silver fir and shore pine are sometimes present while Sitka spruce and Douglas-fir are rare. Nearly pure stands of western hemlock are common in highly wind-exposed sites. The understory is rich in shade-tolerant shrubs such as salal, salmonberry, and vine maple, with sword fern, deer fern, and other moisture-loving ferns abundant. Mosses and lichens form a dense ground and epiphytic layer.

Fire is extremely rare in this system, with natural fire return intervals typically exceeding 1,000 years. Instead, small gap dynamics and periodic windstorms are the dominant disturbance processes. Small windthrow and landslides, as well as insects and fungal pathogens operate to create small gaps in the canopy, while intense wind events, occurring at intervals from decades to centuries, can cause patchy blowdown, especially on ridges and upper slopes, creating larger canopy gaps. Pre-settlement forests were predominantly old growth with abundant coarse woody debris, complex multi-layered canopies, and high structural complexity. Western redcedar can exceed 1,000 years in age, often displaying multiple tops from past wind breakage. In some highly exposed or wind-prone topographic settings, forests may remain in early or mid-seral conditions for long periods due to repeated disturbance.

Since European settlement, this system has been heavily altered by development, timber harvest, road building, fire suppression, tree plantations and introduced diseases. In particular, historic timber harvests and plantation forestry have reduced canopy structural complexity, species diversity, and coarse woody debris with most forest succession truncated well before late-seral characteristics are expressed. Undisturbed conditions of this system are uncommon to rare.

North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest

The second most prevalent vegetation zone in this assessment area, the North Pacific Maritime Mesic-Wet Douglas-fir Western Hemlock Forest is known to occur throughout the lowlands, foothills, and lower montane zones from western British Columbia to Oregon, where it is characterized by a relatively mild climate with high precipitation, long frost-free periods, and low fire frequencies. Elevation ranges from sea level to approximately 2000 feet. Annual precipitation ranges from 30-100 inches, mostly as heavy winter rain, and while snowfall becomes more common at higher elevations, persistent snowpacks rarely form. The topography includes glacial till plains and steep mountainous terrain, with soils that are moist to somewhat wet for much of the year being typically well watered from upslope sources and seeps.

The overstory canopy is dominated by Douglas-fir, western hemlock, and/or western redcedar but grand fir can often be codominant. Bigleaf maple and red alder are commonly found as canopy or subcanopy codominants, especially at lower elevations, and small patches can be dominated by these same broadleaf trees for several decades after a disturbance event. Late seral stands typically have an abundance of large coniferous trees, a multi-layered canopy structure, large snags, and many large logs on the ground. Early seral stands typically have smaller trees, single-storied canopies, and may be dominated by conifers, broadleaf trees, or both. The understory is dominated by sword fern, salmonberry, and devil's club, though salal, Oregon grape, pacific rhododendron, and evergreen huckleberry can be present. Vine maple is a very common tall shrub and mosses are often a major ground cover.

Fire is the major natural disturbance regime in this system. Historically, large, high-severity, stand-replacing wildfires were common every 300-500 years, while about 75 percent of fires were smaller, mixed severity fires occurring every 100-150 years. These more frequent mixed severity fires were possible in the driest areas, but would generally not burn wetter microsites. In addition, insects, fungal pathogens, windstorms and landslides create small gaps in the canopy contributing to stand heterogeneity. Pre-settlement landscapes consisted of a mosaic of forest patches, averaging between one and five square miles in size, growing in different age and stand structure conditions. Approximately 5 percent of the landscape would be in early seral conditions, 20 percent in mid-seral conditions, and 75 percent of the forest in late-seral conditions.

Since European settlement, this system has been heavily altered by development, timber harvest, road building, fire suppression, tree plantations and introduced diseases. Development has fragmented the landscape changing fire regime and connectivity of this system, particularly in lowlands. Historic timber harvests and plantation forestry have reduced canopy structural complexity, species diversity, and coarse woody debris with most forest succession truncated well before late-seral characteristics are expressed.

North Pacific Mesic Western Hemlock Silver Fir Forest

The third most prevalent system in this assessment area, the North Pacific Mesic Western Hemlock Silver Fir Forest is known to occur throughout the mid-montane zone west of the Cascade crest from coastal British Columbia to Washington where it is characterized by a cool, moist climate with an infrequent fire regime. It occupies a distinct elevational band above Douglas-fir / western hemlock forests and below the mountain hemlock zone. The climate is characterized by high annual precipitation, with a winter snowpack lasting between 2 - 6 months. The system is often subject to winter rainfall events on top of snow—earning the nickname "rain-on-snow zone."

The overstory is dominated by western hemlock and Pacific silver fir, with Alaska yellow-cedar codominant at higher elevations. Western redcedar can also be present, but notably, unlike drier systems, Douglas-fir is rare or absent. The understory is dominated by mesic-wet understory species, such as oval-leaf huckleberry, redwood sorrel, and deer fern.

Stand-replacing fires are rare, with estimated return intervals of 700-1000 years. Natural disturbance regimes are primarily shaped by small-scale windthrow events which open gaps in the canopy and allow for successional regeneration. As a result, this forest system tends to develop complex late-seral characteristics, including multi-layered canopies and abundant coarse woody debris.

Since European settlement, this system has been altered by timber harvest and plantation forestry, which have reduced canopy structural complexity, species diversity, and coarse woody debris with most forest succession truncated well before late-seral characteristics are expressed.

North Pacific Maritime Dry-Mesic Douglas-Fir Western Hemlock Forest

This system is closely related to the North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest. The primary difference is lower available soil moisture manifesting in slight differences in species composition. Otherwise, climate and disturbance regimes are similar to the mesic-wet zone.

The overstory is dominated by giant Douglas-fir, often codominant with western hemlock or western redcedar. Other species such as grand fir, bigleaf maple, and western white pine can also be present but are generally less abundant. Western hemlock often regenerates as the dominant understory conifer but is typically absent in younger stands, especially in the Puget Lowlands. Late-seral forests exhibit a multi-layered canopy, large-diameter conifers, abundant snags, and significant coarse woody debris. Early seral forests tend to have single-storied canopies and may be dominated by either conifers or broadleaf trees, retaining biological legacies of prior stands. The understory is dominated by salal, Oregon grape, Pacific rhododendron, vine maple, and evergreen huckleberry. Sword fern is present but not a dominant cover, while mosses often dominate the ground layer in older stands, and canopy lichens are abundant.

North Pacific Seasonal Sitka Spruce Forest

This system is closely related to the North Pacific Hypermaritime Western Redcedar Western Hemlock zone where it occurs at slightly lower elevations up to 1,000 feet. Unlike the hypermaritime zone, it is characterized by more frequent fog events as well as a more vigorous wind disturbance regime that produces large canopy gaps. The additional fog and canopy gaps favor the growth of Sitka spruce. As a result, the overstory is typically dominated or codominated by Sitka spruce, western hemlock, and western redcedar, while Douglas-fir remains rare. Otherwise, disturbance regimes and species compositions closely resemble the hypermaritime zone.

North Pacific Lowland Riparian Forest And Shrubland

This system occurs primarily at low elevations west and east of the Cascade Range from British Columbia to Oregon. It is most common in the Puget Lowlands, Willamette Valley, and lower river valleys, where it forms narrow bands along rivers, streams, and floodplains. Elevation typically ranges from sea level to about 2,000 feet, though it can extend higher along major valley bottoms. The climate is mild and maritime, with wet winters, dry summers, and frequent autumn and spring rain events. Seasonal to episodic flooding is a defining feature, influencing soil development, vegetation composition, and successional pathways.

Flooding is the primary natural disturbance, with return intervals ranging from annual overbank flows to major channel-reforming events occurring every few decades. High flows scour vegetation, deposit new sediment, and create conditions for early-successional plant establishment. Beaver damming alters local hydrology, floods riparian benches, and promotes diverse habitat structure. Infrequent fire can occur in drier riparian terraces, but it is not a dominant process. Windthrow, ice damage, landslides, and insect or disease outbreaks cause localized disturbance and canopy gaps.

Early-seral stands are dominated by fast-growing pioneer trees such as black cottonwood and red alder, often accompanied by willows and a variety of herbaceous and shrub species. Mid- to late-seral forests may support large bigleaf maple and a conifer component including grand fir, Douglas-fir, Sitka spruce, and western redcedar. Conifers historically occupied stable riparian terraces but are now uncommon in many reaches. The shrub layer is often dense, dominated by red-osier dogwood, Pacific ninebark, salmonberry, and snowberry.

Historically, this system exhibited a dynamic shifting mosaic, with patches ranging from newly deposited gravel bars to mature, multi-layered forests over a short distance. Large woody debris, derived from mature forests upstream, was abundant and influenced channel form and habitat diversity. The riparian corridor provided continuous habitat connectivity, supporting fish migration, wildlife movement, and nutrient cycling between aquatic and terrestrial systems.

Since European settlement, extensive hydrologic modification, historic logging, and residential and agricultural development of floodplains have greatly reduced the extent and integrity of this system. Flood control structures have disconnected rivers from their floodplains, altering sediment and wood recruitment. Historic logging removed the majority of mature conifers and agriculture and urban expansion have converted or fragmented the remaining forest. Invasive species such as reed canary grass have replaced native herbaceous and shrub layers in many disturbed sites. These changes have simplified vegetation structure, reduced habitat quality, and impaired the system's natural disturbance-driven processes.

North Pacific Broadleaf Landslide Forest And Shrubland

This system occurs throughout the Pacific Northwest mountains and lowlands where it occurs on steep slopes and bluffs that experience periodic mass soil movements such as landslides, slumps, and earthflows. Soil parent materials are often glacial in origin, including till, outwash, and marine or lake sediments. Heavy rainfall events, freeze–thaw cycles, erosion, and seismic activity, can trigger slope movement.

Vegetation is typically dominated by deciduous broadleaf forests, woodlands, or shrublands. Black cottonwood, red alder, and bigleaf maple are common canopy species, often occurring in mixed stands. Conifers such as Douglas-fir, Sitka spruce, and western redcedar may be present but usually make up less than half the cover in early to mid-successional stands. The shrub layer is often dense, with salmonberry, thimbleberry, stink currant, and devil's club among the dominant species.

Landslides are the primary natural disturbance in this system where they maintain early-successional habitats in otherwise mature forest settings. Recently disturbed areas are typically dominated by fast-growing deciduous trees and shrubs not present on adjacent forestland, though without regular slope movement, these areas would likely succeed to conifer-dominated stands over time. Occasional windstorms and wildfires also affect these systems, which along with insect and fungal pathogens work to create additional stand heterogeneity.

Today, this system is considered imperiled due to its rarity, small patch size, and ongoing threats. Non-native plants such as English ivy and Himalayan blackberry often invade disturbed slopes, displacing native species and altering successional pathways. Human activities, including development at the top of bluffs, road construction, timber harvest on unstable slopes, and slope stabilization projects, have altered natural disturbance processes. These interventions can either accelerate slope failure through poor practices or suppress landslide activity by artificially stabilizing slopes, reducing the natural renewal of early-successional habitats.

Though this system is only a minor component of the assessment area, it is a notable archetypal vegetation zone to consider, given the high frequency of landslide events in the Lake Whatcom watershed.

Climate Change Impacts

Vegetation zones are likely to shift in the coming years as disturbance regimes are modified by climate change and existing species may become less suitable to future growing conditions, but how fast these zones will change is unclear. Under drier and warmer conditions forests will likely experience large-scale, high-severity wildfire events at a frequency that exceeds historical reference conditions. Likewise, drier and hotter conditions reduce the presence of moisture-loving zones, such as the Seasonal Sitka, in favor of similar but drier zones.

Soils

Overview

The wealth of a forest can be measured in its soil. Soil, interacting with local climate and topography, is responsible for determining a forest's potential species composition and productivity. Given the slow process of soil formation, if soil is damaged or lost, it may not be replaceable in the foreseeable future.

Broadly, soils are composed of organic matter, mineral components, and empty space occupied by air or water. Different soil structures have different capacities to store water. Loose, coarsely-textured soils, with large components of gravel and sand, hold less water and drain quickly, while dense, finely-textured soils, containing organic matter, silts and clays, retain more water and drain slowly. Deeper soils provide better anchorage and have higher potential water storage than shallow soils with similar structure.

The timing and duration of soil moisture largely determines which tree species will survive and thrive. Local hydrology and topography determine water availability and soils become saturated when available water exceeds their innate storage capacity. The frequency and duration of soil moisture, known as soil drainage class, is an excellent indicator of soils prone to waterlogging or conversely drought. In the dry summers of the Pacific Northwest, shallow, excessively-drained soils contain insufficient soil moisture for optimal growth and are unsuitable for drought-intolerant species. Conversely, poorly drained soils are prone to waterlogging, especially during wet winters, and only suitable for the most water-tolerant species. Well-drained soils that retain moisture without waterlogging are suitable for many species, and deep, well-drained soils with high potential water storage are the most productive and able to grow giant trees.

Forest productivity is commonly measured by site class, which groups soils from highly productive (Class I) to least productive (Class V) and can be used to estimate a site's potential annual timber growth. Appropriate use of heavy machinery is necessary to maintain productivity and avoid compaction or erosion, especially during wet winters when many soils are saturated. Well-drained soils are usually suitable for winter-time activities, while poor-draining soils are best operated on during drier summer months. Wetland soils that are saturated year-round should be avoided at all times.

Assessment

The sedimentary Chuckanut Formation underlies the majority of the soils in the watershed and primarily consists of fine to medium grain sandstone as well as deposits of conglomerate, shale, and coal. Over millions of years, folding and tilting have exposed the sedimentary layers of this formation, which have eroded at unequal rates leading to the many parallel cliff bands and ridgelines found across the watershed today. In the watershed's southeast corner an older, underlying deposit of metamorphic Darrington Phyllite is exposed and parallel cliff bands are notably absent. Glacial activity during the last Ice Age heavily influenced the region's terrain, carving valleys and leaving behind glacial deposits that fill the flat plains at both the south and north ends of the lake. In addition, periodic volcanic eruptions from nearby Mt Baker and other volcanoes have deposited volcanic ash into the watershed's soils.

Data from the USDA Natural Resource Conservation Service (NRCS) Soil Surveys[3] were used to identify the major soil types that underlay this forest, which are briefly described below.

- **Andic Xerochrepts** - Consists of moderately deep soils restricted by bedrock at 27 inches. They are well drained and can hold 4 inches of water storage within the rooting zone. They have moderate productivity (site class 3) and are most suitable for growing Douglas-fir. They formed in volcanic ash and colluvium from glacial drift, sandstone, and metasedimentary rock. They are commonly found on canyons, mountain slopes, mountains and ridges.
- **Chuckanut** - Consists of deep soils restricted by bedrock at 56 inches. They are well drained and can hold 10 inches of water storage within the rooting zone. They have moderate to high productivity (site class 2) and are most suitable for growing Douglas-fir. They formed in volcanic

[3] While the NRCS soil surveys provide well researched and detailed descriptions of each soil type, the geographic coverage of these soils has been interpolated from limited sampling and remote sensing, therefore minor mapping errors are invariably present. Thus, the soil maps and data presented here should be used as a guide to the soil types likely present in this forest, and some skepticism should be given to their exact delineations in the field.

ash mixed with colluvium derived from sandstone over dense glacial till. They are commonly found on foothills and hillslopes.

- **Getchell** - Consists of moderately deep soils restricted by compacted material around 39 inches. They are moderately well drained and can hold 13 inches of water storage within the rooting zone. They have low to moderate productivity (site class 4) and are most suitable for growing western hemlock. They formed in volcanic ash mixed with colluvium over dense glacial till. They are commonly found on mountain slopes and ridges.
- **Nati** - Consists of moderately deep soils restricted by bedrock around 37 inches. They are well drained and can hold 5 inches of water storage within the rooting zone. They have moderate to high productivity (site class 2) and are most suitable for growing Douglas-fir. They formed in volcanic ash, colluvium, and alluvium deposits derived from sandstone, siltstone and glacial drift. They are commonly found on foothills and hillslopes.
- **Revel** - Consists of moderately deep soils restricted by bedrock around 35 inches. They are well drained and can hold 6 inches of water storage within the rooting zone. They have low to moderate productivity (site class 4) and are most suitable for growing Douglas-fir. They formed in volcanic ash, and colluvium derived from glacial drift, bedrock of mixed lithology, and slope alluvium derived from sandstone and siltstone. They are commonly found on mountain slopes, mountains, plateaus and ridges.
- **Squalicum -** Consists of deep soils restricted by compacted material around 44 inches. They are moderately well drained and can hold 10 inches of water storage within the rooting zone. They have moderate to high productivity (site class 2) and are most suitable for growing Douglas-fir. They formed in volcanic ash, loess, and slope alluvium over glacial drift. They are commonly found on foothills and hillslopes.
- **Welcome** - Consists of deep soils restricted by bedrock around 52 inches. They are well drained and can hold 8 inches of water storage within the rooting zone. They have low to moderate productivity (site class 4) and are most suitable for growing western hemlock. They formed in volcanic ash, and colluvium derived from glacial drift, bedrock of mixed lithology, and slope alluvium derived from sandstone. They are commonly found on mountain slopes, mountains and ridges.

These soil types occur in various mixtures and on varying slopes and topographic positions, yielding unique soil units. Relevant information about major[4] soil units, including their depth, drainage, productivity, and relevant management concerns are listed in the table below. The location of all soil units can be found by property in Section 4.

[4] Major soil units comprise at least two percent of the project area. Minor soil units are not described here for brevity.

Forest Soil Units Summary Table

Soil Unit	Productivity		Management Concerns					Acres (Pct)
	Site Class	Max Growth	Drought Stress Hazard	Wind Throw Hazard	Mass Wasting Hazard	Logging Rutting Hazard	Logging Compact Hazard	
Andic Xerochrepts-Rock Outcrop Complex Ashy Loam 60-90% Slopes Mod. Deep (24in) Well Drained	DF-3	143 ft3/ac/yr	High	High	High	High	High	3,662 (30%)
Chuckanut Series Gravelly Medial Loam 30-65% Slopes Deep (56in) Well Drained	DF-2	186 ft3/ac/yr	Mod. High	Low	High	High	Mod.	1,093 (9%)
Revel-Welcome-Rock Outcrop Complex Ashy Loam 30-60% Slopes Mod. Deep (37in) Well Drained	DF-3 / DF-4	126 ft3/ac/yr	Mod. High	High	High	High	High	911 (7%)
Nati Series Ashy Loam 15-30% Slopes Mod. Deep (31in) Well Drained	DF-2 / DF-3	172 ft3/ac/yr	Mod. High	Medium	High	High	High	836 (7%)
Chuckanut Series Gravelly Medial Loam 15-30% Slopes Deep (56in) Well Drained	DF-2	186 ft3/ac/yr	Mod. High	Low	High	High	Mod.	715 (6%)
Nati Series Ashy Loam 30-60% Slopes Mod. Deep (38in) Well Drained	DF-3	129 ft3/ac/yr	Mod. High	High	High	High	High	701 (6%)
Andic Xerochrepts-Rock Outcrop Complex Ashy Loam 60-90% Slopes Very Shallow Well Drained	DF-4	114 ft3/ac/yr	Mod.	Low	High	High	High	657 (5%)

Soil Unit	Productivity		Management Concerns					Acres (Pct)
	Site Class	Max Growth	Drought Stress Hazard	Wind Throw Hazard	Mass Wasting Hazard	Logging Rutting Hazard	Logging Compact Hazard	
Revel Series Loam 30-60% Slopes Mod. Deep (35in) Well Drained	DF-4	114 ft3/ac/yr	Mod. High	High	High	High	High	388 (3%)
Nati Series Ashy Loam 5-15% Slopes Mod. Deep (37in) Well Drained	DF-2 / DF-3	172 ft3/ac/yr	Mod. High	Medium	High	High	High	368 (3%)
Squalicum Series Gravelly Ashy Loam 5-15% Slopes Deep (44in) Moderately Well Drained	DF-2	186 ft3/ac/yr	Mod.	Low	Mod.	Mod.	High	358 (3%)
Andic Xerochrepts Ashy Loam 60-90% Slopes Mod. Deep (27in) Well Drained	DF-3	143 ft3/ac/yr	High	High	High	High	High	332 (3%)
Revel Series Loam 5-30% Slopes Mod. Deep (39in) Well Drained	DF-4	114 ft3/ac/yr	Mod. High	High	High	High	High	312 (3%)
Getchell Series Decomposed Material 15-30% Slopes Mod. Deep (39in) Moderately Well Drained	WH-4	200 ft3/ac/yr	Low.	High	High	High	Mod.	271 (2%)
Squalicum Series Gravelly Ashy Loam 15-30% Slopes Deep (44in) Moderately Well Drained	DF-2	186 ft3/ac/yr	Mod.	Low	High	Mod.	High	225 (2%)

Soil productivity in the watershed ranges from site class 2-4, with over 75 percent of soils having a site class of at least 3. The highest productivity sites are at lower elevations along the Lake's southern and northern shores, while the lowest productivity sites are situated on high mountain ridgelines and steep slopes where shallow soils have low moisture potential. Like many northwest soils the risk of summertime drought stress is moderate to high across most of the watershed. The risk of windthrow varies by soil type, depending on the soil's rooting depth and mechanical strength. The risk of mass wasting is almost uniformly high across all soil types in the watershed as a result of the steep slopes and shallow, glacially derived soil layers. In addition, almost all soil types are at moderate to high risk of soil compaction or rutting from heavy machinery usage when the soil is moist or saturated.

Recommendations

This plan recommends that forest management activities utilizing heavy equipment be restricted to dry, summertime months, to reduce the risk of soil rutting and compaction. In addition, the high risk of mass wasting needs to be considered when planning forest management activities and additional recommendations are given in the section on Slope Stability.

Since soils play a critical role in forest development, the following best management practices will guide the management recommendations made throughout this plan.

Best Management Practices

- Match Species to Soils. Tree species should be selected for their suitability to soil conditions, with drought-tolerant trees preferred in droughty soils and waterlogging-tolerant trees preferred in poorly drained soils. See Appendix III for a complete list of species tolerances and considerations for seedling establishment in different soil types.
- Retain and Recruit Hardwood Trees. Deciduous trees play an important role in forest nutrient cycling, providing a significant amount of annual leaf litter and woody debris to the forest floor, which quickly rots and is incorporated into the soil. Manage the forest's species composition, targeting around 20 percent of the forest overstory in deciduous hardwoods.
- Seasonally Restrict Equipment Use. Since saturated soils are prone to compaction and rutting, potentially reducing soil productivity and increasing the risk of erosion, heavy equipment use should be limited to periods when soils are dry.
- Timber Harvesting Methods. Limit commercial thinning entries on a single site to no more than once every 10 years to minimize compaction of soils. Frequent passage of equipment across forest soils should be minimized, with activity concentrated on as limited of a trail and/or road network as possible. Woody debris should be deposited on skid trails during logging operations to minimize soil compaction and incorporate debris into the soil.
- Retain Woody Debris. During forest management operations, woody debris (e.g., limbs, tops, poles, non-merchantable logs, etc.) should be redistributed back into the woods to increase soil organic matter. Scatter woody debris across the forest floor to the extent possible without increasing fire or pest risk or creating operational hazards to future management operations.
- Conserve Legacy Structures. As possible, protect legacy structures in the forest, including: old-growth stumps, large downed logs and snags, and old trees from prior generations of the

forest. These legacy structures are known to serve as important refugia for fungi and other microbial communities that are essential to soil health.

Climate Change Impacts

In general, forest productivity is likely to decrease across the Pacific Northwest as higher temperatures increase evapotranspirative demand and reduce the effective growing season of many moisture-limited sites. In some special cases, higher-elevation sites that are currently energy-limited may see an extension of the growing season under future warmer conditions. Young seedlings with limited root networks are particularly exposed to hotter and drier future conditions and the challenges of reforestation are likely to increase.

Slope Stability

Overview

Slope stability is a major concern across the Pacific Northwest where high precipitation can trigger landslides or other mass wasting events on vulnerable terrain, endangering property and reducing water quality. Fundamentally, landslides occur when the pressure or stress on soil exceeds its capacity to support itself. This is most likely to occur in soils whose innate properties confer limited strength and on landforms whose topography increases stresses and reduces holding power. The trigger for many landslides are rain events that saturate the soil with water, temporarily reducing the soil's ability to support itself.

In the forested landscape, tree and plant roots can provide additional strength, holding soils together that may have otherwise slid away. Shallow landslides are those that occur within the rooting zone of trees, while deep-seated landslides occur much deeper in the soil and are not influenced by root strength. In addition to anchoring the soil, forests intercept precipitation before it hits the ground and absorb water through their roots, influencing local hydrology and helping to reduce the amount of water in the soil during extreme rain events.

Forest operations, such as logging and road building have the potential to influence slope stability. Clearcut logging on unstable landforms reduces root strength and has been a historic source of landslides throughout the state. Today, forest regulations in Washington State are designed to reduce the risk of slope instability by identifying and preventing forest operations on all unstable or potentially unstable landforms. These landforms, known as rule-identified landforms (RILs), include inner gorges, convergent headwalls, and bedrock hollows on slopes greater than 70 percent; toe slopes of deep-seated landslides over 65 percent grade; and groundwater recharge area for glacial deep-seated landslides to name a few. Since most landslides occur on these landforms, by avoiding them the risk of mass wasting events is greatly reduced. In addition, poorly designed or maintained roads can transfer large quantities of water onto a slope, causing erosion and increasing the risk of instability during storm events. Historically, forest roads were frequently abandoned without mitigating the roads ongoing hydrological influence, and many landslides have originated from these old road beds. Today, modern forest regulations require that all roads are built and maintained to safely convey the water flows generated during extreme storm events and unused forest roads must be permanently abandoned to ensure no long-term hydrological effects.

Assessment

The Lake Whatcom watershed has a long history of slope instability. The steep slopes and deeply incised stream channels leading into the lake contain many potentially unstable landforms and extensive evidence of past landslide activity. The watershed's shallow soils are prone to erosion and have a high risk of mass wasting when saturated with extensive wintertime precipitation. This manifests primarily as shallow landslide activity in the soils underlain by the sedimentary Chuckanut Formation, with deep-seated landslides a more common risk in the deeper Darrington Phyllite derived soils at the Lake's southeastern shore.

Given these conditions, landslides and other mass wasting events are part of the region's natural geophysical processes. Historical landslide activity has carved out stream channels and deposited debris, building up several alluvial fans which dot the lakeside. Landslides also transport habitat-improving large woody debris into the lake, and are a critical forest disturbance agent where they maintain early-successional habitats in otherwise mature forest settings. More recently, widespread logging and road building across the watershed's steep slopes triggered numerous slope failures during the 20th century, including events in 1917, 1949, 1971, 1983, and 2009[5]. The most notable of these occurred on January 10th, 1983 when extensive rainfall initiated numerous small landslides along the Smith Creek drainage, which swept down the creek and exploded onto the alluvial fan, destroying homes and pushing houses into the lake. Beyond threatening property and lives, landslides are a major concern in the Lake Whatcom watershed because of their potential to introduce major quantities of sediment into the lake, potentially reducing water quality and threatening the drinking water supply of over 120,000 residents.

Previous analyses by the WA DNR, starting with the Lake Whatcom Watershed Analyses in the mid-1990s and culminating in the 2004 Lake Whatcom Landscape Plan, identified areas of potential instability within the watershed. These areas are known as hazard zones and include both known and suspected areas of instability, such as historical landslides, rule-identified landforms, and areas that require additional investigation. Because these zones were generated before the era of high-resolution mapping, they are at times overly restrictive, but serve as an effective screening tool. More recently, the Washington Geological Survey completed a high-resolution landslide mapping and inventory project across most of western Whatcom County, identifying historic and recent landslide activity within the watershed. In addition, the legally mandated Road Maintenance and Abandonment Plan (RMAP) process undertaken by the DNR in the early 2000s surveyed the watershed's active and abandoned road system, initiating improvements in storm water management and proper abandonment of unused road segments. A more thorough description of this process is given in the discussion on Roads and Access.

[5] As documented in the 1988 WWU Master's Thesis "History and Origin of Debris Torrents in the Smith Creek Drainage, Whatcom County, Washington" by Tim Syverson and the 2009 DNR report titled "Summary Report: Landslides, State Trust Lands, and the January 2009 Storm in Whatcom County".

Recommendations

Given the potential for slope instability in the watershed, it is critical that forest management follows existing rules limiting forest operations on unstable landforms. Avoiding unstable landforms is both the law and the best strategy to avoid triggering mass wasting events. Positively identifying these landforms requires field investigation at the time of operation before forest practice applications will be approved by the DNR. If unstable landforms are correctly identified and avoided, then the risk of forest management activities causing slope failures is greatly reduced.

In order to prioritize management activities, this plan utilizes remotely mapped topographic, hazard zone, and historical landslide data to gauge the likelihood that unstable slopes will be found within a proposed management area. The presence of a mapped hazard zone or historical landslide does not preclude management, but indicates that further investigation is required. In some cases, the hazard zones are poorly mapped and field investigation will quickly reveal that no risk of slope instability exists. More commonly an unstable landform, such as a steep stream channel, exists but can be easily avoided during management operations. In addition, mapped landslides are indicative of past instability, and while this is a good indicator of future instability, some landslides are prehistoric and unlikely to move further. In any case, a geotechnical investigation may be necessary to make final determinations about slope stability and allowable management activities.

Best Management Practices

Forest management should adhere to the following best management practices in order to avoid operating on unstable landforms and reduce the risk of landslides and other mass-wasting events:

1. Slope Stability Assessment: Conduct detailed geotechnical assessments prior to management activities to identify unstable areas and avoid them during operations.
2. Selective Thinning: By retaining trees during thinning, the retained living root system continues to stabilize the soil against unforeseen circumstances.
3. Minimize Disturbance: Limit forestry operations adjacent to the most sensitive and unstable slopes to reduce risk of landslides.
4. Reforestation and Revegetation: Replant disturbed areas with native, deep-rooted vegetation to improve slope stability.
5. Erosion Control Measures: Implement erosion control practices such as mulching and using erosion control blankets, on any disturbed soils within proximity of steep or unstable slopes

Climate Change Impacts

Overall, climate change is expected to intensify the natural processes that destabilize steep slopes in western Washington. Projected increases in the frequency and intensity of extreme rainfall events, can lead to increased surface runoff, soil saturation, and heightened erosion on already vulnerable slopes. These wetter conditions weaken soil structure and reduce slope stability, making landslides and slope failures more common in the region, particularly in areas where vegetation cover has been disturbed by development or logging activities.

Furthermore, climate change may accelerate the melting of snowpack as well as rain on snow events, leading to altered hydrological cycles. Reduced snowpack can result in seasonal variability in soil moisture levels, causing cycles of wetting and drying that destabilize slopes. The increased water flow from melting snow also contributes to higher groundwater levels, reducing the cohesive strength of soil and increasing the likelihood of slope failure during heavy rain events. These changes collectively threaten the safety of infrastructure, natural habitats, and communities situated on or near steep slopes.

In addition to water-related impacts, rising temperatures can lead to more frequent and severe wildfires, which greatly affect slope stability. Wildfires remove protective vegetation cover, leaving soil exposed and highly susceptible to erosion during subsequent storms. Post-fire conditions, combined with increased precipitation, can trigger debris flows and landslides that disturb ecosystems, threaten human developments, and potentially reduce water quality in Lake Whatcom.

Hydrology and Water Quality

Overview

The hydrology of the forested landscape is complex, moderated by factors such as precipitation, soil, vegetation, and topography. Seasonal and perennial streams drain water from the forested landscape, while waterbodies and wetlands store water during wet seasons which is steadily released back to the surrounding landscape during the dry season. Streams, waterbodies, and wetlands provide critical habitat for aquatic species, such as fish and amphibians, as well as upland species.

Forests are essential to maintaining water quality within a watershed. They provide shade and moderate water temperature, stabilize streambanks and control sedimentation and erosion, provide nutrient inputs such as leaf litter and woody debris, and contribute to complex riparian and wetland habitats. They can also influence the quantity of water available. Vigorously growing younger forests (less than 40 years old) use substantially more water than older forests, leaving less moisture in the soil and less water in streams and wetlands, especially during dry summers.

Ground-disturbing activities, such as logging, hauling on forest roads, and road maintenance increase the availability of sediment that can be transported by storm events and are a major consideration in forest management. Elevated sediment loads can impact photosynthesis by aquatic plants, bury gravel beds used by fish and invertebrates, reduce habitat complexity, and impair water quality by increasing turbidity and transporting attached nutrients or pollutants. Unconfined surface runoff can be effectively mitigated by appropriately sized buffers of natural vegetation which slow and filter this runoff, preventing sediment from entering surface waters. While forest roads can operate to channel surface runoff, if properly designed with drainage controls and maintained in good operation, sediment delivery can be greatly reduced.

Assessment

The forestland in this assessment primarily drains into the Lake Whatcom basin. Most moisture falls as rain during the fall, winter, and spring, with snow accumulation sometimes occurring at higher elevations. The steep, forested terrain contains many perennial and seasonal streams that flow quickly toward the lake, often flowing down waterfalls and steep channels. Two of the most significant tributaries are Austin Creek, which enters the lake from the west, and Smith Creek, which enters from the east. Perched forested wetlands occur in the folded topography of the Chuckanut Formation, which, along with surrounding glacial deposits, creates complex subsurface flow patterns and areas of natural slope instability. The Lake Whatcom region contains the first foothills east of the Strait of Juan de Fuca, which places it directly in the path of Pacific storm systems. These can deliver heavy rainfall over short periods and occasionally trigger landslides and rapid increases in streamflow.

Most notably, Lake Whatcom is the primary drinking water source for the City of Bellingham and surrounding communities, and water quality in the lake is a major management concern. In 1998, the lake was placed on Washington's 303(d) list for failing to meet dissolved oxygen standards, with excess phosphorus identified as the primary driver. Bacterial contamination is also a documented problem, with levels exceeding state standards in 11 tributaries to Lake Whatcom. Many of these tributaries pass through developed areas where bacteria sources include failing septic systems, sewer overflows, and pet or livestock waste exposed to rainfall.

While Lake Whatcom has naturally occurring levels of phosphorus primarily resulting from natural rates of erosion and sediment delivery to the lake, modern development has increased phosphorus loading above this background rate. Much of the excess phosphorus comes from stormwater runoff, which transports soil particles, fertilizers, organic debris, and other materials from developed areas. On natural landscapes, forests and soils filter stormwater before it reaches streams and lakes, but impervious surfaces such as roads, rooftops, and compacted yards bypass this process, sending runoff directly to surface waters. Phosphorus fuels excessive algal growth when present in high concentrations. The decomposition of algae depletes dissolved oxygen and releases additional phosphorus from sediments, creating a feedback loop that worsens water quality.

Efforts to address these water quality issues are guided by the Lake Whatcom Management Program (LWMP) and the 2016 Total Maximum Daily Load plan, which set phosphorus and bacteria reduction targets. The LWMP is a coordinated effort between the City of Bellingham, Whatcom County, and the Lake Whatcom Water and Sewer District, with policy oversight from their legislative bodies and implementation by the Lake Whatcom Management Program via the Interjurisdictional Coordinating Team. Actions in the 2025–2029 Work Plan span twelve program areas and include constructing and retrofitting stormwater treatment facilities, enforcing land use regulations, preserving forestland, and supporting residential retrofits to reduce runoff. The program also invests in long-term water quality monitoring, education and outreach campaigns, hazardous materials management, recreation and boating rules, and invasive species prevention.

Recommendations

Other than road-related concerns addressed in the following section, all water resources visited during this assessment were in good condition, providing high-quality riparian habitat.

Broadly, management activities in the watershed should seek to minimize sediment delivery to Lake Whatcom, and modern Forest Practices Act rules enforced by the State of Washington around riparian buffers and forest roads are effective at achieving this goal. Logging, road maintenance, and other ground-disturbing activities should be limited to summer months to further reduce the potential for sediment delivery. Additional recommendations will be given on forest road building and maintenance later in this document.

Since forests play a critical role in regional hydrology, the following best management practices will guide the management recommendations made throughout this plan.

Best Management Practices

The DNR regulates timber harvest and other forest management activities on all privately owned forestlands in the state according to the WA State Forest Practices Act. This includes restrictions on activities that can occur within certain distances of wetlands, waterbodies, and streams, known as wetland / riparian management zones. These zones vary in size depending on the water feature and soil type and include several layered buffers that may restrict management activities up to 200 feet from streams and bodies of water and up to 100 feet from wetlands. Before a forest practices act application can be submitted, water features need to be fully delineated and typed, or evidence provided that no such features exist.

Forest management adjacent to streams and wetlands should adhere to the following best management practices:

- Restrict operations and the use of heavy equipment within the buffer zones around streams, waterbodies, and wetlands as required by law.
- Retain or restore canopy cover and shading sufficient to moderate fluctuations in water temperature.
- Retain and recruit snags and downed logs into the wetland / riparian areas to provide aquatic habitat and slow down water flows in riparian areas.
- Promote forest composition trending towards conifer dominance while controlling and/or eliminating nonnative, invasive plants.

Climate Change Impacts

The overall climatic trends of warmer temperatures and shifting precipitation patterns will impact forest hydrology and streamflows. While total annual precipitation is expected to remain the same, summertime precipitation will decrease while wintertime precipitation will increase. Winter storm intensity is projected to increase, with rainfall and snowmelt concentrated into shorter time periods, and hydrological models project streams will experience greater flashiness, higher runoff and more flooding in fall, winter and spring. In the summer, warmer air temperatures will boost evaporation from streams and lakes and increase plant transpiration, reducing soil moisture and ultimately summer stream flows, with cascading effects on the aquatic environment.

Roads and Access

Overview

A well-maintained forest road and trail system is important to ongoing forest management activities. It enables access for monitoring and harvesting and provides quick access for firefighters in the case of a wildfire. Depending on the consistency and intensity of management activities, forest roads may be used seasonally or year-round, and may or may not be surfaced. Some roads may be maintained and used annually, and some roads (or road segments) may be left alone or decommissioned until the next logging cycle. Finally, not all access needs to be roads. A network of walking trails can provide access to roadless or sensitive areas to help facilitate annual monitoring and provide recreational opportunities.

While forest roads are necessary for many forest operations, they also create problems. Many invasive species get their initial start along road edges, and roads may be subject to unauthorized use and dumping. Though forest roads are typically small and infrequently used, they can create permanent, early-seral habitat along their edges and influence the behavior of some wildlife species. Perhaps more concerning is the potential roads have to influence hydrology and water quality. On flatter terrain, roads can prevent the natural flow of water, causing ponding and saturated road beds if proper drainage is not provided. On steep terrain, roads intercept and route surface runoff, which during storm events can turn into large flows of water that need to be controlled and safely deposited downhill of the road bed. Failure to control these surface water flows can send sediment-laden water into local surface waters reducing water quality. Roads designed with adequate drainage and maintained in good operation are able to handle these flows and minimize sediment delivery.

The Washington State Forest Practices Act requires that forest landowners construct and maintain roads to minimize impacts to public resources, such as water quality and fish habitat. When roads are no longer needed, they must be abandoned following Forest Practices Act guidelines. By building, maintaining, and abandoning roads to these standards, the potential impacts of forest roads can be greatly mitigated. In most cases a professional forester or road engineer should be consulted before building any forest roads to ensure compliance with these standards.

Forest roads broadly fall into three categories: Active, Abandoned, and Orphaned. Active roads are roads that are maintained regularly and are currently available for forest management activities. Abandoned roads are roads that have been formally abandoned following the DNR's abandonment procedures. Orphaned roads were built and abandoned prior to the regulation of forest roads in 1975, and while not the legal obligation of the landowner, may continue to influence local hydrology and pose resource concerns even today. Though modern roads are designed to avoid crossing water features whenever possible, crossings are inevitable in our steep and hydrologically complex landscape. Depending on the water type - fish-bearing, non-fish-bearing but perennially flowing, or seasonally flowing - different regulations govern crossing design, but can include bridges, culverts, and potentially fords that allow the roadway to cross over a stream or other water feature. Drainage control structures include ditches, cross-draining culverts, ditchouts, rolling dips, and waterbars which work to contain water intercepted by the roadway and redistribute it safely downhill.

Assessment

Forest roads were assessed to determine their status and suitability for management activities as well as to identify any potential maintenance or design issues. Active and recently abandoned forest roads were identified from City and County staff records as well as publicly available forest road inventory data from the WA DNR. Older forest roads were identified using lidar imagery and historic Road Maintenance and Abandonment Planning (RMAP) documents acquired from the WA DNR. During this assessment, all active roads were walked or driven in their entirety. Water crossings, drainage control structures, and road surfaces were inspected throughout the active road system to identify potential issues. In addition, a sample of abandoned roads were spot-checked to confirm their current status and the conclusions of previous RMAP investigations. Finally, this assessment also examined the potential for future road building and/or the restoration of old road grades to assist in forest management activities.

In total, this assessment reviewed 76 water crossings, 206 drainage control structures (e.g. cross-draining culverts and ditchouts), assessed over 30 miles of active roadway, and spot-checked 32 orphaned road systems. Though this assessment was thorough, it did not include an engineering assessment of roads or drainage structures, nor did it identify all potential road-related issues in the watershed. In practice, this assessment sampled the forest road infrastructure across the watershed, and further assessments will be necessary in order to form a complete and thorough analysis of the road system. Notable findings of this assessment are summarized below and additional details are included in the property-specific sections in Section 4.

- **Neglected and/or Improperly Abandoned Roads.** Several roads were identified that, having not been officially abandoned, are theoretically “active” but maintenance has been neglected for many years. Examples of these roads include the SH-94 road at Lake Whatcom Park, the LM-1000 and LM-2400 roads at Lookout Mountain Forest Preserve, unnamed roads in the southeastern corner of Blue Canyon Preserve and at South Lake Whatcom Preserve, and unnamed spurs off the LM-4000 road at West Beaver Creek Preserve. Without ongoing maintenance, the drainage control structures, such as ditches and culverts, on these roads may fail, causing erosion and slope stability issues that could endanger local water quality. Improperly abandoned roads were also identified at the city-owned Agate Creek and Agate Pond Preserves.
- **Existing Orphan Roads.** These roads exist throughout the Lake Whatcom watershed where modern day lidar data can identify faint traces of these old road grades. This assessment did not identify any major concern with existing orphan roads that warrant a management recommendation. The RMAP process undertaken by the DNR at Lookout Mountain Forest Preserve and Lake Whatcom Park prior to reconveyance included a thorough investigation of

these orphaned road systems. Spot checks of these roads concurred with the DNR findings that these roads posed a limited risk. Though no culverts or water crossings were found on these historic road beds, evidence of past sidecast failures and small landslide activity was observed, and the roads are now reforested with large diameter trees growing on the old road grade. The RMAP process mitigated several high-consequence road segments and crossings, but under the assumption that most potentially unstable areas have already failed, concluded that attempting to mitigate the entire road bed grade with heavy equipment would cause more issues than it solved. Though city-owned properties have not benefited from the same RMAP process, field investigations of orphaned road segments at South Lake Whatcom Preserve, Three Creeks Preserve, and Blue Canyon did not identify any immediate concerns. In other cases, such as North Beaver Creek Preserve and West Beaver Creek Preserve, old road grades have been repurposed as hiking and biking trails.

- **Fish Passage Issues**. Given the steep topography of the region, fish-bearing streams are generally limited, and only two potential fish-passage issues were identified. At Lookout Mountain Forest Preserve, the current Rufus Creek Trail repurposed a defunct forest road and uses an existing culvert to pass over a fish-bearing stream. Similarly, at Lake Whatcom Park, the Hertz Trail passes over a culvert containing a fish-bearing stream. Both of these culverts are failing and lack natural streambed material posing a potential barrier to fish passage.
- **Drainage Control Issues on Active Roads.** Several active roads were identified as suffering from deferred maintenance of their drainage control structures, primarily road grades, ditches, and cross-draining culverts. In some situations, this has caused water to enter the roadway resulting in minor channelization on the road surface. These issues primarily occur on the Lookout Mountain LM-2000 road and to a lesser degree on the Lake Whatcom Park Wickersham Truck Trail road where both road systems have likely suffered a reduction in maintenance staffing and spending since their transfer from the DNR to Whatcom County. Across the watershed, drainage control issues identified include:
    - **Inoperable Cross-Draining Culverts.** Over time culvert inlets can become obstructed by large woody debris or buried under sediment if not properly maintained. Steel culverts are also prone to rusting and culvert outfalls may cause erosion if energy dissipation devices, such as rock armoring or downflumes are not properly installed and maintained. Of the 184 drainage culverts surveyed across the watershed, 23 were partially plugged, 4 were completely obstructed, and 3 had energy dissipation issues.
    - **Obstructed Ditches.** Ditches become obstructed or otherwise inoperable for many reasons, including sloughing hillsides, large debris, and unsanctioned recreational use. Obstructed ditches force water onto the roadway, where it bypasses well designed cross-draining culverts and uncontrollably exits the roadway, causing erosion and/or delivering sediment into nearby streams. Over 38 observations of obstructed ditches were identified, the majority occurring at Lookout Mountain Forest Preserve.
    - **Improperly Maintained Road Grades**. When water does enter the road a properly maintained road grade ensures the water is shed quickly. With crowned or insloping roads the water is directly, at least partially, back into the ditch while outsloping roads

direct water downslope. When road grades are neglected, ruts can form, and the grade flattens out, failing to shed water and allowing it to form channels on the road surface. Over 12 observations of water on the roadway were identified, the majority once again occurring at Lookout Mountain Forest Preserve and to a lesser degree at Lake Whatcom Park.

- **Culvert Condition.** 184 cross-draining culverts and 41 stream-crossing culverts were evaluated during this assessment. Culvert diameter, material, and condition were noted and the bankfull width measured for stream crossings. As described earlier, though culvert inlets were partially obstructed as a result of deferred maintenance, the culverts themselves were generally in good condition. Though nine crossdrains were flagged as undersized according to Forest Practices Act requirements, the majority of culverts were 18 inches or larger as required by state regulations. Of the 41 stream-crossing culverts identified during this assessment, 25 had diameters less than the bankfull width of the stream they carried. While this does imply they are functionally undersized, additional analysis is required to determine if these culverts are appropriately sized to meet current WA DNR requirements. Over 75 percent of culverts inspected during this assessment were constructed from galvanized steel, which has a serviceable life from 20-40 years. Many of these culverts date from the RMAP process from the early 2000s and are likely around 20 years old, though some may be considerably older. During this assessment the majority of steel culverts surveyed were in good condition and only four steel culverts were identified as having rusted out and an additional two showed signs of ongoing corrosion. Still, culvert failures are predicted to increase in the future as steel culverts reach the end of their serviceable life.
- **Road Failures.** Several historic road failures and one active failure were identified during this assessment which are important guides to the types of future issues that this road system may experience.
    - In 2018, a large storm saturated the roadway and surrounding soils, causing uncontrolled water on the roadway and extensive erosion at the intersection of the LM-2000 and LM-2400 road at Lookout Mountain Forest Preserve, closing the LM-2400 road to vehicle traffic ever since. Repairs of the failed section, including upgraded drainage control systems, are currently underway with construction projected to finish in early 2026.
    - Another recent failure also occurred on the LM-2000 road where the northern fork of Austin Creek passes under the road in a large 6ft culvert. During a storm in 2021, this culvert became plugged and the river overtopped the road, eroding some of the road bed but leaving the culvert in place. Notably, the current culvert is considered appropriately sized to pass the volume of water calculated to occur during the 100-year flood event, but was unable to pass the large woody debris transported by this flood. Though repairs have been made, this failure indicates that this water crossing needs to be upgraded to handle future storm events and the County is planning to undertake this upgrade in 2026.

    - During this assessment an acute issue was identified with another water crossing at the Lookout Mountain Forest Preserve. This crossing is on the current Rufus Creek Trail where a defunct forest road has been repurposed as a biking and hiking trail. The trail crosses over an existing road culvert on a fish-bearing stream that has rusted out, failing to contain the stream and causing erosion of the overlying road surface. Though this location is on very flat topography it has the potential to deliver sediment into the local watershed in the future.

Recommendations

The following are generalized management recommendations for forest roads and drainage structures. More detailed, site-specific recommendations are included in the property sections

- **Neglected and/or Improperly Abandoned Roads.** Neglected roads necessary for recommended forest management activities should be restored to active condition. Neglected or improperly abandoned roads that are not required, should be decommissioned following the DNR's abandonment procedures.
- **Drainage Control Issues on Active Roads.** Implement a maintenance plan for ditches, culverts, and road grades. See the best management practices identified below.
- **Culvert Condition.** Upgrade undersized culverts. Future culvert installation, particularly of cross-draining culverts, should prioritize modern, longer lasting HDPE plastic culverts. Culverts should be evaluated to confirm they are sized appropriately for their respective upstream basins.
- **Fish Passage.** Evaluate and rectify identified fish passage issues.
- **New Roads.** Without road access, heavy equipment cannot be used in forest management activities, and thinning recommendations must be implemented as non-commercial cut and drop. This greatly increases the cost of forest management and likely reduces the amount of the landscape that can be actively managed to reach its desired future condition. Given the challenges of properly maintaining roads on steep terrain, the decision to build new roads requires careful planning. New road construction, if any, should consider the following guidelines:
    - Absent a compelling reason, no new mainline roads should be built in the watershed. Though many areas of the current watershed are not currently accessible, building extensive mainline roads to reach these areas will be expensive and counterproductive to the management goals outlined in this plan.
    - Any new road segments should be short, temporarily constructed spurs off existing roads necessary for forest health improvement projects.
    - New roads should be situated in locations that are less likely to interfere with local hydrology and require reduced maintenance, such as along ridgelines and flat topographies.
    - New roads should consider re-using orphaned road grades in order to reduce the road footprint in the watershed. However, given that older roads were not built or located to modern standards, it may not be advisable to reuse old road beds in all circumstances.

- Roads should be decommissioned when no longer needed for forest management activities.

Best Management Practices

1. **Inspection and Monitoring**
    - Conduct regular inspections, especially before and after major storms or freeze–thaw cycles.
    - Implement a “storm watch” program that involves City and County staff actively monitoring forest roads during significant rain events.
    - Check critical points first: stream crossings, steep grades, road–ditch intersections, and known problem areas.
    - Record and prioritize findings—high-risk sites near streams or unstable slopes get top attention.
    - Inspect culverts, relief drains, ditches, and cross-drains for blockage, deformation, or erosion.
2. **Surface and Drainage Maintenance**
    - Maintain the road surface to shed water: regrade ruts and potholes, restore road grade as designed, and prevent ponding.
    - Keep ditches clear and functional—remove sediment, vegetation, or debris that blocks flow. Ditches should only be cleaned on an as-needed basis, versus on a strict schedule, when they no longer adequately carry drainage water. Excessive cleaning can lead to scouring of ditch and may compromise road integrity.
    - Clean or replace cross drains and relief culverts to ensure unimpeded water flow.
    - Install or refresh energy dissipators (rock aprons, slash mats, or sediment traps) where outflows discharge onto bare soil.
    - Break up long grades with additional water bars or dips to disperse runoff.
3. **Erosion and Sediment Control**
    - Stabilize exposed soil using native vegetation, straw mulch, or gravel armoring on problem spots.
    - Armor outlets and inlets to prevent scouring and sediment transport.
    - Minimize sediment delivery to water: divert ditch water onto stable, vegetated slopes instead of directly to streams.
    - Inspect and maintain erosion control structures and replace as needed.
4. **Culvert and Stream Crossing Maintenance**
    - Remove debris from culvert inlets and outlets regularly.
    - Check alignment and slope to ensure proper flow and prevent undercutting.
    - Repair eroded fill and armor with rock where necessary.
    - Maintain fish passage at all fish-bearing stream crossings—remove barriers and sediment deposits.
    - Replace undersized culverts as part of maintenance where chronic plugging or flooding occurs.

- Routinely inspect and replace metal culverts with plastic culverts as necessary. Metal culverts have a maximum lifespan of 40 years.

5. **Vegetation Management**
   - Control encroaching vegetation to maintain visibility and drainage function.
   - Retain ground cover on cut and fill slopes—avoid scalping vegetation that stabilizes soil.
   - Use native species for reseeding or slope stabilization after maintenance work.
6. **Road Use and Surface Protection**
   - Restrict hauling during wet periods to prevent rutting and road surface damage.
   - Use rock surfacing or temporary mats where soft or erodible surfaces are unavoidable. Road surfacing should include a combination of coarse (1”+) and fine (1”-) rock.
   - Limit traffic on closed or low-use roads to maintain stability and minimize maintenance needs.
7. **Road Abandonment and Decommissioning Maintenance**
   - For roads slated for temporary closure or abandonment, maintain stable drainage by installing or refreshing water bars, outsloping, and re-establishing natural drainage paths.
   - Monitor decommissioned roads until vegetation is well established and erosion potential is low.
8. **Lake Whatcom Watershed Considerations**
   - Apply maintenance BMPs more frequently and proactively than the statewide minimum.
   - Emphasize sediment source control near surface water.
   - Coordinate maintenance schedules with Lake Whatcom Management Program (LWMP) objectives and local road inventories.

Priority Road Maintenance Actions Summary Table

Focus Area	Maintenance Practice	Frequency / Trigger
Drainage	Clean ditches, culverts, and cross drains	After major storms, annually minimum
Surface	Grade and restore crown/outslopes	As needed, typically 1–2× per year
Erosion	Repair gullies, apply surface rock, reseed slopes	As needed
Crossings	Clear debris, inspect for erosion/fish passage	Before/after storm season
Slopes	Monitor for tension cracks or slides	Quarterly or post-storm
Vegetation	Clear brush in ditches/road shoulders	Annually or as needed

Climate Change Impacts

Climatologists predict that a warming climate will lead to more intense rainstorms, leading to higher peak run-off events. As a result, culverts and other drainage structures on road systems must be reevaluated for their capacity to withstand these higher-flow episodes. This may require the installation of larger culverts at stream crossings, and greater attention to waterbars, crowning, and rolling dips on improved forest roads.

Health and Resiliency

Overview

Forest health is an often used and misunderstood term, with at least two broad definitions. In terms of timber production, a healthy forest has vigorously-growing, commercially valuable trees that are free of insects, diseases and defects. However, this definition frames forest health solely in anthropogenic terms. Forest health can also be defined in ecological terms that consider how naturally occurring disturbance events shape the composition and character of a forest over time. Therefore, forests that contain dead, diseased, broken, old, and slow-growing trees of all species and ages, can also be considered healthy.

Forest resiliency means the capacity of a forest ecosystem to adapt to disturbances and retain its basic ecological functions and services over a specified timeframe and spatial scale. Averaged over large enough spatial and temporal scales, most forests are extremely resilient, but this may be inadequate for the landowner who wishes to maintain specific ecological function and services within a specific area over a specific timeframe. In these cases, forest resistance, the capacity for a forest to resist changes, may be a more appropriate metric.

Given these definitions, this plan considers a healthy forest one that is able to resist and/or rapidly recover from natural disturbances while maintaining ecosystem functions similar to historical reference conditions. Broadly, structurally complex stands which include a diverse arrangement of trees of different sizes and species occupying multiple canopy positions, have more options to adapt to disturbances and changing growing conditions. As an example, an insect infestation may target all trees of a certain species but leave other species untouched; a windstorm may blow down the overstory, but a healthy cohort of midstory trees is ready to replace them; or hotter and drier conditions may cause the decline of a drought-intolerant species, but more drought-resistant species are present to continue the stand trajectory.

During the field assessment process, the forest was evaluated for a wide-range of potential forest health and resiliency issues, including insect and fungal infestations, storm damage, invasive species, drought-stress and overcrowding. These findings are summarized in the sub-sections below and make specific recommendations in each property-specific section.

Invasive Species

Overview

Invasive plant species are becoming increasingly common in Northwest forests, and frequently enter forests following disturbances that expose soils such as fire, development, and forest management activities. Invasive species frequently outcompete their native counterparts, disturb ecosystems, and can preclude the establishment of young forests. Invasive species spread in many ways, including by animals who consume their seeds and by human beings who transport their seeds on clothing, boots or tires. These seeds can remain dormant for years, waiting for the ideal conditions to sprout and begin establishing in the understory. Species like Himalayan blackberry and scotch broom grow quickly, suppressing native vegetation and tree seedlings. Species like Japanese honeysuckle and English ivy can grow up existing trees and, if left unchecked, can eventually smother the tree under their weight.

Assessment

The forested properties in this assessment are, like many others, impacted by a variety of common invasive plant species. As is now increasingly common in Washington state, English holly was observed at low levels throughout the understory of almost all forested properties within this plan. Likewise, Scotch broom was also common at low, sporadic levels along forest edges and roadways throughout the watershed. English ivy and Japanese honeysuckle were observed at several localized sites that had a history of residential use but were not widespread. The most common invasive species was Himalayan blackberry, which was found consistently growing at low background levels around road edges and clearings across the watershed. Though invasive species were identified across all properties, they are generally not affecting forest development. In only a few notable cases, such as Agate Bay Preserve, Agate Creek Preserve, and Olsen Creek Preserve, blackberry infestations were extremely dense and extensive, preventing the establishment of new forest cover.

Recommendations

Since invasive species eradication is not a major objective of this planning effort, recommendations to manage invasive species will only be made if invasive species are precluding the establishment of new forests or affecting the growth and development of existing forests. Treatment of invasive plant species should adhere to the Whatcom County Noxious Weed Program guidelines, which follows the directives of the WA State Noxious Weed Law (Chapter 17.10 RCW) and for those plant species adopted to the WA State Noxious Weed List (WAC 16.750). Property-level management recommendations are made later in this plan as appropriate and the following best management practices will guide the management recommendations made throughout this plan.

Best Management Practices

Though effective management of invasive species typically requires species-specific treatment plans, the following best management practices are generally advised:

- Maintain closed forest canopies that provide sufficient shade to suppress shade intolerant invasive plants (e.g., scotch broom, Himalayan blackberry).
- Regularly monitor the forest to detect new species and populations and create a plan for controlling and/or eliminating them.
- As time and resources allow, remove and destroy invasive plants, being sure to dispose of plants appropriately.
- Prevent non-native plant introductions during forest management projects by requiring all heavy equipment be pressure-washed before it enters the property.

Overstocked Stands

Overview

Following a natural disturbance, pioneer tree species can colonize the disturbed soils at unsustainably high density. In time, competition-induced mortality will eventually thin the forest naturally, but this process can take several decades or more, causing stress among trees which contributes to their susceptibility to disease and disturbance. Highly overstocked stands may experience the following;

- **Competition Mortality**. Competition for sunlight forces individual trees to grow as quickly as possible to avoid being suppressed in the shade of their neighbors. Faster growing trees taking up dominant canopy positions and slower growing trees falling back into intermediate or suppressed canopy positions. In the dense canopy of an overstocked forest, many of these suppressed and intermediate trees will eventually die from competition-induced mortality.
- **Reduced Growth and Vigor**. In overstocked stands, the extreme competition for sunlight, soil nutrients, and especially soil moisture during long, dry summers, stresses trees to their maximum. Even if trees don't die from competition mortality their growth stagnates and under these stressful conditions, they are more susceptible to disease or insect infestations.
- **Stand instability.** High canopy competition causes all trees to sacrifice diameter growth in favor of height growth as they compete for limited sunlight. This results in tall, skinny trees with high "height-to-diameter-ratios", which are unstable and can blow over or break apart during storms.
- **Wildfire**. High density forests produce large quantities of dead wood, either as small trees killed by competition, blown over in windstorms, or lower branches jettisoned in the race to grow, all of which increase fire risk.

Assessment

Broadly many of the stands in this assessment are overstocked and/or growing at unsustainable densities. This includes naturally regenerated stands that are in the Stem Exclusion phase of development as well as plantations that have experienced extensive infilling by natural regenerating hemlock and alder, thus increasing their densities to unsustainable levels. In some cases, stocking exceeds 600 trees per acre and relative densities of 75 or even higher are fairly common. At these densities, competition-induced mortality is rampant, stands are increasingly unstable, and dead material is accumulating as potential wildfire fuel. This overstocking is addressed in greater detail by property later in this plan.

Recommendations

In order to accelerate development towards later seral conditions and/or meet other management objectives, overstocked stands can be thinned to a residual density that is appropriate for the size of the dominant cohort of trees and the conditions of the site. As previously discussed, thinning to a relative density of 35 is a reasonable stocking target. In highly overstocked stands it may take two entries over a 10-year period to safely reduce density and establish stability in the stand. Specific property-level management recommendations are made later in this plan as appropriate.

Drought Vulnerability

Overview

Drought vulnerability is an increasingly important consideration for forest management in the Pacific Northwest as climate change brings hotter, drier summers and more variable precipitation patterns. Tree species vary in their ability to withstand drought, and those differences can shape long-term forest health and resilience. Some drought-intolerant species, such as western hemlock, often establish successfully under current conditions but are less likely to persist on dry sites as water availability decreases. In contrast, Douglas-fir demonstrates relatively high drought tolerance due in part to its deeper rooting capacity. Drought impacts also vary across the landscape, with shallow soils and south-facing slopes especially prone to moisture stress compared to cooler, wetter microsites. In addition, extended drought can interact with other disturbances, reducing tree vigor and increasing susceptibility to insects, pathogens, and wildfire. Stand density also plays a role, as higher densities intensify competition for limited soil moisture and increase stress across all species.

Assessment

Though they receive substantial winter rainfall, the steep terrain and shallow, glacially-derived soils common in the Lake Whatcom watershed increase the likelihood of summertime drought stress under warmer future climates. Moisture availability is generally lower on upper slopes compared to lower slope positions, creating site conditions that will become more limiting as summers grow hotter and drier. Currently, some of these upper slope areas—particularly near the top of Lookout Mountain on the west side of the lake and near the top of the Smith Creek drainage on the east side—are dominated by western hemlock and Pacific silver fir. Both species are relatively drought-intolerant, and while they are persisting under present conditions, they may be poorly suited to these terrain positions in a warmer, drier climate. Of particular concern are south and western facing aspects along these upper ridgelines which have the lowest moisture potentials and will face the most drought stress.

Recommendations

Broadly, overstocked stands growing on steep, south or southwest facing slopes, on the ridgelines of the watershed are of particular concern for drought tolerance and resiliency. This plan recommends reducing, but not eliminating, the dominance of western hemlock and silver fir in favor of more drought-tolerant redcedar or Douglas-fir.

Property-level management recommendations are made later in this plan as appropriate and the following best management practices will guide the management recommendations made throughout this plan.

Best Management Practice

- Managing species that are well matched to the growing conditions will be important under a warmer, drier climate. On sites with shallow, well-drained soils, south-facing or upper slopes that naturally retain less moisture, prioritize more drought-tolerant species to reduce the risk of long-term decline and mortality. You can see a full list of species tolerances in Appendix III.
- Drought-intolerant species should not be eliminated entirely, as they provide ecological and structural diversity. Instead, their presence should be concentrated in local microsites where soil moisture is naturally higher—such as riparian zones, wet depressions, or north-facing slopes—that can act as refugia under drier future conditions.
- Thinning to reduce stand density can improve resilience by lowering competition for limited water resources. This practice can enable drought-intolerant species to persist on drier terrain, while also promoting overall stand vigor, reducing stress, and providing a buffer against uncertain climate trajectories.

Fungal and Parasitic Pathogens

Overview

Naturally occurring root and stem funguses, parasitic infestations, and other pathogens are important agents of stand diversification, however, when pathogens have an adverse effect on the desired condition of a forest, they may be perceived as a problem. Most pathogens are host-specific, reducing growth and, in many cases, eventually causing mortality in the infected tree. In doing so, they contribute snags and downed logs that provide important habitat and nutrient cycling functions, create openings in the forest for other species to become established, and overall contribute to a highly heterogeneous and uneven-aged stand composition.

Assessment

Broadly, the observed level of disease and fungal pathogens in this forest is not excessively impacting the forest's growth and productivity and is not a major concern at this time. Some localized pockets of laminated root-rot were observed sporadically across the forested properties in this assessment, but are operating within normal levels. Most notably, at Lookout Mountain, several large patches of hemlock dwarf mistletoe were observed. These observations are discussed in greater detail by property later in the plan.

Recommendations

Unless disease and fungal activity is excessively impacting the growth and objectives of a forest they should be accepted as part of the ecological processes of the forest and allowed to function as agents of stand diversification. Property-level management recommendations are made later in this plan as appropriate and the following best management practices will guide the management recommendations made throughout this plan.

Best Management Practices

Best management practices for containing larger outbreaks include:

- Large patch cuts that remove all trees out to 50ft from the last known infected tree in order to isolate the disease, but this produces large openings in the forest, leaves the land unproductive for many years, and does not work on all pathogens;
- In overstocked stands, thinning can sometimes reduce stress and improve the vigor of the remaining trees, thereby increasing resistance to the disease, but it will not alleviate the disease, only slow it;
- Since pathogens have preferred hosts, planting or promoting a mix of species, including non-susceptible tree species, will serve to gradually transition infected sites to a species composition that can tolerate the disease.

Insect Pests

Overview

Insects are an integral component of forest ecosystems and important agents of stand diversification, however, when insects have an adverse effect on the desired condition of a forest, they may be perceived as a problem. Most insects are host-specific, only targeting trees of a certain species and/or size. In the Pacific Northwest they commonly act on a small-scale to kill trees and thin out forests. Locally this creates snags and downed logs that provide important habitat and nutrient cycling functions. Across a larger area, these small-scale disturbances contribute to highly heterogeneous and uneven-aged forest structure. Notably, insect infestations are typically not the primary cause of decline in forest health, but rather a symptom of stress-causing conditions, such as overstocking or drought, that attract the insects or make their presence more impactful. Relative to timber production, severe insect infestations can severely decrease the growth rates of infected trees, and lead to excessive mortality that reduces future timber harvest volume.

Assessment

Low-level Douglas-fir beetle activity was observed sporadically in the older mixed-conifer forests and overstocked plantations around Lake Whatcom. Out of all the properties visited, only one, Brannian Creek Preserve, was suffering from a major insect infestation with elevated mortality levels that was dramatically impacting the forest’s growth and development. The majority of stands were only experiencing limited outbreaks that were serving to produce small canopy gaps consistent with management objectives. Additional details on observed insect infestations are available in the relevant property sections.

Recommendations

Unless insect activity is excessively impacting the growth and productivity of a forest they should be accepted as part of the ecological processes of the forest and allowed to function as agents of stand diversification. Property-level management recommendations are made later in this plan as appropriate and the following best management practices will guide the management recommendations made throughout this plan.

Best Management Practices

The presence of insects and their activities are usually kept in check in forests that are moderately stocked and include a diversity of tree species and ages. Some light infestations can be controlled or the impacts mitigated with silvicultural solutions, such as thinning or pruning. In severe cases, other options may be considered, including pheromone traps and insecticides, but a forest entomologist should be consulted to determine the appropriate course of action.

Chemical Use Guidelines

The application of any pesticide should be done in compliance with applicable county and city policies and adhere to the following guidelines:

- **Appropriate Use.** Noxious weeds and insects should be identified and treated in accordance with state noxious weed control board best management recommendations.
- **Judicious Usage.** Chemical pesticides, fungicides, and herbicides will be used only when and where research or empirical experience has demonstrated that less environmentally hazardous, non-chemical pest/disease management practices are ineffective.
- **Targeted Application.** The most environmentally safe and efficacious chemicals should be chosen, with an emphasis on narrowly targeted chemicals that minimize effects on non-target species.
- **Legal Application.** Chemicals should be applied in accordance with all state and federal pesticide laws, using the appropriate training and equipment to minimize health and environmental risks.
- **Protect Key Resources.** Chemicals should only be applied if they pose no threat to supplies of domestic water, aquatic and riparian habitats, or habitats of rare species.
- **Record Keeping.** Records should be kept of pest occurrences and an WSDA Pesticide Application Record should be filled out after each application which includes the method of application; type, brand, and concentration of pesticide; and area of coverage.
- **Adaptive Management.** Over time these records will help to identify the most effective control methods for this forest.

Climate Change Impacts

The effects of climate change on forest health are wide-ranging and, in some cases, currently unknown. The warmer and drier summer conditions forecasted under future climate scenarios will increase evapotranspiration and moisture competition among trees, resulting in a certain increase in competition-induced mortality in overcrowded stands. The resulting dead wood will increase forest fuel loadings and may locally increase the risk of wildfire severity. The ecosystem disruptions wrought by the changing climate may provide additional opportunities for the many exotic and weedy species already present in the landscape to colonize newly disturbed sites, leading to increased prevalence of invasive species.

Climate change may lead to increased drought stress and reduced resistance to fungal diseases and pathogens, as well as insect infestations. While the impact of climate change on many pathogens is unknown, specific effects of climate change on tree pathology may include:

- Root and canker diseases, such as Armillaria root disease and Cytospora canker, that are favored by warmer, drier summers may increase in presence and severity.
- Foliar and rust diseases favored by warmer and wetter winters, such as sudden oak death and Phytophthora root rot, may also increase.
- Swiss needle cast may also increase in areas where winter and spring temperatures are mild and where there is ample moisture.
- Warmer winters will likely lead to more insects successfully overwintering leading to potentially larger insect outbreaks in the future, though exactly which species will be favored under these changing conditions is currently unknown.

Wildlife and Fish Habitat

Overview

A well-managed forest can harbor numerous native animals, birds, reptiles, fish, and insects if sufficient habitat components are present to support each species' biological needs. These needs typically consist of some arrangement of food, water, and shelter or nesting sites. While some species may spend their entire lives in one habitat type, other species may make use of multiple habitats, such as nesting in a mature stand and foraging in a nearby meadow or shrubland.

Providing a diversity of habitats requires a diversity of forested areas in different stages of successional development. This can occur naturally through natural disturbance events, such as wildfire and windstorms, but also through appropriate disturbance-mimicking management practices, such as thinning or small-scale gap creation, which opens dense forest stands and introduces a new progression of vegetation types. Still, no single forest should be expected to provide the entire breadth of habitat diversity necessary to support all wildlife species in a particular region. Instead, managers should focus on actions that provide specific habitat features or functions that are missing or limited in the surrounding landscape.

An important habitat component often lacking in regional forests are large-diameter snags and decaying logs which provide important structures for cavity-dependent bird and small-mammal species, food sources for woodpeckers and other foragers, hunting perches for birds of prey, and slow-release nutrients for the forest in general. In the Pacific Northwest numerous species of birds, mammals, reptiles, and amphibians need snags for nesting, roosting, shelter, denning, and feeding. Snag recruitment occurs naturally as trees succumb to diseases or insects, or be subject to natural disturbance events such as wind and ice storms. While large-diameter snags can remain standing for decades, they eventually fall over, introducing large amounts of large woody debris on the forest floor. Large woody debris includes fallen trees and large branches as well as logs and large pieces of wood left from thinning and logging operations. This habitat component serves many of the same purposes as snags, providing many species with important food and shelter.

Assessment

The Lake Whatcom watershed supports an extraordinarily diverse array of habitat types. These include aquatic, such as the lake itself, the streams that feed it, and wetlands throughout the upland forest. The lake and streams directly support fish, amphibians, aquatic invertebrates, and waterfowl, while forested riparian areas along streams offer important cover, food resources, and movement corridors for many additional wildlife species. Upland habitats vary from moist, shaded lowland forests to drier slopes and ridgetops at higher elevations, creating a gradient of ecological niches. Steep slopes, rocky outcrops, and forest openings further diversify the landscape, allowing for species with differing habitat preferences to coexist within the watershed.

Small pockets of old-growth forest remain within the watershed, most notably in the Smith Creek drainage. These forests contain a diverse mix of tree sizes and multilayered canopies, along with large standing snags and fallen logs that support an array of plant and animal life. Large live trees provide substrate for epiphytes such as mosses and lichens, which in turn support invertebrate communities and are used by bird species, including the marbled murrelet, for nesting material. The structural complexity of old-growth stands creates abundant nesting, roosting, and foraging opportunities for birds, mammals, amphibians, and insects. Younger forests, which often develop after timber harvest or other disturbances, support dense growth of shrubs, grasses, and forbs. These areas provide critical forage for deer, small mammals, and insects, and offer thick cover that can protect wildlife from predators and harsh weather. Large portions of the watershed, particularly on Lookout Mountain, consist of second-growth forests in the Stem Exclusion forest stage. These stands, which regenerated at high densities following logging or other major disturbances, are dominated by uniform tree sizes and closed canopies, resulting in limited understory vegetation and relatively low habitat diversity. Although such forests currently provide less food and cover, they are gradually developing more wildlife features like large snags and downed logs as they age.

Streams and nearshore lake environments also provide habitat for cutthroat trout, sculpin, and other native fish species, as well as amphibians and aquatic invertebrates that form important links in the food web. Natural barriers, such as the series of waterfalls in Whatcom Falls Park, prevent fish from traveling between Bellingham Bay and Lake Whatcom, and no anadromous fish passage occurs within the streams of the watershed. Cutthroat trout and kokanee salmon are notable fish populations in the lake and streams. The kokanee salmon population, derived from sockeye salmon, completes its entire life cycle in freshwater, spawning in streams and gravel beds along the lakeshore. Several creeks, including Anderson, Olsen, and Austin are known to host spawning populations and a hatchery at Brannian creek has been operating for over 100 years, providing kokanee fry across the state and nation. While the lake supports healthy fish populations, the rapidly rising topography of the watershed means that most streams are rendered naturally impassable to fish only a few hundred feet uphill by physical barriers such as waterfalls and steep bedrock sections.

Several rare and sensitive species are likely present within the Lake Whatcom watershed, according to the Washington State Department of Fish and Wildlife (DFW) Priority Species Database. The marbled murrelet, listed as endangered in Washington, is known to nest in mature and old-growth conifer forests within approximately 50 miles of marine waters. These seabirds require large, moss-covered branches high in the canopy for nesting platforms, typically in trees over 200 years old. Townsend's big-eared bat, a candidate species in Washington, favors caves and large hollow trees for roosting. The little brown bat and Yuma myotis bat both utilize forest edges and riparian zones for foraging, feeding primarily on insects. Past observations of federally endangered gray wolves have been documented within the 23,000-acre township that contains part of the Lake Whatcom watershed on the east side of the lake, but the DFW does not consider there to be ongoing wolf presence in this local area.

Recommendations

Property-level management recommendations are made later in this plan as appropriate and the following best management practices will guide the management recommendations made throughout this plan.

Best Management Practices

Common management practices to optimize wildlife habitat and plant species diversity will include:

1. **Conserve and/or recruit snags and downed coarse woody debris.** A minimum of two snags and two downed logs per acre are recommended, with preference given to snags and logs over 12 inches DBH. Storm damaged trees will be retained to naturally recruit as snags. During commercial harvesting, unmerchantable trees can be girdled or cut at 20 feet above ground to manually create snags. Additionally, non-merchantable portions of logs can be scattered throughout the forest floor to augment coarse woody debris.

2. **Promote tree size and species diversity.** Manage for a 20/80 mix of hardwoods to conifer while planting and/or promoting the growth of more diverse conifer species. Retain trees over 36 inches DBH in most cases.

3. **Manage for variable densities and habitats.** Create and maintain spatial heterogeneity in order to ensure a mix of habitat niches exist - from open early seral shrublands to dark late-seral forests. Diverse and minimally disturbed vegetation along stream corridors provides wildlife corridors and additional habitat heterogeneity.
4. **Improve food and shelter availability.** Wildlife habitat piles and constructed logs can be created using woody material generated during thinning. A minimum of one habitat pile per five acres and two constructed logs per acre is recommended.

Climate Change Impacts

Changing climate conditions will likely impact many species, but predicting these changes is beyond the scope of this plan. Some species are likely to see reductions in available habitat and face increasing pressures on their survival, while other species may enjoy increases in foraging or nesting habitat and expanded ranges.

Wildfire Susceptibility

Overview

Fire has long shaped the forest dynamics of the Pacific Northwest. Given the great productivity of the region's forest, large quantities of biomass grow and die every year, leading to the buildup of vast quantities of burnable fuels. The high relative humidity of the region means these fuels remain damp and difficult to ignite most of the year. During summer, these fuels dry out and become increasingly combustible. Ignitions - either human or lighting caused - are common but the high humidity means most fires remain isolated surface fires consuming understory vegetation and intermittently torching a few trees. Occasionally, during periods of extreme fire weather, very dry air and fast winds can cause a normally benign surface fire to rapidly spread into running crown fires that blacken the forest for thousands of acres.

The impact of wildfires on forests is ranked by severity. Low-severity wildfires mostly stay on the surface, burning the understory but killing less than 25 percent of overstory trees. They scorch and char surface litter but leave the soil mostly intact. Conversely, high-severity wildfires typically involve both surface and crown fires, and over 75 percent of overstory trees are killed. The fire completely burns the understory, consuming small-diameter woody debris and surface organic matter, leaving behind exposed soils that are at increased risk of post-fire erosion during storm events. Mixed-severity wildfires fall in between and may involve a surface-fire with some limited torching of individual tree crowns or small groups of trees and soils may be partially burned and exposed. The natural fire regime in the Lake Whatcom watershed varies by vegetation zone previously described, but is generally thought to include smaller, moderate severity fires burning infrequently every 100 to 150 years punctuated by high-severity, stand-replacing fires every 300 to 1,000 years which reset the forest’s ecological succession.

Assessment

Wildfire susceptibility is a major concern in the Lake Whatcom watershed, where, depending on size and severity, future wildfires have the potential to reduce forest cover, increase erosion and reduce water quality, and potentially endanger the municipal drinking water supply for over 120,000 people. The impact of wildfires in the watershed is influenced by the following factors: probability of ignition, response effectiveness, and the size and severity of the burned area.

Most wildfires are started by human ignitions and the risk of ignition remains high in the watershed. This risk is particularly high at the northern end of the lake where residential development abuts many of the forested properties in this assessment. Here risk runs both ways - a wildfire could potentially enter a residential area causing destruction, or more likely, a structure fire or backyard burn could turn into a wildfire. Recreation is also a common cause of wildfire ignition, but since most recreation in the watershed is non-motorized and day-use only, these risks are reduced, but still remain substantial given the high amounts of recreational use.

Though wildfire ignitions do occur, In most scenarios, these fires can be quickly contained by modern firefighting, as long as extreme winds are not present. Firefighters can deploy aerial assets, such as helicopters and planes, to drop water on the advancing fire. In this scenario, Lake Whatcom itself is an enormous asset that helps reduce the spread of wildfires in the watershed. Though water drops are an important strategy, containment of any fire also requires ground crews to dig containment lines and mop up hot-spots. As a result, roads and trails that increase firefighting access throughout the forested properties of the lake help put out fires sooner. Though firefighting response can limit the size of burned areas, it has little impact on the burn severity.

Once ignited, a combination of weather and forest conditions determine if the fire will burn at low, mixed or high severity. Weather is one of the most important determinants of wildfire severity. When extremely dry and windy weather is present, low-severity surface fires are accelerated into high-severity running crown fires and firefighting effectiveness can be extremely limited. At Lake Whatcom these extreme summertime winds typically come from the northeast out of the Fraser River Valley and have the potential to funnel north to south down the lake. These winds hit as recently as the summer of 2021, but no fire was burning at that time and the watershed escaped unscathed.

After fire weather, fuel loading plays a major role in determining wildfire severity. The more surface fuels present, such as dead branches, needles, and downed logs, the hotter and more intense surface fires can burn. Ladder fuels, such as small trees, shrubs, or branches, increase the chance that a surface fire spreads to the upper canopy. Once in the canopy, a crown fire can spread rapidly in forests with dense, interlocking crowns.

Finally, individual tree qualities such as size and bark thickness, can influence fire severity. Bark thickness insulates the living tissue of a tree against the killing heat of forest fires. Larger trees typically have thicker bark and are able to resist wildfire better than small trees. And some species, such as Douglas-fir are famous for their extremely thick bark and can exhibit impressive fire scars, but emerge largely unscathed as long as crowns and living foliage are not burned. Deciduous hardwood trees with their large water-laden leaves and lower content of resin and pitch are less likely to burn in a fire and their low-density crowns can reduce the chance of a crown fire spreading.

A forest's susceptibility to high-severity wildfire shifts throughout its stages of development. Young, dense stands or plantations in the Stem Exclusion phase of development can be more susceptible to high-severity fire as they have high levels of fine woody debris, lack larger trees that are more resistant to fire, have low canopies and many potential ladder fuels. As stands exit Stem Exclusion and enter the Mature-I phase of stand development they are perhaps the least vulnerable to high-severity fire. The competition of Stem Exclusion has caused crowns to rise significantly and dead branches to drop, preventing ground fires from easily entering the canopy. In addition, much of the dead wood generated during Stem Exclusion has rotted away and lower densities reduce fuel loads. Without significant midstory trees, ladder fuels are mostly absent, and larger diameter trees are more resistant to the effects of fire. Susceptibility increases slightly during the Mature-II stage of development as the new cohort of trees entering the midstory now serves as potential ladder fuels, but the increasingly large diameter trees and lower canopy densities are increasingly resistant to fire. Though ladder fuels continue to increase as canopy complexity improves in older stands, the increasingly lower overstory densities, larger trees, and increased spatial variation present at this stage of development reduce fire susceptibility overall.

The recent Blue Canyon Fire in 2023 is a recent example of potential wildfire activity in the watershed, highlighting several of the factors discussed above. The fire was ignited in late-August by lightning and burned 30-40 acres in steep terrain on the southeast side of the lake. The firefighting response was rapid, involving helicopter water drops every five minutes and ground crews making short hikes to engage the fire from nearby road access points. This fire was notable for burning in an older, naturally-regenerated forest that had a high-level of species and age diversity prior to the fire. This forest is generally around 100 years old but contains a large component of much older Douglas-fir trees that are over 400 years old and have survived prior fire events. While the fire primarily operated as a surface-fire, ladder fuels did enable the fire to occasionally enter the canopy, scorching and killing some trees. Given the lower densities of this stand these crown fire events were not sustained and fire severity was low to moderate across much of the fire. While many smaller diameter trees died in this blaze, most of the medium to large-sized trees are still alive two years later and ground-cover has re-established in many areas. Though the fire burned at a lower severity, the site was not immune to erosion and some soil instability was observed on these steep slopes, likely causing sediment delivery into the lake.

Recommendations

Though fire risk can never be fully eliminated, and small, low-severity fires will likely occur again in the watershed over the coming decades, management should focus on reducing the forest's susceptibility to high-severity wildfire. Although management recommendations by stand type are made later in this document, thinning is the primary strategy for reducing stand densities and accelerating the transition to later stages of stand development that are more resistant to high-severity wildfire. Removing smaller, suppressed trees through thinning reduces the potential for a surface fire to reach the canopy by increasing the spacing between trees, creates larger, more vigorous, and fire-resistant trees, and raises the base of tree crowns, thus reducing ladder fuels. Lastly, maintaining at least 10-20 percent of the forest composition in deciduous hardwoods will help reduce fire risk and accelerate forest recovery following fire.

After thinning highly stocked stands, a large amount of woody debris may be left on the ground. This can elevate fire susceptibility in the short term, but as debris decays, the stand will experience lower, long-term susceptibility. Fine woody debris under 4 inches diameter is the most flammable, and slash mitigation efforts should therefore focus on this category of slash, as described above in the "Thinning Considerations" section. Because smaller diameter slash decay faster than larger diameters it is often prudent to schedule a thinning entry sooner than later, all other factors being equal.

Reducing the forest's susceptibility to fire deserves special attention in areas adjacent to residential development, along public roads, and in recreation zones, as these are the most likely to experience ignition in the coming years. In particular shaded fuel-breaks are recommended within 100 feet of publicly accessible roads and buildings. Access-restricted roads, such as gated forest roads, pose a low risk for fire ignition and do not require shaded fuel breaks. Given the restrictions on motorized use, fuel breaks are also not necessary along recreational trails, but may be prudent on highly accessible Class A trails (e.g. Hertz Trail) where past human-caused fire ignitions have been known to occur.

When properly installed, these fuel breaks increase the likelihood that fire remains on the ground (instead of spreading into the canopy), and slows the fire's spread until firefighting resources arrive. A modified[6] shaded fuel break can be created by implementing the following practices:

- Thin overstory trees to 80-110 TPA.
- Cut small-diameter and/or standing dead trees to eliminate ladder fuels, and prune overstory trees to a minimum of 15 feet high or three times the height of the dominant shrub layer to reduce the potential spread of surface fires into the canopy.
- Reduce shrubs to small clumps (e.g., 6-12 feet wide). Separate the clumps by a distance equal to the width of the clump.
- Remove all slash that is less than four inches in diameter from this zone. Slash can be chipped, or burned in small piles outside of fire season as air quality conditions allow.

Best Management Practices

Managing for lower forest densities, minimizing woody fuels after thinning, and maintaining fuel breaks are all strategies for mitigating the risk of fire. Additional best management practices include:

- Maintain seasonal forest road access that is sufficient to allow emergency vehicle access (e.g., 4-wheel drive trucks).

[6] Fuel breaks which include 10 feet of spacing between live crowns are the most effective at stopping the spread of crown fires, but this requires significant reduction in canopy density. The recommended "modified" fuel break achieves the objective of slowing fire spread and preventing surface fires from easily reaching the canopy, without excessively reducing canopy density.

- Minimize logging slash left in the woods and/or accelerate the decomposition of slash by getting as much ground contact as possible with woody debris.
- Over time, manage for older, larger diameter trees with thicker bark that are more fire resistant.
- Managing potential ladder fuels by reducing understory tree and shrub density and by pruning overstory trees (up to 15 feet or three times the height of the dominant shrub layer), in particular along edges of forest and/or forest roads.
- Utilize best available science and data sources to evaluate changes in wildfire risk, including, but not limited to wildfire risk maps published by the DNR.

Climate Change Impacts

Climate change is altering how forests currently burn, and forests are increasingly at risk of large-scale high-severity wildfire events. Fuel loading will increase as dry summer conditions increase mortality among drought-intolerant trees and within overstocked forests. In addition, the growth of shrubs and other understory vegetation may increase due to heavier spring rains, creating more biomass that is susceptible to drying out during prolonged summer droughts. The warmer, drier conditions associated with climate change will lead to vegetation drying out quicker and is likely to increase the length of the fire season. While the frequency of extremely fast and dry eastern wind events is likely to remain the same, when these wind events occur, they are likely to encounter more fire-prone conditions, leading to the likelihood that a small surface fire blows up into a major stand-replacing high-severity wildfire.

Carbon Storage

Overview

Forests are one of the largest natural stores of terrestrial carbon. Broadly the forest carbon cycle can be characterized as carbon gained through biomass growth and carbon lost through decay or combustion and conceptually organized into three pools: living biomass, naturally decaying biomass (i.e. dead wood), and wood products. Carbon is sequestered by growing trees and stored in their living biomass, which includes any living vegetation, such as trees, shrubs, branches, foliage, and bark, as well as below ground biomass such as roots. Eventually, natural processes or management interventions cause this biomass to die at which time it either begins to decay naturally, slowly releasing its carbon to the atmosphere, or is removed from the forest and processed into durable wood products.

Natural processes, such as dead branches, seasonal litterfall, and sporadic mortality resulting in standing snags and downed logs move carbon stored in living biomass into the dead wood pool. Likewise, management activities, such as pruning or tree felling, cause living tree biomass to die, and, if extracted from the forest, some of this biomass ends up in wood products. Over time, the carbon in the dead wood pool is released back to the atmosphere through decay, typically by fungi, or chemical combustion by fire. This rate of decay is dependent on species characteristics that give wood more or less microbial protection as well as diameter, with larger pieces of dead wood taking much longer to decay than small pieces. Likewise, carbon stored in wood products also decays, with different wood products decaying at different rates depending on how long they are used before being sent to the landfill or burned.

Forest management can improve carbon storage in several ways. Actions that improve site-productivity or growth - such as maintaining optimal densities, choosing long-lived and well-suited species, and improving soil moisture or nutrient availability - increase the rate of carbon sequestration into the living biomass pool. Similarly, interventions to increase stocking, reforest unforested areas, or shift stand composition from shorter-lived species to longer-lived species ensure the growing space is fully utilized to sequester and store carbon. When harvesting does occur, managers can design carbon-optimal harvests that produce a higher proportion of large, long-lived wood products, thus increasing storage in the wood products pool. Likewise, managers can employ logging methods that reduce soil disturbance and retain partial canopy cover, thus slowing the decay rate of carbon stored as dead biomass.

Assessment

Though a full carbon accounting is beyond the scope of this management plan, broad trends in carbon storage have been assessed across the forest properties in this plan. Carbon storage is particularly high on properties where historical disturbance patterns have resulted in the establishment of highly-stocked and long-lived conifer forests. Many of these forests are overstocked with slowing rates of carbon sequestration and growing rates of mortality, which in time will reduce carbon storage unless intervention occurs. A small minority of sites have been recently disturbed by clearcut logging or are being reforested following previous residential or agricultural uses and are often understocked but growing rapidly. These young forests will continue to sequester carbon for years to come, but are currently holding very little stored carbon. Finally, sites stocked with a high proportion of short-lived hardwoods are currently storing an average amount of carbon, but will see reductions in total carbon stored as these overstory trees die off in the coming years.

Recommendations

Though carbon storage is not a primary objective of this management plan, the following best management practices will generally improve carbon storage:

- **Plant Trees.** Reforestation of understocked or unforested areas is an excellent way to increase carbon storage.
- **Manage Competition.** Manage forest density to ensure optimal growth and reduce mortality, thus ensuring more carbon is sequestered into living biomass where it remains safe from decay. Periodic commercial thinning entries improve stand productivity and capture imminent mortality, storing carbon as durable wood products.
- **Consider Species Suitability and Longevity.** Manage forest composition to include a mixture of species well suited to current and future growing conditions and sufficiently long lived to continue growing and maintaining forest cover at the site for years to come.

- **Grow Bigger Trees.** Extending final harvest timing and growing older and larger trees give forests enough time to hit their maximum growth rates, leading to more carbon stored in living biomass. Likewise, larger trees, when harvested produce a higher proportion of durable wood products, locking away carbon for longer periods of time.
- **Grow Complex Forests.** Stands with multiple canopy layers and a mixture of species with complementary growth patterns, better utilizes the growing space, leading to greater total biomass accumulation and, over time, higher carbon storage per acre.

Climate Change Impacts

In general, forest productivity, and therefore carbon storage, is likely to decrease across the Pacific Northwest as higher temperatures increase evapotranspirative demand and reduce the effective growing season of many moisture-limited sites. Increased winter temperatures may increase background decomposition rates, especially on colder sites, potentially decreasing carbon storage potential. Species composition may change under future climate conditions, favoring species from growing zones further to the south, but long-lived and fast-growing conifers should maintain their dominance across the region and continue to store carbon at some of the highest rates in the world.

Cultural Resources

Overview

The Lake Whatcom watershed is a landscape rich with cultural significance for Indigenous peoples. Coast Salish peoples, including the Lummi, Nooksack, and Swinomish tribes have long stewarded this landscape, maintaining deep spiritual, cultural, and subsistence connections to the lands and waters of the region. Though the arrival of Euro-American settlers in the 19th century and subsequent development have transformed the region, tribes continue to steward the land and tribal cultural resources in the watershed remain an essential part of regional heritage and ongoing tribal identity.

Prior to European-American colonization, the Lake Whatcom area was home to a thriving network of villages and seasonal camps used by Coast Salish peoples for fishing, hunting, gathering, and ceremonial purposes. Archaeological evidence, oral histories, and traditional ecological knowledge indicate that the watershed supported a diverse array of plants, animals, and aquatic species that were managed and used in sustainable ways. The arrival of non-Indigenous settlers in the 19th century transformed the region and led to treaties signed in the 1850s, including the Treaty of Point Elliott, which reserved the tribes' rights to fish, hunt, and gather in traditional areas, rights which continue to be defended today through legal and political means.

Today, the lake and surrounding areas continue to contain culturally significant sites. These places are considered part of the tribal cultural landscape with important meaning that is passed down through generations. Many of these sites remain undocumented or are protected by tribal knowledge holders to preserve their integrity in the face of modern development[7]. Safeguarding the watershed's cultural resources is essential not only to honor this history but also to ensure a more inclusive and respectful future for all who depend on its waters and lands.

Other historic resources also exist in the Lake Whatcom Watershed, including historic mining and forestry, as well as early homesteads, logging camps, transportation corridors such as historic rail grades and wagon roads, and the remnants of company towns like the Blue Canyon Coal Mine settlement. These resources are recognized for their cultural significance and are subject to protection under local, state, and federal historic preservation laws.

Assessment

Though this management planning effort did not assess cultural resources present within the watershed, the region's history suggests sensitive cultural resources and sites exist in the watershed for both Tribal and other historic items. The Final Environmental Impact Statement for the 2004 Lake Whatcom Landscape Plan identified a wide range of sensitive cultural resources and sites exist in association with lands previously owned by the DNR.

The Forest Practices Act requires that cultural resources be protected during forest management activities. Actions identified in this management plan often trigger a regulatory nexus for Cultural Resource review, but some actions do not have a formal regulatory connection.

Recommendations

Whatcom County and the City of Bellingham are committed to working with tribes and others to ensure that historic and current cultural resources and uses of the Lake Whatcom watershed are conserved and improved. This plan recommends the following:

- For proposed forest management activities that do not trigger a regulatory nexus but that include ground disturbing activities, forest management activities should be screened for sensitivity to cultural resources, which may result in tribal review and consultation and require identification of a plan to ensure the protection of these resources.
- For proposed forest management activities that trigger a regulatory nexus, city and county staff will follow all existing state and federal rules, regulations, and agreements around the protection of historical, archaeological and cultural resources, including initiating required communications with tribal and state historic preservation officials.

[7] As documented in the Final Environmental Impact Statement for the 2004 Lake Whatcom Landscape Plan.

Recreation

Overview

As stated in the Introduction to this plan, while recreation is an important topic for the community, managing recreational access and development of trails or other amenities is not within the scope of this forest management planning effort. Instead, this plan seeks to ensure that management recommendations align with and support recreation goals that are appropriate for the County and City respectively.

The Lake Whatcom watershed is a treasured natural asset for outdoor recreation. Spanning over 14 miles in length and surrounded by forested hills and mountainous terrain, Lake Whatcom and its surrounding watershed offer a diverse array of recreational opportunities that attract residents and visitors alike. Over the years, the balance between recreation and environmental stewardship has become a central theme in managing this sensitive and heavily used watershed.

Lake Whatcom itself provides numerous water-based recreational activities, particularly during the warmer months. Boating, kayaking, paddleboarding, and swimming are among the most popular water-based activities. Public access is available at several points around the lake, including Bloedel Donovan Park, the Sudden Valley Marina, and on a more limited basis, at Lake Whatcom Park and South Fork Park. Anglers frequent the lake for its populations of kokanee salmon, cutthroat throat, and other species.

On land, the Lake Whatcom watershed supports a network of trails and parklands that appeal to hikers, mountain bikers, trail runners, and nature enthusiasts. The Lake Whatcom Park and Lookout Mountain Forest Preserve areas, managed by Whatcom County Parks, feature well-maintained trails that meander through old forests, wetlands, and along scenic ridgelines. Many of these trails make use of old road and railroad grades previously used for logging and mining activities and are maintained to high standards to prevent erosion.

In recent years, mountain biking has become a common recreational activity within the watershed. The North Beaver Preserve, owned by the City, includes a trail network that allows residents to access the bike trail system at Galbraith Mountain. The Lookout Mountain Forest Preserve, a portion of which is under joint ownership, contains both hiking and designated downhill bike trails and provides eastern access to Galbraith Mountain. These forestlands are managed for both recreation and conservation, with trail development carried out in coordination with local organizations such as the Whatcom Mountain Bike Coalition and the Washington Trails Association. City and County trail planning and construction incorporate sustainable design standards that emphasize long-term durability, minimized maintenance needs, appropriate trail siting, and design features that manage drainage, limit soil displacement, and maintain ecological integrity across the trail system.

Assessment

Recreational activities within the forested landscape of the Lake Whatcom watershed offer valuable community benefits, but also present several environmental challenges that require careful management to protect water quality and ecological health. Lake Whatcom is the drinking water source for over 120,000 people, and activities that disturb soil, increase runoff, or introduce invasive species can compromise this critical resource.

Recreational trail building and use within the watershed have the potential to cause soil erosion and sedimentation, particularly on steep slopes or where trail systems are poorly designed. Without proper management of trail design, construction, and maintenance, vegetation can be disturbed or compacted by repeated foot or bike traffic, leaving exposed soil that may wash into nearby streams and ultimately the lake, carrying sediment and phosphorus that degrade water quality. While many trails are formally maintained by groups such as the Whatcom Mountain Bike Coalition in coordination with land managers, unofficial trails can bypass environmental review, create unintended impacts to sensitive ecosystems, wetlands, and riparian zones, and increase the risk of injury to users and liability for underlying landowners. Unauthorized trail building has been a major occurrence in the Lookout Mountain Forest Preserve area and, to a lesser degree, at Lake Whatcom Park, Lake Geneva Preserve, and South Lake Whatcom Preserve. The extent of unauthorized trail building cannot be overstated, particularly at Lookout Mountain, where such activity has facilitated the descent of mountain bikes down nearly every major ridgeline in the forest.

The risk of human-caused wildfires also increases as recreational uses expand throughout the watershed, particularly during the dry summer months when vegetation is more flammable. Although recreation on publicly owned lands within the watershed are limited to nonmotorized activities only, unauthorized campfires, discarded cigarettes, or use of fireworks can ignite fires in forested areas that are often difficult to access for firefighting. With more people on trails and in remote parts of the watershed, the likelihood of accidental ignition rises, posing a serious threat to public safety, forest health, water quality, and critical infrastructure.

Recreation management in the watershed is increasingly a collaborative effort involving the City of Bellingham departments, Whatcom County departments, state agencies, and local nonprofit organizations. Policies such as dog waste bag stations, signage, waste disposal facilities, and restrictions on new development in sensitive areas help minimize human impact. Public outreach and stewardship programs encourage responsible recreation and volunteerism to maintain trails and restore habitats.

As previously referenced, the basis for reconveyance of Lookout Mountain Forest Preserve and Lake Whatcom Park was their need for public park purposes, and as such, maintaining appropriate recreation with these properties is a high priority for Whatcom County. To this end, in 2016 the County developed a recreational trail plan for Lookout Mountain and Lake Whatcom Park which identifies strategies for managing and developing recreational amenities on those properties. Conversely, the City of Bellingham has acquired the properties in this plan for preservation purposes, and recreation is not the primary goal. The City allows limited recreation consistent with the Lake Whatcom Property Acquisition Program land management policy.

Recommendations

Making recommendations about the management of recreational access or the development of recreational amenities is outside the scope of this plan. Current recreational development planning on County properties is addressed in the 2016 Lookout Mountain Forest Preserve & Lake Whatcom Park Recreational Trail Plan. For City properties, recreational planning is addressed on a case-by-case basis consistent with the Lake Whatcom Property Acquisition Program land management policy. As identified in these planning documents, when recreational trails are developed, they should employ best management practices to reduce erosion and sediment delivery to the watershed.

Active forest management involves practices such as thinning, invasive species control, and habitat restoration. These actions are designed to improve forest resilience, reduce wildfire risks, protect water quality and biodiversity, but can also improve aesthetics and recreational opportunities as well. Many forest management activities can be safely integrated with recreation, but some may require temporary access closures to ensure public safety. Communication and collaborative planning among land managers, recreation groups, and community stakeholders helps ensure successful outcomes for the forest and those who recreate within it. Some strategies include:

- Educational signage and outreach efforts can help users understand the benefits of forest management and why short-term inconveniences may be necessary for long-term forest health;
- Scheduling management activities to account for recreational use patterns;
- Aligning forest treatments to improve recreational experiences by opening or preserving scenic views;
- Capitalizing on heavy equipment used during some forest treatments to commission new trails or access points, repair damage to sanctioned trails, and restore or decommission unauthorized trail access.
- Limiting recreational activities in sensitive areas. For instance, temporary or permanent trails closures, and other measures may be necessary to prevent impacts to forest resources

Certain forest management activities will result in higher impacts to recreational infrastructure than others. Forest thinning that involves tree cutting and removal typically requires large equipment that may disrupt trails and render a site less suitable for near term recreational use. After thinning, recreational amenities should be assessed for impacts and slash and debris chipped or piled away from public areas to reduce fire risk and improve aesthetics. Any disturbed soils should be stabilized to prevent erosion. Trails impacted by logging can be restored, potentially needing regrading of surfaces and drainage repair. This is also an opportunity to choose which trails should remain on the landscape.

Unauthorized trails can be abandoned under logging debris and/or actively decommissioned. Finally, before public access is allowed, the site should be assessed for hazardous trees left by the thinning operation to ensure public safety.

SECTION 3: FOREST TYPES & MANAGEMENT RECOMMENDATIONS

Forest Types

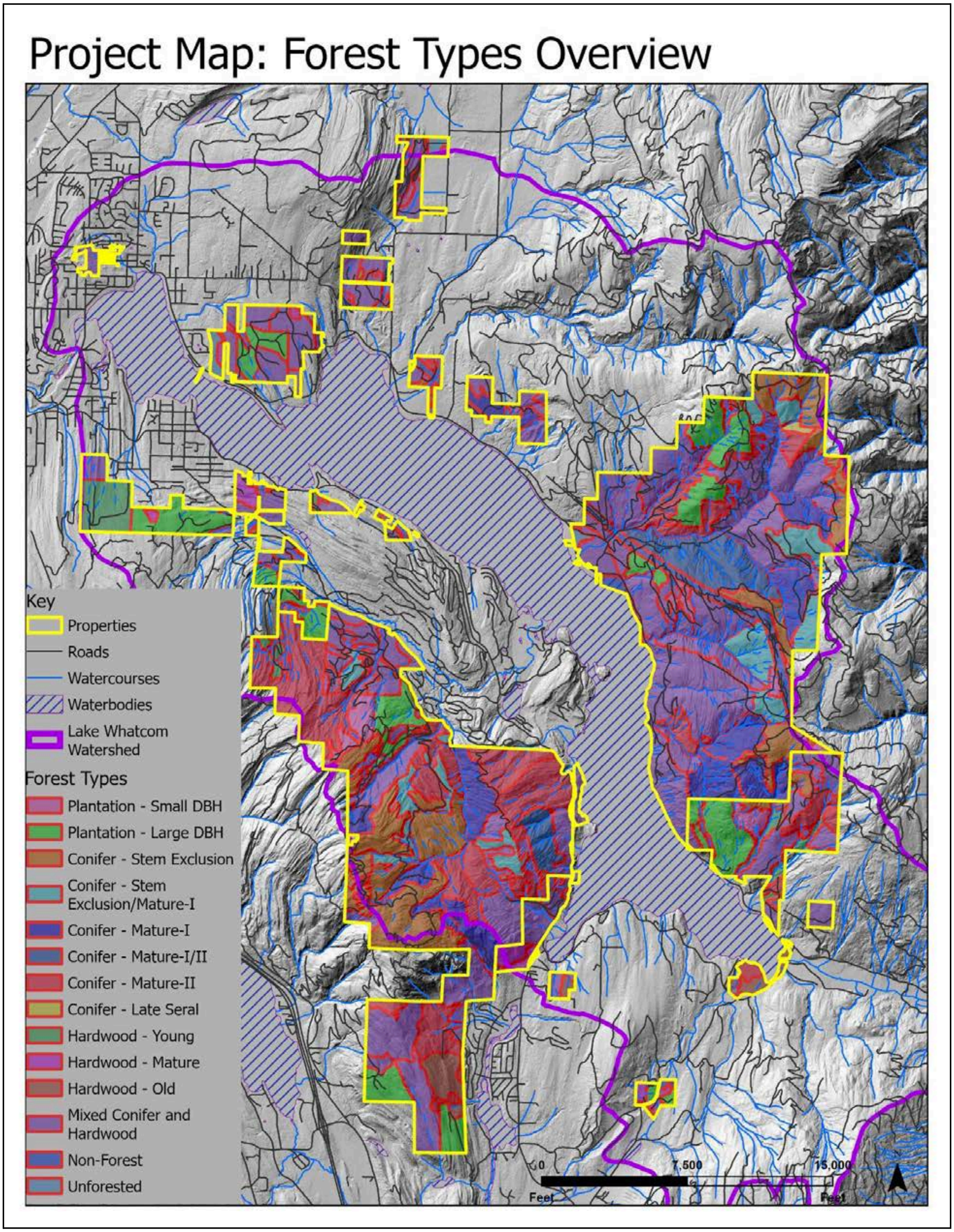
During the forest management planning process forest cover in the Lake Whatcom watershed was delineated into several broad forest types. Individual forest types are determined based on similarities in species composition, age, or other characteristics that forest stands share in common. When a forest type is compared to the objectives of the County and City, they are useful for determining where and when active management may be necessary to meet those objectives. Operationally, forest types are further delineated into *forest management units* for which specific management recommendations are then made. The forest types identified in the Lake Whatcom watershed are defined below, along with general management recommendations for each forest type. Management recommendations that are unique to individual forest management units are addressed in property-specific sections later in this plan.

Forest Types Summary Table

Forest Type	Acres	Proportion
Conifer Plantation - Small DBH	242	2%
Conifer Plantation - Large DBH	1,013	8%
Mixed Conifer - Stem Exclusion	1,402	11%
Mixed Conifer - Stem Exclusion/Mature-I	446	4%
Mixed Conifer - Mature-I	1,091	9%
Mixed Conifer - Mature-I/Mature-II	438	4%
Mixed Conifer - Mature-II	1,745	14%
Mixed Conifer - Late Seral	17	0%
Mixed Conifer and Hardwood	4,475	37%
Mixed Hardwood - Young	235	2%
Mixed Hardwood - Mature	95	1%
Mixed Hardwood - Old	168	1%
Unforested	44	0%
Non-Forest (Powerline, Water)	228	2%
Pending	565	5%
Total	**12,205**	**100%**

Acknowledging that resources are limited, this plan proposes prioritizing management activities into four categories from high priority (level 1) to low priority (level 4) based on biological development and management priorities.

Forest Types Overview Map



Mixed Conifer

Overview

Stands dominated by multiple conifer species are the most common forest type in the Lake Whatcom watershed. These stands naturally regenerated following logging over the last 125 years, although several stands appear to have originated following wildfires within the last 200 years or more. The defining characteristic of these stands is an overstory dominated by a variety of conifer tree species, chiefly Douglas-fir, western hemlock and western redcedar. Other conifer species that occur less abundantly include silver fir, white pine, Sitka spruce, and grand fir. This forest type does not include conifer plantations which are addressed separately.

Assessment

The natural lifespan of the conifer species that occupy the Lake Whatcom watershed can be quite long, with all species capable of reaching 300 years old or more. Although drought tolerance varies significantly by species, conifer needles are an adaptation to growing in drier climates, and Douglas-fir in particular, is well suited to the droughty soils that occur across much of the watershed. Because many of the forests in the watershed regenerated naturally and have been growing for decades with little to no active management, they generally occur at high densities and exhibit many signs of competition including reduced live crown ratios, high height to diameter ratios, significant mortality across suppressed and intermediate trees, limited understory plant diversity, and limited regeneration of new cohorts of understory trees.

Mixed conifer stands are further delineated into the following developmental stages:

Stem Exclusion

Stands in the Stem Exclusion phase are growing at high densities that result in a high degree of competition between the individual trees. These stands tend to be structurally simple in that they are dominated by a single species (e.g. Douglas-fir) and age of trees, exhibit limited diameter ranges, and have almost no understory or regeneration of new seedlings. These stands are dominated by a single canopy stratum, and any trees occurring in the midstory are either extremely shade tolerant (e.g. western hemlock) or are suppressed trees of the same age cohort as the canopy trees.

Without understory vegetation or large diameter snags and downed wood, these stands provide considerably less habitat opportunities than more structurally complex stands. When these stands are in a young phase of growth they use more water than older stands, thereby reducing downstream water availability. As the trees compete, lower branches die off, leaving behind a ladder of small fuels which, coupled with high initial stocking densities, and lower canopies can increase susceptibility to wildfire. These homogenous stands are also more susceptible to disease outbreak, and are generally less resilient to disturbance than more complex, multi-species and multi-aged stands.

Mature-I

As stands self-thin they gradually leave the Stem Exclusion phase and enter the first stage of maturity, which is often characterized by an initiation of tree regeneration in the understory. Though overall stand density begins to decrease, density still remains sufficiently high to continue to drive competition-induced mortality. Stand structure remains very simple, the overstory canopy remains homogenous, and species diversity is low as the dense canopy only allows for the regeneration of the most shade tolerant understory species. Although the stand begins to recruit an increasing volume of small diameter snags and downed logs, it remains lacking in large diameter dead wood that provides critical habitat for many wildlife species. Although lower densities reduce drought stress, the homogenous stand may remain susceptible to disease and insect outbreaks, as well as high wind events.

This stand type has a relatively low susceptibility to fire as compared to other stand types given the lack of ladder fuels (e.g. dead lower branches, understory trees and shrubs, etc.), and dominance by thick-barked Douglas-fir.

Mature-II

The Mature-II stage of development is characterized by increasing structural complexity as continued density-dependent competition further thins the stand, thereby opening the canopy and supporting the presence of shade-tolerant trees in the midstory. Understory plants and shrubs are present, and canopy gaps are beginning to emerge and be filled by new trees, thereby increasing species diversity. As varying natural mortality agents, such as disease, kill older trees, larger diameter snags and downed logs are recruited into the stand and wildlife habitat is broadly improved, with multiple habitat niches emerging. Compared to Mature-I, midstory trees in Mature-II stands can serve as ladder fuels, thereby increasing the potential for fire to reach the canopy of the forest. However, larger diameter and thicker barked trees are also less susceptible to lower intensity fires.

Older Stands

Older stands are characterized by increasing levels of vertical and horizontal heterogeneity as localized disturbance agents continue creating gaps and new shade-tolerant trees grow into upper canopy positions. The original pioneer cohort has now grown very large and tall, creating extensive nesting platforms, and in death, large diameter standing snags and downed wood habitat. The multi-aged and multi-species stand is very resilient to pest and disease outbreaks as well as changing climate conditions. Though ladder fuels are prevalent, lower densities and large diameters reduce the forest’s susceptibility to high severity wildfire.

Management Recommendations

The target density for dominant trees within mixed conifer stands is 80-110 TPA. At this density natural tree regeneration should occur throughout the understory contributing new cohorts and species of trees to the stand. Natural mortality agents will continue to reduce and adjust canopy density and species composition, with understory cohorts gradually replacing canopy trees.

Ecologically-based thinning is recommended for mixed conifer stands that exceed this density. The purpose of thinning is to reduce competition in the overstory, create the opportunity for natural understory tree regeneration, accelerate the development of stand complexity, and increase resilience to drought and wildfire. Building off the thinning considerations previously discussed, a sequence of thinning entries and associated density targets are defined below.

Stem Exclusion

Mixed conifer stands that exceed 200 TPA tend to be in the Stem Exclusion phase of development. Because this growth phase meets few management objectives and can last for decades to centuries, thinning is an effective tool for accelerating stand development towards later-seral conditions. A sequence of variable density thinning entries are recommended aimed at reducing competition and increasing species diversity and structural complexity. Thinning entries should be spaced at least 10 years apart in order to minimize soil compaction and to allow the stand to redevelop wind firmness.

Stands Exceeding 340 TPA

Mixed conifer stands with extremely high densities that exceed 340 TPA should be thinned from below with no more than 50 percent of the individual trees cut. Thinning should focus on suppressed, intermediate, and codominant trees. Given the very high stocking density, this is a high priority (level 1) management recommendation.

Stands Between 200-340 TPA

Mixed conifer stands with 200-340 TPA should be thinned to 140-170 TPA. If this is the first thinning of a stand, thinning should be from below, prioritizing the removal of suppressed, intermediate, and codominant trees. If this is the second thinning of the stand, thinning can occur across diameters and species. Dominant trees should only be removed where they will release vigorously growing understory trees. Given the high stocking density, this is a moderately-high priority (level 2) management recommendation.

Stands Less Than 200 TPA

Mixed conifer stands with less than 200 TPA in the overstory should be assessed for the following conditions to determine the need for thinning:

1. Are there a minimum of 50 TPA naturally regenerating seedlings or saplings throughout the understory of a species that is suitable for the site?
2. Does the overstory contain at least 2-3 species of conifers and/or hardwoods?

If either condition is not met, the stand should be thinned to 80-110 TPA. Thinning can occur across both diameters and species of trees to enhance uneven-aged structural complexity and biological diversity. No more than 30 - 40 percent of dominant overstory trees should be removed in order to protect the wind firmness of the stand. From this residual density the stand can be allowed to develop under normal succession pathways. Natural disturbance agents (e.g. disease, pests, storms) will continue to induce mortality amongst overstory trees, thereby further reducing canopy density, supporting regeneration of new cohorts in the understory, and adding to dead wood structures in the stand. Given the moderate stocking density, this is a moderate priority (level 3) management recommendation.

Mature-I

Though this phase of development meets more management objectives, these early maturation stands may still benefit from thinning in order to further reduce density, shift species composition and accelerate the transition towards later-seral conditions. Because this stand type has already begun to exhibit an understory, the priority of action is lower across all recommendations.

<u>Stands Exceeding 200 TPA</u>

Mature-I mixed conifer stands that exceed 200 TPA should be thinned to 140-170 TPA. If this is the first thinning of a stand, thinning should be from below, prioritizing the removal of suppressed, intermediate, and codominant trees. If this is the second thinning of the stand, thinning can occur across diameters and species. Dominant trees should only be removed where they will release vigorously growing understory trees. Given the moderately-high stocking density and initial understory regeneration, this is a moderate priority (level 3) management recommendation.

<u>Stands Less Than 200 TPA</u>

Mixed conifer stands with less than 200 TPA in the overstory should be assessed for the following conditions to determine the need for thinning:

1. Are there a minimum of 50 TPA naturally regenerating seedlings or saplings throughout the understory of a species that is suitable for the site?
2. Does the overstory contain at least 2-3 species of conifers and/or hardwoods?

If either condition is not met, the stand should be thinned to 80-110 TPA. Thinning can occur across both diameters and species of trees to enhance uneven-aged structural complexity and biological diversity. No more than 30 - 40 percent of dominant overstory trees should be removed in order to protect the wind firmness of the stand. From this residual density the stand can be allowed to develop under normal succession pathways. Natural disturbance agents (e.g. disease, pests, storms) will continue to induce mortality amongst overstory trees, thereby further reducing canopy density, supporting regeneration of new cohorts in the understory, and adding to dead wood structures in the stand. Given the moderate stocking density and initial understory regeneration, this is a low priority (level 4) management recommendation.

Mature-II

This phase of development meets a wide range of management objectives and in most cases requires little to no management intervention. In some cases, snag creation or opportunistic light thinning in stands adjacent to other thinning projects can be used to fine-tune stand composition, but these are low priority interventions and any recommendations will be custom-tailored to the stand conditions.

Older Stands

This phase of development meets most management objectives and no management is recommended in these stands.

Mixed Hardwoods

Overview

Hardwood-dominant stands occur across the Lake Whatcom basin. These stands naturally regenerated following clearcut harvests of the previous forest. Many of these stands are quite young, having originated after recent disturbances, while other or older stands, established after initial logging or land clearing 75-125 years ago. The defining characteristic of these stands is an overstory dominated by hardwood species, such as red alder, bigleaf maple, black cottonwood, bitter cherry and paper birch. Conifer trees are notably absent in these stands, often as a result of rapid, post-disturbance site colonization by hardwoods, but also because many of these stands occur in riparian and wetland floodplains where high water tables favor water-tolerant species such as cottonwood and red alder. Because of the deciduous canopy, more light is able to reach the forest floor, and strong shrub understories are common, even in highly stocked stands.

With the exception of bigleaf maple, which is moderately long-lived and can reach 200-300 years of age, the other hardwood species have relatively short natural lifespans. Bitter cherry has the shortest lifespan, frequently dying off around 30-40 years of age. Red alder and paper birch are considered quite old at 80 years of age and rarely live beyond 100 years old. Cottonwood lives a little longer, but typically dies by the time it reaches 150 years. As a result, many older hardwood-dominant forests are well on their way to reaching later stages of stand development, including pioneer cohort loss, where the early pioneer species die off and are replaced by new cohorts of trees.

Assessment

In general, hardwood trees have lower fire risk as they contain more water in their foliage, have a lower content of flammable resins than conifers, and their lower density canopies rarely support crown fires. Drought tolerance varies by species, but given the large foliage of broadleaf trees, is lower than most conifers. Importantly, most hardwood species have some capacity to establish sprouts from their stumps in the event of a catastrophic windstorm or wildfire, thus providing additional resiliency. Most notably, the aforementioned shrub layer common to these stands can preclude establishment of new tree species, which, coupled with their relatively short lifespans, means these forests can become dominated by persistent shrubs for many decades to come. Otherwise, this strong shrub layer provides excellent wildlife forage for many species as well as cultural uses, such as berry picking.

Management Recommendations

The major concern for mixed hardwood stands in the Lake Whatcom watershed is ensuring that a smooth transition is made between relatively short-lived hardwood trees and longer-lived conifers, thus ensuring that the stand remains forested into the future. As a result, a common management recommendation is to underplant these forests with shade-tolerant conifers. Any time planting occurs in established shrub layers, care is needed to prepare planting spots and maintain the plantation until the trees reach a free to grow height above the existing shrub canopy. See the section on Planting Considerations for additional information on successful planting.

In some circumstances, overstory densities should also be reduced to decrease competition and improve the growing conditions for understory trees. Given the relatively shorter lifespans of these forests as well as their multiple benefits, including critical wildlife habitat and increased fire resistance, actively managing to accelerate stand development stages, as is recommended for mixed conifer stands, is not recommended and instead these stands should be allowed to naturally develop.

Mixed hardwood stands and their management recommendations are delineated into the following categories:

Riparian Sites

If a site is very wet, commonly with a perched winter water table, it may simply be too wet for many conifer species to establish. In these cases, the stand is likely to remain a hardwood-dominated forest, and management interventions should focus on monitoring and invasive species management as needed to ensure a healthy forest.

Maple Stands

Mixed hardwood stands with more than 50 percent bigleaf maple by overall species may require some additional consideration. Since maples are moderately long-lived, they provide a much longer window under which a new cohort of trees can establish, and they ensure that the stand retains some hardwood component for years to come. Given these considerations, maples are a preferred species to retain during thinning entries in mixed hardwood stands. They are also difficult to successfully thin once over 5-10 inches DBH, as they sprout prodigiously from cut stumps and almost always produce new coppiced stems that quickly fill the growing space after thinning.

As a result, if a young stand contains more maple than desired, thinning is recommended before maples get too large to easily manage with a moderately-high (level 2) priority. Once maple exceeds ten inches in diameter, thinning efforts should be focused on other short-lived hardwoods within the stand and preferentially retaining maple in most cases. In completely maple-dominated forests, monitoring stand development is recommended, and underplanting with shade-tolerant conifers may occur once density has been sufficiently reduced through natural mortality of the overstory trees.

Young Stands

Young hardwood stands, typically in the Stem Exclusion phase or younger, are often growing at high natural densities that preclude the establishment of a new cohort of trees. There are two management options to consider in this scenario:

1. **Pre-commercial thinning and underplanting with shade-tolerant conifers** is a good choice for hardwood stands that exceed 340 TPA and average less than 10 inches DBH where ensuring the future establishment of conifer trees is a priority. In addition, pre-commercial thinning when trees are small can be cheaper than non-commercial thinning at a later date.
2. **Allowing stand development to progress naturally and monitoring natural tree regeneration** is a good choice when resources are limited or the stand is growing at moderate densities. In many cases, simply waiting will allow natural processes sufficient time to reduce stand density and establish conifers on the site.

<u>Pre-Commercial Thinning & Underplanting</u>

Pre-commercial thinning of early seral hardwoods should target residual densities of 150-200 TPA in order to reduce the growing space sufficiently for successful underplanting efforts. Thinning should be from below, removing small, suppressed and damaged trees in order to release and retain the most vigorous, dominant, and highest-quality trees of each species that are suitable for the site. All mixed hardwood species can be targeted for removal, but retain all conifers and target at least 10-20 percent of the retained species composition in bigleaf maple if present. Thinning before the stand grows into a larger diameter class is a moderately-high priority (level 2) management recommendation.

Following thinning, underplant the site with a mixture of suitable conifer species. Prepare planting spots in the shrub layer and plant 150 TPA under the existing canopy and up to 250 TPA into more open canopy gaps. After planting, manage competing vegetation until the trees are taller than the shrub layer.

Mature Stands

If a forest is older, such as the early stages of maturation, and still doesn't have new tree establishment, then management may be necessary to open the canopy, remove the persistent shrub layer, and establish conifer trees through manual planting. Since there is a long window to execute this recommendation, it is a low priority (level 4) management recommendation.

<u>Thinning & Underplanting</u>

If mature hardwood stands exceed 200 TPA then should be thinned to a residual density of 150-200 TPA. Thinning can either be done uniformly from below or utilize variable density thinning to create a spatially-variable patchwork of densities, including heavily thinned areas that are more suitable for the establishment of less shade tolerant species. All mixed hardwood species can be targeted for removal, but as previously mentioned, thinning of bigleaf maple over 10 inches can prove to be ineffective in the long run without subsequent herbicide treatment of cut stumps. Retain all conifers and target at least 20 percent of the retained species composition in bigleaf maple if present.

Following thinning, underplant the site with a mixture of suitable conifer species. Prepare planting spots in the shrub layer and plant around 150 TPA under the existing canopy and up to 250 TPA into more open canopy gaps. After planting, manage competing vegetation until the trees are taller than the shrub layer.

Older Stands

Older hardwood stands tend to diminish in density as the pioneer cohort dies off, and no thinning is therefore typically needed.

Underplanting

Underplant these stands with a mixture of suitable conifer species. Prepare planting spots in the shrub layer and plant 150 TPA under the existing canopy and up to 250 TPA in more open canopy gaps which can support less shade-tolerant species. After planting, manage competing vegetation until the trees are taller than the shrub layer. Underplanting before forest cover is lost is a high priority (level 1) management recommendation.

Mixed Conifer and Hardwood

Overview

Stands with overstories composed of both conifers and hardwoods are also present across the Lake Whatcom watershed. Depending on their species mix, they may share characteristics of either hardwood-dominated or conifer-dominated stands as previously described.

Assessment

Broadly, these stands are some of the most resilient forests on the landscape. The hardwood component of these stands reduces fire risk and allows for healthy understory vegetation, providing wildlife habitat. The conifer component increases the stand's longevity and, depending on the species, also its drought tolerance, while typically preventing the establishment of extensive shrub layers that can be common in hardwood-only forests. Because of the increased species diversity, these stands have a high resiliency to disturbances and are at a greatly reduced risk of insect or disease outbreaks. Given their species diversity, these stands have the potential to exhibit high structural complexity, though in younger stages of development, this complexity may not have developed yet.

Management Recommendations

Depending on the ratio of hardwoods to conifers, these stands may be managed on a conifer trajectory (if the stand is >75% conifer) or on a hardwood trajectory (if the stand is >75% hardwood). Management recommendations for these stands are site and stand specific, and typically focus on addressing forest health concerns, such as overstocking, invasive species, and species suitability. Some species, while growing on a site at the moment, may be deemed poorly suited to future growing conditions and action - such as selective cutting and underplanting of more tolerant species - can be taken to mitigate this risk. Management may also be useful, but not necessary in order to introduce more complexity into a young stand - such as thinning from above to remove overstory trees and recruit midstory trees into the upper canopy.

In the Lake Whatcom watershed, active management within these stands is not recommended except for occasional forest health concerns. Property-specific recommendations will be made as appropriate.

Conifer Plantations

Overview

Conifer plantations are the most common form of silviculture in the Pacific Northwest and excel at producing the most timber value per acre in the shortest time. The conventional management of these plantations generally starts with site preparation to remove competing vegetation, followed by planting at initially high stocking densities of 350-400 TPA. Douglas-fir is by far the most common species planted, though occasionally hemlock, noble fir, or cedar are also planted given site conditions or management objectives. Natural infilling by hemlock and hardwoods, such as red alder and cottonwood, is common and, without management, stocking can rise above target densities. After planting, the stand is commonly pre-commercially thinned at a young age to reduce density below 300 TPA (or lower depending on future thinning plans). After that, the forest is typically left to grow unimpeded before a final harvest between 35-50 years of age.

Assessment

Given that these stands were designed for the single objective of timber production, they fall short of the multiple benefits that diverse forests can provide. Since plantations never leave the Stem Exclusion stage of development, they lack major components of stand complexity, such as multiple canopy layers, multiple species, or a mixture of age and size classes. Without understory vegetation or large-diameter snags and downed wood, these stands provide habitat to only a limited number of species. In addition, these fast-growing young stands also use more water per acre and can reduce water availability in their local watershed compared to older, more complex stands. As the trees compete, lower branches die off, leaving behind a ladder of fine fuels which, coupled with high initial stocking densities, make these stands more likely to burn at high severity than other more structurally complex forests. Finally, because plantations consist of single species growing at around the same diameter in a single canopy layer, these stands are more susceptible to disease outbreaks. Additionally, though Douglas-fir is quite drought-tolerant, the high stocking levels commonly present in these stands can lead to drought stress on water-poor sites and may be more of a concern in warmer and drier future climates.

Management Recommendations

Almost all plantations are good candidates for periodic thinning designed to reduce density, accelerate the development of stand complexity, increase resilience to drought, and improve fire resistance. Building off the thinning considerations previously discussed, a sequence of thinning entries and associated density targets are identified below. Given high-levels of homogeneity and the likelihood that multiple entries are needed to restore forest function, thinning plantations is one of the highest priority management recommendations made in this plan.

Small Diameter

Stands Exceeding 340 TPA

Plantations with trees less than 10 inches DBH that exceed 340 TPA should be pre-commercially thinned to 250-300 TPA after canopy closure. The lower target density is preferable in most cases as it provides more growing space and buys time before the next thinning entry is required. The retained trees will grow rapidly and, depending on site-class, the now larger-diameter stand will require additional thinning in 10-20 years. Given the high stocking density and plantation structure, this is a high priority (level 1) management recommendation.

Large Diameter

Stands Exceeding 340 TPA

Plantations with trees larger than 10 inches DBH that exceed 340 TPA should be commercially or noncommercially thinned to 140-170 TPA. The lower target density is preferable in most cases as it provides more growing space and buys time before the next thinning entry is required. The retained trees will grow rapidly and, depending on site-class, the now larger-diameter stand will require additional thinning in 10-20 years. Given the high stocking density and plantation structure, this is a high priority (level 1) management recommendation.

Stands Between 200-340 TPA

Plantations with 200-340 TPA should be thinned to a residual density of 140-170 TPA. Wait at least 10 years after thinning for stand conditions to stabilize before thinning again. Given the moderately-high stocking density and plantation structure, this remains a high priority (level 1) management recommendation.

Stands Less Than 200 TPA

Plantations with less than 200 TPA should be thinned to a final residual density of 80-110 TPA. This "final target" is an excellent density to achieve the management objectives articulated in this plan. Regeneration is almost certain to occur and new seedlings and midstory trees will grow quickly at these reduced density levels, quickly increasing stand complexity and resiliency. Given the moderate stocking density and plantation structure, this is a moderately-high priority (level 2) management recommendation.

Unforested

Overview

After a disturbance, forests can fail to naturally regenerate and establish on the newly disturbed site for several reasons. In the Lake Whatcom watershed, these unforested areas are common on old residential homesites recently purchased by the City of Bellingham, where previously cleared land has been abandoned. It is also a common condition in logged areas where legally required reforestation was not undertaken or where a plantation was started, but ultimately failed to establish. Today these areas are typically dominated by grass and shrub layers and frequently colonized by invasive species that make the regeneration of a future forest difficult.

Assessment

Given the broad objective to maintain forest cover, these unforested stands are not meeting management objectives.

Management Recommendations

In these situations, reforestation is recommended using the previously discussed sequence of site-preparation, manual planting, and post-planting vegetation management. Since these are open areas, planting should target densities between 250-300 TPA, including a mixture of species well-suited to the site. See the earlier discussion on Planting Considerations for additional details.

Management Summary by Forest Type

Acknowledging that resources are limited, this plan proposes prioritizing management activities into four categories from high priority (level 1) to low priority (level 4) based on biological development and management priorities. A summary of management recommendations by stand type is given below.

Management Summary Table

Mixed Conifers			
Stand Type	**Characteristics**	**Recommendations**	**Priority**
Stem Exclusion	High-density, simple structure, limited understory, high wildfire and disease risk.	If >340 TPA thin by removing up to 50% of trees.	1
		If 200-340 TPA, thin to 140-170 TPA	2
		If <200 TPA, thin to 80-110 TPA*	3
Mature-I	Densities decreasing, some regeneration, simple structure, few large snags.	If 200-340 TPA thin to 140-170 TPA	3
		If <200 TPA, thin to 80-110 TPA*	4
Mature-II	Increased structural complexity, presence of midstory, gaps forming, more habitat.	Minimal management; allow natural progression; consider low-impact thinning if necessary.	4
Older Stands	Multi-aged, resilient, large dead wood, complex habitat.	No active management recommended.	NA
*Thinning to 80-110 TPA is not necessary if both of the following conditions are present: 1) minimum of 50 TPA naturally regenerating seedlings / saplings suitable to the site and 2) the overstory contains at least 2-3 species of conifers and/or hardwoods.			
Mixed Hardwoods			
Stand Type	**Characteristics**	**Recommendations**	**Priority**
Hardwoods & Conifer Regen	>50 TPA conifer regen in understory.	No Management	NA
Older Stands	Vigor and density are declining due to age. No conifer regen.	Underplant with shade tolerant conifers	1
Young Stands	<10” DBH and >340 TPA. No conifer regen.	PCT to 150-200 TPA. Underplant with shade tolerant conifers.	2
Maple	>50% stocking in maple.	Thin if maple is <10” DBH. Underplant with shade	2

Dominant	No conifer regen.	tolerant conifers.	
Mature Stands	Mixed mature hardwoods. No conifer regen.	If >200 TPA thin to 150-200 TPA. Underplant with shade tolerant conifers.	3
Riparian	Adjacent to streams and wetlands. No conifer regen.	No management. Monitor for invasive plant species. Consider underplanting with shade tolerant conifers.	4
Mixed Conifers and Hardwoods			
Stand Type	**Characteristics**	**Recommendations**	**Priority**
Mixed Conifer and Hardwood	Mixed species stands of varying densities and composition.	In more than 75% conifer, follow mixed conifer management recommendations. If more than 75% hardwood, follow mixed hardwood management recommendations. Otherwise, active management is not recommended except for forest health concerns.	NA
Conifer Plantations			
Stand Type	**Characteristics**	**Recommendations**	**Priority**
Smaller Diameter, High Stocking	Trees <10” DBH & >340 TPA	PCT to 250-300 TPA.	1
Larger Diameter, High Stocking	Trees >10” DBH & >340 TPA	CT or NCT to 140-170 TPA.	1
Larger Diameter, Moderately High Stocking	Trees >10” DBH & 200-340 TPA	Thin to 140-170 TPA.	1
Larger Diameter, Moderate Stocking	Trees >10” DBH & <200 TPA	Thin to 80-110 TPA.	2
Unforested			
Stand Type	**Characteristics**	**Recommendations**	**Priority**
Unforested	Unforested	Plant with mixed hardwoods and conifers at 250-300 TPA.	1

SECTION 4. PROPERTY DESCRIPTIONS & MANAGEMENT RECOMMENDATIONS

Detailed assessments and recommendations of individual properties included in this plan are identified below for county-owned and city-owned properties respectively.

County-owned properties in this plan include:

- Lake Whatcom Park
- Lookout Mountain Forest Preserve
- South Lake Whatcom Park

City-owned properties in this plan include:

- Agate Bay Preserve
- Agate Creek Preserve
- Agate Pond Preserve
- Blue Canyon Preserve
- Brannian Creek Preserve
- Dutch Harbor Preserve
- Lake Geneva Preserve
- North Beaver Creek Preserve
- Olsen Creek Preserve
- Silver Beach Preserve
- Soto Rynders Preserve
- South Bay Preserve
- South Lake Whatcom Preserve
- Three Creeks Preserve
- Watts-Lebeau Family Preserve
- West Beaver Creek Preserve

County Properties

Lake Whatcom Park

Overview

Site Description

Lake Whatcom Park is a large, 4,660-acre property owned by Whatcom County on the east side of Lake Whatcom. The park is accessed via the North Shore Road where two trailheads (upper and lower) provide public recreational access. The upper trailhead provides gated access to Wickersham Truck Trail which leads into the upper watershed. The lower trailhead provides gated access to the Hertz Trail which provides access along the east shore of Lake Whatcom. The property extends from the eastern shore of Lake Whatcom up western-facing slopes to the upper ridgelines of Stuart Mountain. To the north and east it borders forestland primarily owned by the Washington Department of Natural Resources (DNR). To the south it borders forestland in the Blue Canyon Preserve owned by the City of Bellingham. The community of Sunnyside sits near the park's entrance.

Property Information

This forest is located in Sections 02, 03, 04, 05, 09, 10, 15, and 16 of Township 37N, Range 04E, and Sections 26, 27, 28, 32, 33, 34, and 35 of Township 38N, Range 04E of the US Public Land Survey System and includes 34 parcels listed at the end of this section. Property corners and boundaries are not regularly marked.

Management History

Most of the forestland at Lake Whatcom Park was originally logged by early settlers during the late 19th and early 20th century, and large timber companies would eventually come to own most of the land in the watershed. A railroad operated by the Bellingham Bay and Eastern Railway (later part of the Northern Pacific Railroad) once transported coal and logs along the east shore of Lake Whatcom in the late 1800s. Logging started lower on the mountain and in easy-to-access locations, before progressing upslope onto steeper and less accessible terrain. Much of the area was logged out by the 1940s, but logging continued in the Smith Creek basin through the early 1960s. In time most of the original old growth was removed, though in some locations, the forest appears to have originated in wildfires preceding the logging era and has never been logged. For a time, post-logging broadcast burning was commonly employed to reduce logging slash, and many older hand-cut stumps bear the mark of these fires. At higher elevations, the stands are younger, frequently cut with power saws, and fire marks are infrequent. While many timberlands remained in private hands throughout the 20th century, some timber companies stopped paying property taxes after cutting the lucrative timber, and the properties were foreclosed upon by Whatcom County, which in turn transferred them in trust to the State of Washington Department of Natural Resources (DNR).

The second growth forests on Lake Whatcom Park began to be harvested again in the early 1990s and were replanted with conventional Douglas-fir plantations. In 1998 the County acquired five parcels at the end of the North Shore Road and formed the original North Lake Whatcom Park. Growing concern about forest management activities in the Lake Whatcom watershed spurred the creation of the 2004 Lake Whatcom Landscape Plan, which was created to guide forest management activities on state-owned forestlands in the watershed. In 2012 the County began the process of reconveying these lands back to county ownership, taking over title in early 2014. Not all of these reconveyed parcels had been under continuous, decades-long DNR management, as many parcels were previously owned by the Trillium Corporation and its predecessor, industrial timberland owner Georgia Pacific, prior to a large land swap in 1994 that consolidated DNR holdings into contiguous blocks around Lake Whatcom. Today this property is known as Lake Whatcom Park and managed by the Whatcom County Parks and Recreation Department.

Property Overview Map

Assessment

Topoclimate

The park is situated on the western-facing slopes of Stuart Mountain at elevations ranging from 200 to 2,800 feet. The property is characterized by steep terrain that descends toward the shores of Lake Whatcom, with numerous drainages feeding into Smith Creek and its tributaries. As part of the last foothills before the larger Cascade Mountains, the area receives higher rainfall than locations west of the lake due to orographic lift. When moist air from the lowlands is forced upward by the rising terrain, it cools and condenses, producing increased precipitation. Upper slopes are cooler and can receive snowfall in winter, while lower elevations near the lake experience milder temperatures year-round. During the winter, storm fronts moving inland from the Pacific collide with the ridges of Lake Whatcom Park, leading to intense winter storms that can deliver large volumes of precipitation in short time spans.

Vegetation Zone

According to vegetation zone maps for North America, the following Ecological Systems were likely present prior to Euro-American settlement. More information on these maps and full descriptions of each system can be found in the discussion of Vegetation Zones in Section 2 of this document.

- North Pacific Hypermaritime Western Red-cedar-Western Hemlock Forest
- North Pacific Maritime Mesic-Wet Douglas-fir-Western Hemlock Forest
- North Pacific Mesic Western Hemlock-Silver Fir Forest
- North Pacific Maritime Dry-Mesic Douglas-fir-Western Hemlock Forest

Soils

Data from the USDA Natural Resource Conservation Service (NRCS) Soil Surveys were used to identify the major soil types that underlay this forest, which are described in more detail in the discussion of Soil Productivity in Section 2. Information about specific soil units likely present at this property, including depth, drainage, productivity, and relevant management concerns are listed in the table below. The location of these soil units can be found in the accompanied map packet for this property.

Forest Soil Units Summary Table

Soil Unit	Productivity		Management Concerns					Acres (Pct)
	Site Class	Max Growth	Drought Stress Hazard	Wind Throw Hazard	Mass Wasting Hazard	Logging Rutting Hazard	Logging Compact Hazard	
Andic Xerochrepts-Rock Outcrop Complex Ashy Loam 60-90% Slopes Mod. Deep (24in)	DF-3	143 ft3/ac/yr	High	High	Severe	High	High	2,150 (46%)

Soil Unit	Productivity		Management Concerns					Acres (Pct)
	Site Class	Max Growth	Drought Stress Hazard	Wind Throw Hazard	Mass Wasting Hazard	Logging Rutting Hazard	Logging Compact Hazard	
Well Drained								
Andic Xerochrepts-Rock Outcrop Complex Ashy Loam 60-90% Slopes Very Shallow (0in) Well Drained	DF-4	114 ft3/ac/yr	Mod.	Low	Severe	High	High	657 (14%)
Andic Xerochrepts Ashy Loam on 60-90% Slopes; Mod. Deep (27in); Well Drained	DF-3	143 ft3/ac/yr	High	High	Severe	High	High	303 (7%)
Chuckanut Series Gravelly Medial Loam 30-65% Slopes Deep (56in) Well Drained	DF-2	186 ft3/ac/yr	Mod. High	Low	Severe	High	Mod.	256 (5%)
Nati Series Ashy Loam 30-60% Slopes Mod. Deep (38in) Well Drained	DF-3	129 ft3/ac/yr	Mod. High	High	Severe	High	High	251 (5%)
Chuckanut Series Gravelly Medial Loam 15-30% Slopes Deep (56in) Well Drained	DF-2	186 ft3/ac/yr	Mod. High	Low	Severe	High	Mod.	249 (5%)
Getchell Series Decomposed Plant Material 15-30% Slopes Mod. Deep (39in) Moderately Well Drained	WH-4	200 ft3/ac/yr	Low.	High	Severe	High	Mod.	196 (4%)
Typic Cryorthods Loam 60-90% Slopes Well Drained	WH-4	157 ft3/ac/yr	Low.	Low	Severe	High	High	192 (4%)

Soil Unit	Productivity		Management Concerns					Acres (Pct)
	Site Class	Max Growth	Drought Stress Hazard	Wind Throw Hazard	Mass Wasting Hazard	Logging Rutting Hazard	Logging Compact Hazard	
Revel Series Loam 30-60% Slopes Mod. Deep (35in) Well Drained	DF-4	114 ft3/ac/yr	Mod. High	High	Severe	High	High	98 (2%)
Kline Series Very Gravelly Loamy Sand 2-8% Slopes Moderately Well Drained	DF-3	143 ft3/ac/yr	High	Low	Moderate	Mod.	Mod.	72 (2%)

Slope Stability

As previously described in Section 2, this plan utilizes remotely mapped topographic data as well as hazard zones and historic landslides identified by the DNR to gauge the likelihood that unstable slopes will be found within a proposed management area. The presence of a mapped hazard zone or historic landslide does not preclude management, but indicates that further investigation is required.

Steep slopes are present across Lake Whatcom Park, but are most prominent along the banks of Smith Creek and the unnamed southern major streams and their tributaries. Almost all of the stream channels across the property are potential hazard zones as well as the steep slopes directly above many of the channels. These include the steep gorges of the major streams which likely have rule-identified inner gorges as well as potentially other unstable landforms. The headwaters of several of the tributaries of Smith Creek and the unnamed southern creeks contain likely rule-identified convergent headwalls. There is also a large hazard zone that stretches across the slopes directly above the shore of Lake Whatcom on the south side of the property.

Many historic landslides have been mapped across Lake Whatcom Park, particularly in the drainage systems of the major streams. Alluvial fans at the mouth of Smith Creek and other unnamed streams indicate the long history of slope instability in this watershed. As described in Section 2, widespread logging and road building across Lake Whatcom Park's steep slopes triggered numerous slope failures during the 20th century, including events in 1917, 1949, 1971, and 1983. During the 1983 event, extensive rainfall initiated numerous small landslides along the Smith Creek drainage, which swept down the creek and exploded onto the alluvial fan, destroying homes and pushing houses into the lake. This event also destroyed access to much of the road system that used to provide access into the Smith Creek drainage. In response the County built berms along the mouth of Smith Creek to protect homes and mitigate any future potential debris flows and has undertaken annual monitoring of Smith Creek.

During this assessment, small recent landslide activity was observed on steep headwalls and inner stream gorges. In addition, some minor soil instability was observed at the site of the 2023 Blue Canyon Fire at the southern end of Lake Whatcom Park.

Hydrology

The property lies primarily within the Lake Whatcom hydrologic basin, with water generally flowing west into Lake Whatcom. A few small areas along the eastern ridgeline drain east into the Acme basin. Both basins are part of the Nooksack Water Resource Inventory Area (WRIA). On the north side of the property, streams and tributaries flow through steep terrain into Smith Creek. Most of Smith Creek, including its north, main, and south forks are classified as fish-bearing by the DNR's hydrography database. Smaller tributaries are non-fish-bearing due to steep cliffs that block fish passage. On the south side of the property, three unnamed stream systems drain west toward Lake Whatcom. The northernmost and southernmost are identified as fish-bearing, while the middle stream is identified as non-fish-bearing.

A handful of forested wetlands can be found across the property, but no waterbodies are present. The folding pattern of the Chuckanut formation, which shaped the geology of Lake Whatcom Park influences the hydrology by creating wet sites between the small ridges that were created by this folding. As a result, more forested wetlands are likely present but not currently delineated.

Roads and Access

The primary access point to the property is through a gated road at the Chanterelle Trailhead, located off the North Shore Road. This road is known variously as the Wickersham Truck Trail, Cub Creek Mainline, or H-3300 road. This road proceeds uphill gaining the first ridgeline rising above Lake Whatcom and running parallel to the powerline transmission corridor. At a highpoint on the ridgeline, the road passes through another county-owned gate and hits an intersection with forks going to the south and north. The southern fork continues downhill to the town of Acme. The northern fork passes through private timberlands before gaining the southern ridgeline of Stewart Mountain. This fork is known in some records as the Sultan Hill Mainline (SH-ML) and runs north, passing above the headwaters of Smith Creek before entering the Olsen Creek State Forest road system and other industrial timberlands. These roads eventually lead back down to a gate on Y Road. The Bonneville Power Administration maintains an access agreement on the Wickersham Truck Trail to service the transmission power lines. And the DNR, and possibly other timber companies, have easements on the Truck Trail as well as the Sultan Hill Mainline to access nearby forestlands. Both of these mainline roads are in good condition, with recent maintenance focusing on brush management and limited ditch shaping.

Additional access includes the Class-A Hertz Trail which is gated but drivable for around two miles. This trail runs along the lakeshore of Lake Whatcom on an old railroad grade. The trail crosses several unnamed creeks and includes two footbridges to cross fish-bearing streams with vehicle traffic crossing through a nearby ford. Along the northern boundary of the park, the SH-94 and SH-9404 roads provide access down high ridgelines in the upper drainage of Smith Creek. In the park's south the CC-57 road provides a short access to the City of Bellingham's Blue Canyon Preserve and the H-3300F road provides access to the Chanterelle Trail overlook.

Small spur roads once ran off these main access routes at several locations but have either been formally abandoned or, in cases of roads dating before 1975, orphaned. Notable orphaned roads include the H-3300E spur which leaves the Wickersham Truck Trail after 0.75 miles and has been repurposed into the current Chanterelle Trail. Further up, the H-3300D route is a potentially abandoned railroad grade which provided access north of the powerlines along the south fork of Smith Creek. The H-3300C1 and C2 orphan roads were likely also a railroad line that enabled the historic logging of the south and west-facing slopes of the Park leading down to Lake Whatcom. Along the shores of Lake Whatcom, the Hertz Trail now runs in an abandoned railroad grade. At the current location of the Chanterelle Connector Trail, an orphaned grade runs uphill bypassing the lakeshore cliffs and providing access for historical logging along the lower slopes. During the 1983 storm and debris torrent, over 10 miles of road system that once provided access to the lower slopes of the Smith Creek drainage was destroyed and abandoned. Today, access into this basin is only from the upper ridgelines.

Forest roads were assessed to determine their status and suitability for management activities as well as to identify any potential maintenance or design issues. Notable findings of this assessment are summarized below.

Neglected and/or Improperly Abandoned Roads. Several roads were identified that, having not been officially abandoned, are theoretically "active" but maintenance has been neglected for many years. At Lake Whatcom Park this includes the SH-94 and SH-9404 roads which were active at the time of reconveyance. These roads currently are overgrown, but have culverts still in place as well as paved asphalt segments. No other improperly abandoned roads were identified. The Sultan Hill mainline was blocked by a fallen tree during the assessment but is in otherwise good condition.

Existing Orphan Roads. This assessment did not identify any major concern with existing orphan roads that warrant a management recommendation. As discussed in Section 2, the RMAP process undertaken by the DNR at Lake Whatcom Park prior to reconveyance included a thorough investigation of these orphaned road systems. Spot checks of these roads concurred with the DNR findings that these orphaned roads currently pose a limited risk.

Fish Passage Issues. One potential fish passage issue was identified on a culvert on the current Hertz Trail. This stream is currently identified as fish-bearing in the DNR's hydrography database, but it is likely so for only a very short distance, and further investigation is required to confirm the stream's fish-bearing status. The culvert in this location is right on the lakeshore and has currently rusted out, failing to contain the stream flow. The 30-inch diameter culvert is likely undersized for its basin and lacks natural streambed material which poses a potential barrier to fish passage if the stream is determined to be fish-bearing.

Drainage Control Issues on Active Roads. Several active roads were identified as suffering from deferred maintenance of their drainage control structures, primarily road grades, ditches, and cross-draining culverts. In some situations, this has caused water to enter the roadway resulting in minor channelization on the road surface. These issues were most pronounced on the Wickersham Truck Trail and include:

- **Inoperable Cross-Draining Culverts.** Over time culvert inlets can become obstructed by large woody debris or buried under sediment if not properly maintained. Steel culverts are also prone to rusting and culvert outfalls may cause erosion if energy dissipation devices, such as rock armoring or downflumes are not properly installed and maintained. Of the 81 drainage culverts surveyed, 4 were partially plugged, 2 were majorly plugged, and one had collapsed internally.
- **Obstructed Ditches.** Ditches become obstructed or otherwise inoperable for many reasons, including sloughing hillsides, large debris, and unsanctioned recreational use. Obstructed ditches force water onto the roadway, where it bypasses well designed cross-draining culverts and uncontrollably exits the roadway, causing erosion and/or delivering sediment into nearby streams. Over 7 observations of obstructed ditches were identified.
- **Improperly Maintained Road Grades**. When water does enter the road a properly maintained road grade ensures the water is shed quickly and does not continue down the road system, leading to channelization, erosion, and potential slope instability issues. Over 5 observations of water on the roadway were identified.

Culvert Condition. Culvert diameter, material, and condition were noted during this assessment and the bankfull width measured for stream crossings. As described earlier, though culverts inlets were partially obstructed as a result of deferred maintenance, the culverts themselves were generally in good condition. With the exception of two locations where the Chanterelle Trail crossed the Wickersham Truck Trial ditch, all crossdrains were 18 inches or larger as required by state regulations. Of the 14 stream-crossing culverts identified during this assessment, 7 had diameters less than the bankfull width of the stream they carried. While this does imply they are functionally undersized, additional analysis is required to determine if these culverts are appropriately sized to meet current WA DNR requirements. As previously discussed in Section 2, the majority of culverts at Lake Whatcom Park are galvanized steel, which has a serviceable life from 20-40 years. Many of these culverts date from the RMAP process from the early 2000s and are likely around 20 years old, though some may be considerably older. During this assessment the majority of steel culverts surveyed were in good condition. Still, culvert failures are predicted to increase in the future as steel culverts reach the end of their serviceable life.

Health and Resiliency

Invasive species pressure was low across the forests of Lake Whatcom Park. Himalayan blackberry was observed in limited locations along road edges and near the Chanterelle Trailhead. In general, blackberry at this property is not nearly as prevalent as elsewhere in the watershed. English holly was also found in the understory of many stands. There is a moderate amount of English ivy near the shoreline and Hertz Trail, climbing trees and affecting understory plants. It can also be found moving up in elevation along the Chanterelle Trail and is likely increasing its populations in upper slopes due to fruit and seed dispersal by birds

Overstocking is the most important forest health problem facing the forests at Lake Whatcom Park where many stands are overstocked and/or growing at unsustainable densities. This includes naturally regenerated stands that are in the Stem Exclusion stage of development as well as previously-established plantations that have experienced extensive infilling by natural regenerating hemlock and alder, thus increasing their densities to unsustainable levels. In many cases, stocking exceeds 400 trees per acre, and relative densities of 60 or even higher are fairly common. At these densities, competition-induced mortality is rampant, stands are increasingly unstable, and dead material is accumulating as potential wildfire fuel.

In addition, localized pockets of laminated root-rot and hemlock dwarf mistletoe were observed sporadically across the forest, but are operating within normal levels.

The upper slopes of Lake Whatcom Park include stands dominated primarily by drought-intolerant western hemlock but also silver fir. Stands growing on sites with low moisture potential, such as top of ridgelines and south-facing aspects, are at particular risk of drought stress, which is expected to increase under future hotter and drier climates.

Wildlife Habitat

A review of the Washington State Department of Fish and Wildlife Priority Species Database identified Townsend's big-eared bat, myotis bat, and gray wolf as having been documented somewhere within the 23,000-acre township containing Lake Whatcom Park. Additionally, the fish-bearing streams are identified as habitat for cutthroat trout, and there is potential habitat for marbled murrelet in a southern section along the shore of Lake Whatcom.

The property supports a variety of wildlife habitats due to its mix of forest ages and structures. Small pockets of old-growth forest contain large trees and complex canopy layers that provide diverse habitat features for many species. Much of the forest on the upper slopes is in the Stem Exclusion phase which offers more limited habitat value because of their dense, uniform structure. However, some forest stands are beginning to transition into more structurally complex stages, with larger trees and developing understories that support greater biodiversity. Additionally, the numerous stream channels across Lake Whatcom Park and their associated riparian zones offer valuable wildlife habitat, with increased species diversity, structural complexity, and reliable water sources. The lower sections of the streams offer important habitat for fish species that are found in Lake Whatcom.

Wildfire Susceptibility

The risk of wildfire ignition is generally moderate at Lake Whatcom Park. Most of the surrounding properties are not residential, and there is limited public access to much of the property, particularly on the north side of the park. However, the recreational trails in the central and southern parts of the property increases the risk of wildfire ignition in these areas. Notably, at least two small ignitions have occurred along the Hertz Trail over the last decade. Fortunately, these fires remained small and were extinguished before they could spread further. The developed road network in the central zone and along the upper ridgeline ensures a rapid response to fires in these areas. However, much of the property has limited road access, particularly in the large Smith Creek drainage system on the north side and on the lower slopes of the south side of the property. Firefighting capabilities are limited in these remote areas.

As discussed in Section 2, overstocked, mixed-conifer stands and Douglas-fir plantations in Stem Exclusion are more susceptible to high-severity fire as they have high levels of fine woody debris, lack larger trees that are more resistant to fire, and have low canopies and many potential ladder fuels. Older mixed conifer forests in the Mature-I and Mature-II stages of development have lower densities, taller crowns, and reduced fuel loads which reduce their susceptibility to high-severity fire. Mixed conifer and hardwood forests are also less susceptible to fire because hardwood species have large water-laden leaves and lower content of resin and pitch that makes them less likely to burn in a fire, and their low-density crowns can reduce the chance of a crown fire spreading. These stand types are further identified below, but approximately one quarter of the forestland at Lake Whatcom Park consists of overstocked stands in Stem Exclusion which are susceptible to high-severity fire.

The recent Blue Canyon Fire in 2023 is a recent example of potential wildfire activity in the watershed. The fire was ignited in late-August by lightning and burned 30-40 acres in steep terrain on the southern slopes of Lake Whatcom Park near the end of the Hertz Trail. The firefighting response was rapid, involving helicopter water drops every five minutes and ground crews making short hikes to engage the fire from nearby road access points. This fire was notable for burning in an older, naturally-regenerated forest that had a high-level of species and age diversity prior to the fire. This forest is generally around 100 years old but contains a large component of much older Douglas-fir trees that are over 400 years old and have survived prior fire events. While the fire primarily operated as a surface-fire, prevalent ladder fuels did enable the fire to occasionally enter the canopy, scorching and killing some trees. Given the lower densities of this stand these crown fire events were not sustained and fire severity was low to moderate across much of the fire. While many smaller diameter trees died in this blaze, most of the medium to large-sized trees are still alive two years later and ground-cover has re-established in many areas.

Carbon Storage

The property's forests are largely conifer-dominated, providing strong long-term carbon storage potential. Remnant patches of old-growth forest demonstrate the landscape's high capacity for carbon storage, featuring large, long-lived conifers alongside younger, fast-growing trees that are actively sequestering carbon. However, many previously logged areas are in a stem exclusion phase, where dense competition has slowed tree growth and carbon accumulation. Thinning these areas to reduce competition and promote dominant tree growth would enhance carbon storage over time. On upper slopes, stands dominated by western hemlock may face reduced long-term carbon potential if warming and drying conditions lead to slower growth or higher mortality. Lower on the slopes near Smith Creek and its tributaries, red alder is more common, which offers relatively low carbon storage potential due to its short lifespan.

Cultural Resources

The Lake Whatcom watershed is a landscape rich with cultural significance for Indigenous peoples—particularly the Lummi Nation and the Nooksack and Swinomish Tribes—who have maintained deep spiritual, cultural, and subsistence connections to the landscape. Although a review of the Washington State Department of Archaeology and Historic Preservation Wisaard online database did not identify any known historical sites on this property and none were encountered while developing this plan, this property has a long history of human use and artifacts may be present. Please see the previous discussion about cultural use practices in the Lake Whatcom Watershed for a more detailed assessment of best management practices moving forward.

Recreation

Non-motorized recreational use is common in portions of the Lake Whatcom Park forestlands. At the park entrance, the Chanterelle Trailhead includes two parking lots and bathroom facilities. The Chanterelle Trail ascends up a ridgeline in the central zone of the park utilizing old road beds in some locations and generally paralleling the Wickersham Truck Trail. A downhill mountain bike trail descends from the upper ridgeline back to the Chanterelle Trailhead. The Hertz Trail runs from the Chanterelle Trailhead south along the shore of Lake Whatcom following the old railroad grade that once existed here. Halfway along this trail is the start of the Chanterelle Connector Trail which ascends up a southern ridgeline before connecting with the Chanterelle Trail near the top of the ridgeline. The public also frequently hikes and bikes along undeveloped forest roads in the upper ridgelines of the park but there are no developed recreational trails in the larger Smith Creek basin on the north side of the property or on the far south side of the property. The public also uses the orphaned road system directly north of the North Shore Road bridge over Smith Creek to access adjacent roads and trails in the DNR owned Olsen Creek State Forest. Unsanctioned recreational trails were identified along the upper ridgelines nearby to the Wickersham Truck Trail and powerline easement in the central portion of the property.

Recommendations

Roads and Access

This plan recommends the following actions be taken to improve the maintenance and function of the existing road system at Lake Whatcom Park:

- **Neglected and/or Improperly Abandoned Roads.** Restoring access on the SH-94 and 9404 roads will provide critical access to the majority of young plantations at Lake Whatcom Park. These stands are in need of thinning interventions over several decades, and maintaining access on these road spurs will be critical to enacting the recommendations outlined in this plan. If management recommendations are not followed, these neglected roads should be formally decommissioned to ensure no long-term hydrological effects.
- **Drainage Control Issues on Active Roads.** The Wickersham Truck Trail needs ditch cleanouts, culvert clearing, and regrading across numerous sections to ensure proper drainage. After this

has been done, implement a maintenance plan for ditches, culverts, and road grades to ensure all active roads maintain a high standard of function. See the best management practices identified in Section 2.

- **Culvert Condition.** Replace failed culverts. Upgrade undersized cross-draining culverts and evaluated stream-crossing culverts to confirm they are sized appropriately for their respective basins. Future culvert installation, particularly of cross-draining culverts, should prioritize modern, longer lasting HDPE plastic culverts.
- **Fish Passage & Current Failures.** Evaluate and rectify the ongoing stream-crossing culvert failure identified on the Hertz Trail, which is also a potential barrier to fish passage. This culvert should be replaced, potentially with a footbridge to maintain recreational access.

Without road access, heavy equipment cannot be used in forest management activities, and thinning recommendations must be implemented as non-commercial cut and drop. This greatly increases the cost of forest management and likely reduces the amount of the landscape that can be actively managed to reach its desired future condition. Given the challenges of properly maintaining roads on steep terrain, the decision to build new roads requires careful planning and should follow the guidelines identified in Section 2. Specific recommendations for creating or restoring temporary spur roads to facilitate forest management activities are given by FMU below.

Health and Resiliency

Though continued treatment and monitoring of Himalayan blackberry would be a prudent decision to prevent its spread, it does not present a significant management concern at this property. In a few localized areas blackberry is impacting future forest development and specific recommendations are given at the management unit level below. English ivy infestations should be treated to prevent their spread and improve understory health and diversity.

Recommendations for addressing observed overstocking are given at the management unit level below.

Wildfire Susceptibility

Shaded fuel breaks are recommended within 100 feet of public roads and existing structures which are designed to keep fires on the ground and slow their spread until firefighting resources can arrive. For additional details on implementation, see the description of a shaded fuel break given in the discussion of Wildfire Susceptibility in Section 2 of this document.

Forest Types

Summarized below are the general forest types present at Lake Whatcom Park and their management recommendations.

Forest Types Summary Table

Forest Type	Acres	Proportion
Conifer Plantation - Small DBH	84	2%
Conifer Plantation - Large DBH	306	7%
Mixed Conifer - Stem Exclusion	481	10%
Mixed Conifer - Stem Exclusion/Mature-I	411	9%
Mixed Conifer - Mature-I	539	12%
Mixed Conifer - Mature-I/II	326	7%
Mixed Conifer - Mature-II	284	6%
Mixed Conifer - Late Seral	17	0%
Mixed Hardwood - Young	0	0%
Mixed Hardwood - Mature	0	0%
Mixed Hardwood - Old	0	0%
Mixed Conifer and Hardwood	2,008	43%
Unforested	15	0%
Non-Forest	189	4%
Total	**4,660**	**100%**

Mixed Conifer Stands

Mixed conifer stands are very common at Lake Whatcom Park, representing about 44% of the property. These stands regenerated naturally following clearcut harvests between 60 to 125 years ago. After clearcutting, the forest was left to regenerate naturally, and in most cases, no intervening management has occurred. Based on observed fire scars and a lack of logging evidence, it is estimated that there are stands in Smith Creek and in the south side of the property along the lake shore that regenerated following a wildfire and were never logged. At the time of logging, these forests likely had smaller trees that regenerated following an earlier fire, and were likely not cut due to their smaller size and lower value compared to the trees in the surrounding forests. Within these areas, clusters of trees over 400 years or older were observed during the assessment that survived these fires.

Today, these stands are primarily dominated by a mixture of conifers, primarily Douglas-fir and western hemlock, though western redcedar and pacific silver fir are also present. Douglas-fir is more common at lower elevations, while hemlock is more common at higher elevations. A majority of the mixed conifer stands at Lake Whatcom Park are in Stem Exclusion or Mature-I stage of development, where density remains relatively high to very high. There are some early Mature-II stands that have begun to develop as well as some older fire origin stands that exhibit later seral characteristics, but these are a minority.

As previously described in Section 3, the management of mixed conifer stands is best delineated by stand development stage, and recommendations follow the general discussion earlier in this document. For stands in Stem Exclusion, this plan recommends variable density commercial thinning, with priority varying from moderate (level 3) to high (level 1) depending on stocking. Given their generally high priority, when commercial access is not possible, non-commercial thinning should be utilized in the most overstocked stands. This plan recommends variable density thinning in Mature-I stands, but assigns these stands priority varying from low (level 4) to moderate (level 3) depending on stocking. Finally, this plan generally does not recommend management in Mature-II or older stands at Lake Whatcom Park.

Plantations

Around 9% of Lake Whatcom Park forestland are Douglas-fir plantations. These stands are typically third generation forests, having been established after clearcut harvests of the naturally regenerated second growth forests over the last 15 to 40 years. These plantations were established at high densities of primarily Douglas-fir but in many cases have experienced significant infilling by western hemlock. Subsequent pre-commercial thinning operations have not occurred in these plantations since reconveyance, and many of these stands are currently growing at extremely high levels of stocking.

A more complete description and assessment of plantation silviculture and recommendations for these stands is provided in Section 3 of this document. Broadly, all plantations at Lake Whatcom Park require management interventions to accelerate the transition of these stands towards forests with more complex stand structures, thereby improving resiliency, reducing fire risk, increasing hydrological maturity, and providing additional wildlife habitat. As previously described in Section 3, pre-commercial thinning is recommended in overstocked, small diameter stands and variable density commercial thinning in overstocked, large-diameter stands. Given high-levels of homogeneity and the likelihood that multiple entries are needed to restore forest function, thinning plantations is one of the highest priority management recommendations made in this plan. Broadly, access to these stands is good and thinning can be primarily commercial. Additional details are provided in each management unit below.

Mixed Conifer and Hardwoods

Mixed conifer and hardwood stands are very common at Lake Whatcom Park, representing about 43% of the property. These stands regenerated all across the property following clearcut harvests between 60 to 125 years ago. Unlike other conifer-dominated stands, these stands either initiated with a large component of hardwoods or have grown at lower densities, allowing new hardwood species to establish in subsequent years. In either case, these stands now include a wide range of species growing in multiple canopy positions.

As previously described in Section 3, the management of these stands can follow either more mixed-conifer recommendations or mixed-hardwood recommendations depending on the proportion of species present, but in well-mixed stands typically focuses on forest health issues. At Lake Whatcom Park, since these stands are generally in good health, exhibiting high diversity, and growing at sustainable densities, large-scale management is not recommended in most cases.

Management Units

Forest cover was delineated into the forest management units (FMUs) using both remotely sensed data, historic inventory units, and field inventory data. The forestland within these management units share similar forest characteristics and management recommendations. For each FMU, this plan describes the geophysical attributes and forest conditions and assesses the unit against the plans management objectives using the previously described framework by forest type. Recommendations are then given by FMU, typically referencing general recommendations by forest type, but more information is given as needed. Finally, a schedule of management activities by year and FMU is given at the end of this section.

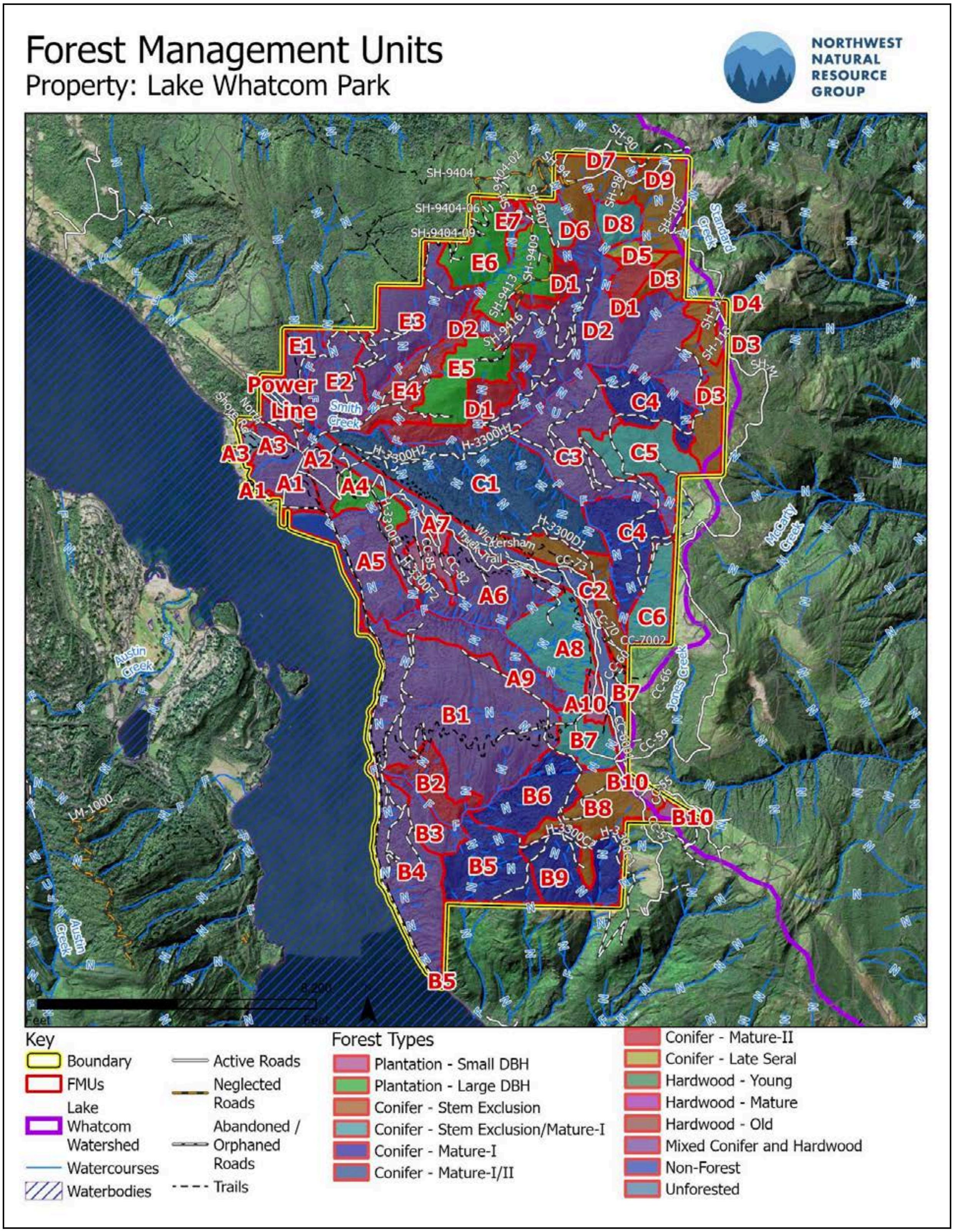
Because this property is so large, it is also delineated into sub-areas based on stream basins and shared access routes. The letter at the beginning of the FMU label represents the area or “series” to which it belongs. Series A FMUs are located near the Chanterelle Trailhead and extend up the ridgeline accessed by the Wickersham Truck Trail. Series B FMUs occur on the west facing slopes and drainages south from the A series. These FMUs can be accessed via the Hertz Trail on the bottom and the upper reaches by the Wickersham Truck Trail. Series C FMUs occur on the south fork of Smith Creek, series D FMUs on the main fork of Smith Creek, and series E FMUs on the north fork of Smith Creek. An overview of these units is available in the table and maps below.

Summary of Forest Management Units

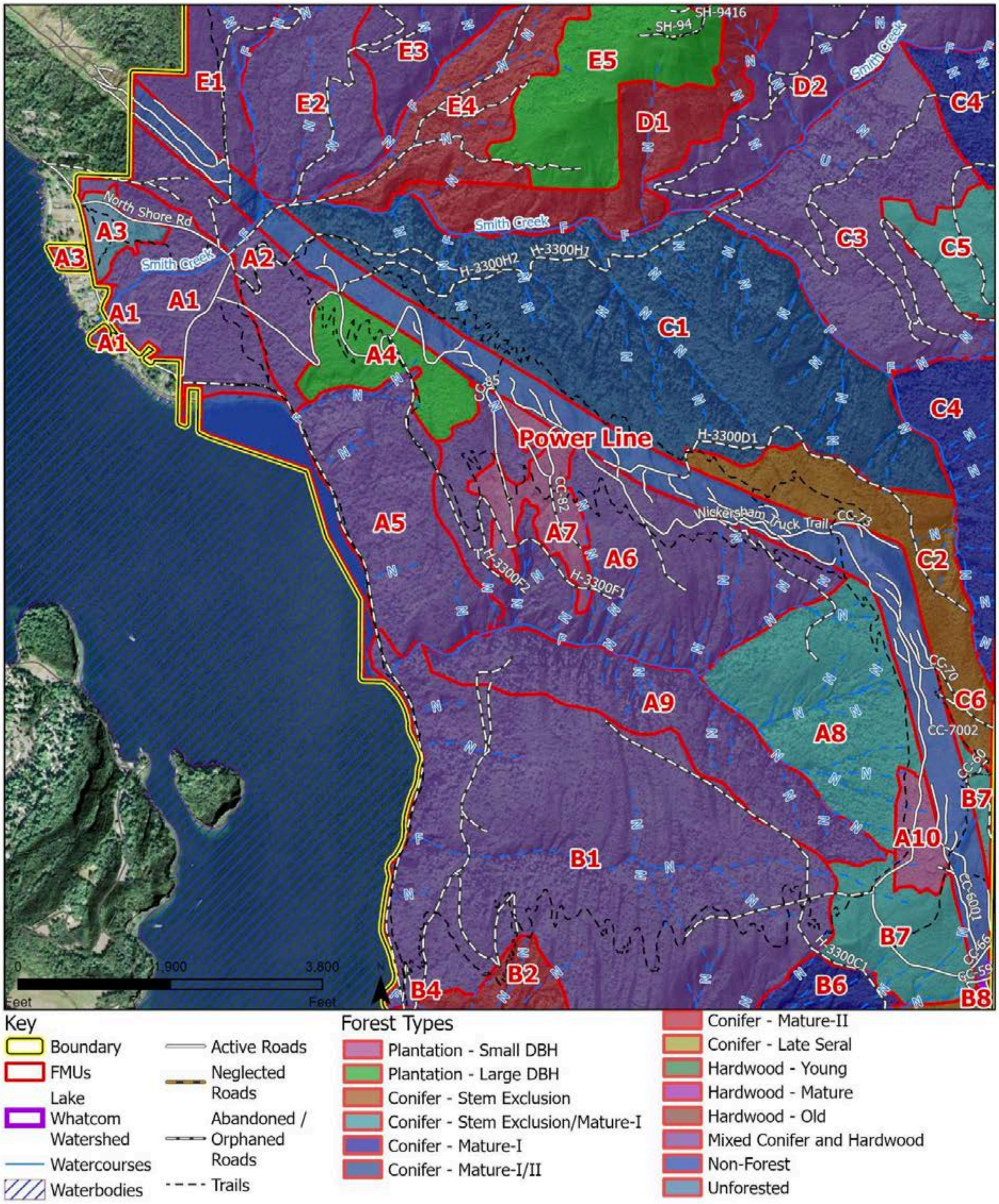
FMU	Acres	Forest Type	Management
A1	76	Mixed Conifer and Hardwood	Invasive Species Management
A2	54	Mixed Conifer and Hardwood	None
A3	15	Unforested	Invasive Species & Planting
A4	43	Conifer Plantation - Large DBH	Thinning
A5	105	Mixed Conifer and Hardwood	None
A6	179	Mixed Conifer and Hardwood	Thinning
A7	38	Conifer Plantation - Small DBH	Thinning
A8	114	Mixed Conifer - Stem Exclusion/Mature-I	Thinning
A9	101	Mixed Conifer and Hardwood	None
A10	18	Conifer Plantation - Small DBH	Thinning
B1	426	Mixed Conifer and Hardwood	None
B2	59	Mixed Conifer - Mature-II	None
B3	44	Mixed Conifer and Hardwood	None
B4	158	Mixed Conifer and Hardwood	None
B5	121	Mixed Conifer - Mature-I	None
B6	103	Mixed Conifer - Mature-I	None
B7	64	Mixed Conifer - Stem Exclusion/Mature-I	Thinning
B8	102	Mixed Conifer - Stem Exclusion	Thinning
B9	117	Mixed Conifer - Mature-I	None
B10	18	Conifer Plantation - Small DBH	Thinning
C1	326	Mixed Conifer - Mature-I/II	None
C2	80	Mixed Conifer - Stem Exclusion	Thinning
C3	186	Mixed Conifer and Hardwood	None
C4	198	Mixed Conifer - Mature-I	None
C5	97	Mixed Conifer - Stem Exclusion/Mature-I	Thinning
C6	64	Mixed Conifer - Stem Exclusion/Mature-I	Thinning
D1	135	Mixed Conifer - Mature-II	None
D2	378	Mixed Conifer and Hardwood	None
D3	107	Mixed Conifer - Stem Exclusion	Thinning
D4	21	Mixed Conifer - Stem Exclusion	Thinning
D5	17	Mixed Conifer - Late Seral	None
D6	35	Mixed Conifer - Stem Exclusion/Mature-I	Thinning
D7	61	Mixed Conifer - Stem Exclusion	Thinning
D8	37	Mixed Conifer - Stem Exclusion/Mature-I	Thinning
D9	110	Mixed Conifer - Stem Exclusion	Thinning

FMU	Acres	Forest Type	Management
E1	55	Mixed Conifer and Hardwood	Monitor Invasive Species
E2	91	Mixed Conifer and Hardwood	Invasive Species Management
E3	155	Mixed Conifer and Hardwood	None
E4	90	Mixed Conifer - Mature-II	None
E5	94	Conifer Plantation - Large DBH	Thinning
E6	169	Conifer Plantation - Large DBH	Thinning
E7	10	Conifer Plantation - Small DBH	Thinning
Power Line	160	Unforested	Not Applicable
Total	**4,660**		

Maps of Forest Management Units

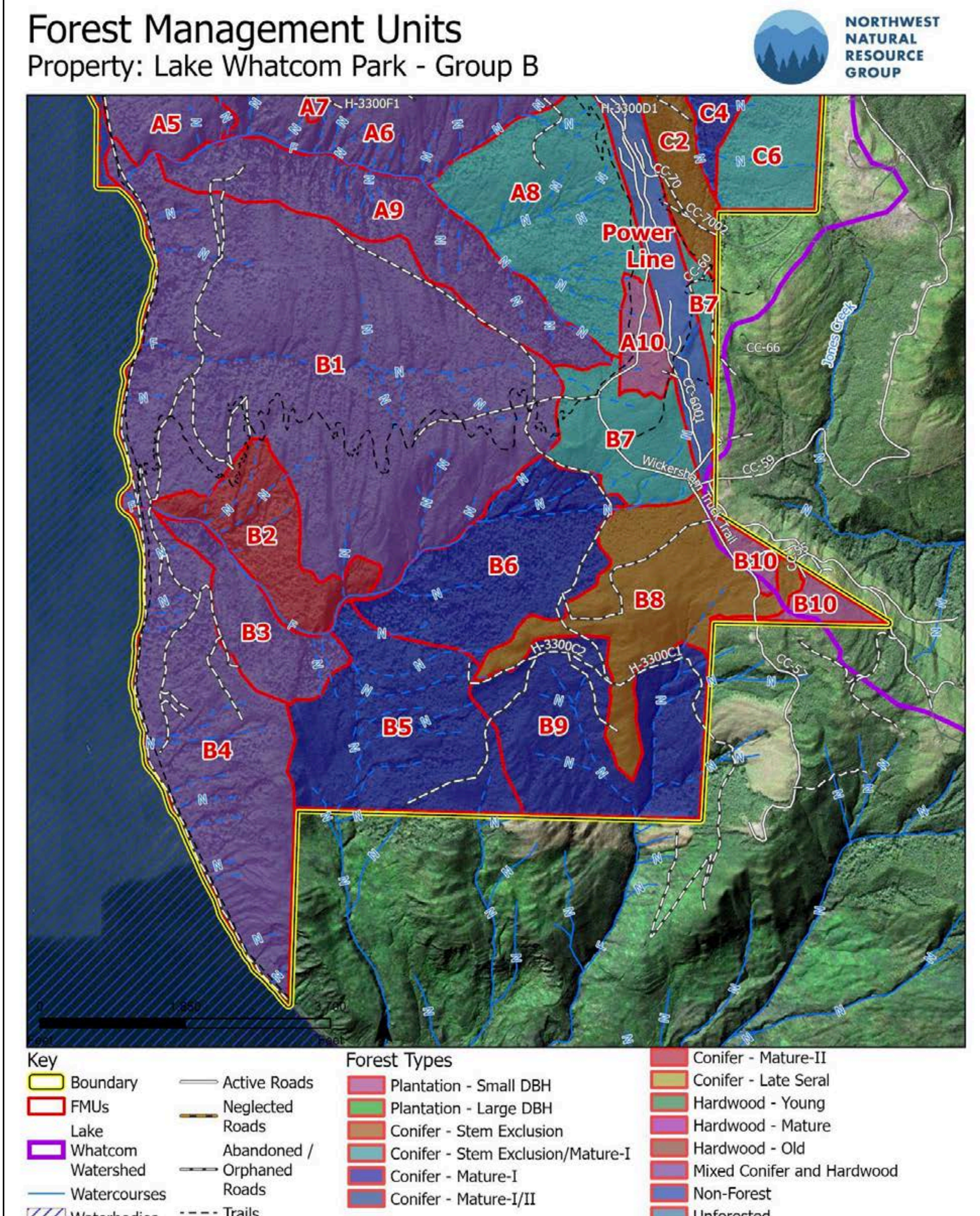


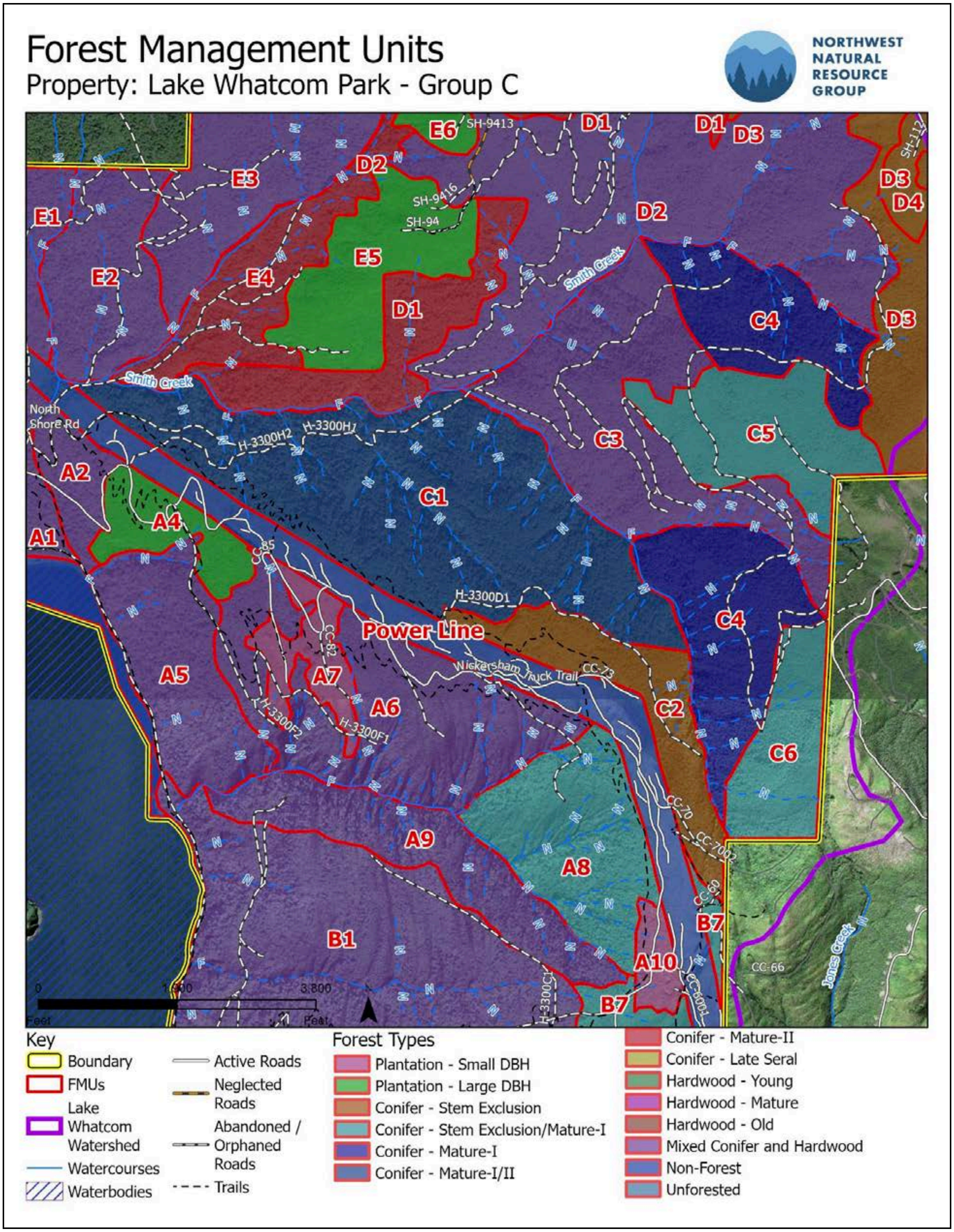
Forest Management Units
Property: Lake Whatcom Park - Group A



Forest Management Units

Property: Lake Whatcom Park - Group B

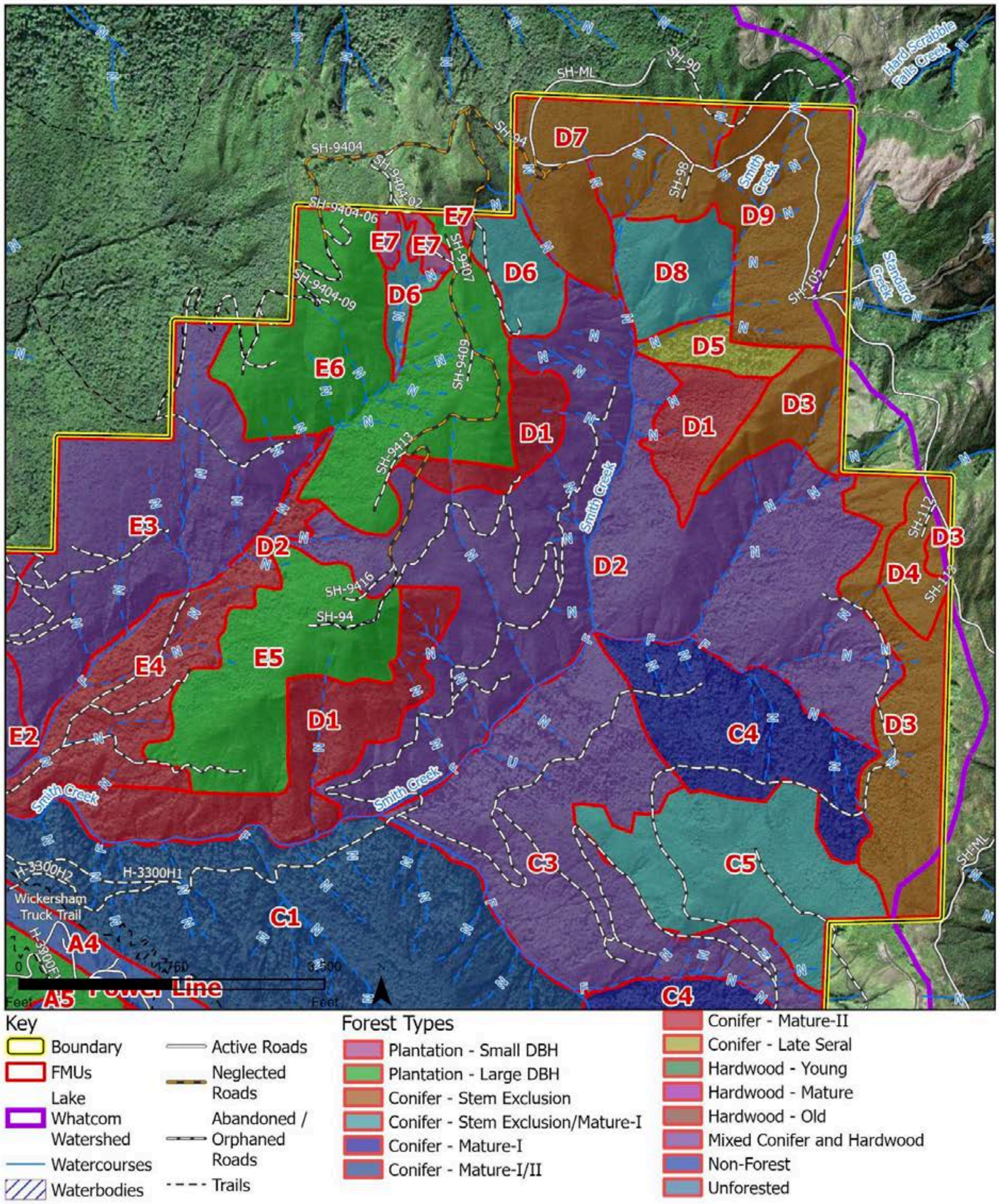



Forest Management Units
Property: Lake Whatcom Park - Group C
NORTHWEST NATURAL RESOURCE GROUP
E6
SH-9413
D1
D1
D3
D2
E3
E1
SH-9416
SH-94
D3
D4
D2
E5
E2
E4
Smith Creek
D1
C4
D3
Smith Creek
North Shore Rd
H-3300H2
H-3300H1
C5
C3
A2
C1
A4
A1
CC-85
H-3300D1
C4
Power Line
CC-82
Wickersham Truck Trail
CC-73
A5
A7
A6
C2
H-3300F2
H-3300F1
C6
CC-70
CC-7002
A9
A8
CC-60
B7
B1
A10
CC-66
Jones Creek
H-3300C1
B7
0
1,900
3,800
Feet
Key
Boundary
FMUs
Lake Whatcom Watershed
Watercourses
Waterbodies
Active Roads
Neglected Roads
Abandoned / Orphaned Roads
Trails
Forest Types
Plantation - Small DBH
Plantation - Large DBH
Conifer - Stem Exclusion
Conifer - Stem Exclusion/Mature-I
Conifer - Mature-I
Conifer - Mature-I/II
Conifer - Mature-II
Conifer - Late Seral
Hardwood - Young
Hardwood - Mature
Hardwood - Old
Mixed Conifer and Hardwood
Non-Forest
Unforested

Forest Management Units

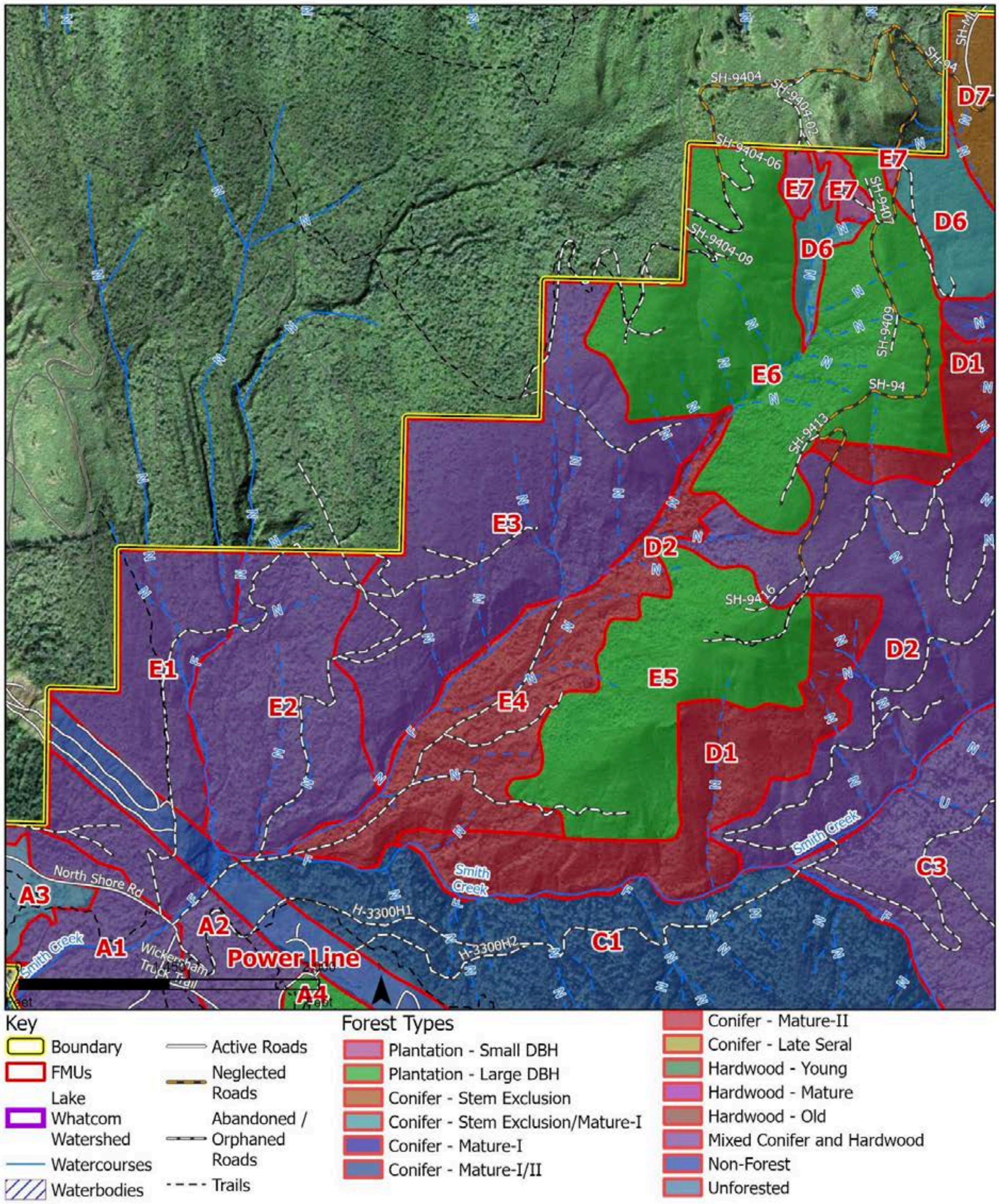
Property: Lake Whatcom Park - Group D

NORTHWEST NATURAL RESOURCE GROUP



Forest Management Units
Property: Lake Whatcom Park - Group E

NORTHWEST NATURAL RESOURCE GROUP



FMU A1 - Mixed Conifer and Hardwood

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	RC	77	95	173	56	8	16	36	86
	Minor	BM	18	25	31		8	14	24	96
		DF	25	67	107		12	25	36	160
		WH	11	13	14		10	12	14	80
	All	All	144	224	356		8	17	36	103
Midstory	Major	RC	20	10	19	6	2	9	14	60
		WH	26	11	20		2	8	14	48
	All	All	50	24	45		2	9	18	55
Total	All	All	194	248	400	62	2	15	36	91

Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.

This FMU is located on the west side of the property near the shoreline of Lake Whatcom and the Chanterelle Trailhead. It is the floodplain or Smith Creek which flows through the center of the unit. It contains mostly flat terrain and has a soil productivity rating of site class III. It was likely logged in the early 1900s and also experienced a flooding event in 1983. Total stocking is approximately 194 TPA. The overstory contains approximately 144 TPA and is primarily composed of western redcedar, with small components of bigleaf maple, Douglas-fir and western hemlock. Overstory western redcedar average 16 inches DBH and 86 ft tall. The midstory contains approximately 50 TPA and is primarily composed of western hemlock and western redcedar. Midstory redcedar average 9 inches DBH and 60 ft tall, and hemlock average 8 inches DBH and 48 ft tall. Per the earlier discussion of mixed conifer and hardwood forests, no large-scale management activities are recommended in this forest. However, large infestations of invasive species, particularly Himalayan blackberry, cutleaf blackberry, and English ivy, are present near the road and edges of this stand, and treatment and restoration of these areas is recommended. This unit is accessible from the North Shore Road.

FMU A2 - Mixed Conifer and Hardwood

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	DF	50	93	131	60	10	18	36	118
		RC	58	110	165		10	19	36	124
	Minor	BM	24	44	47		10	15	28	125
	All	All	145	274	371		10	18	36	124
Midstory	Major	RC	62	34	56	9	4	9	14	58

		WH	21	7	15		4	8	12	60
	All	All	83	41	70		4	9	14	59
Total	All	All	228	315	442	69	4	15	36	100

Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.

This FMU is located on the lower slopes of the west side of the property near the Chanterelle Trailhead. Smith Creek runs through the center of the unit with moderate west-facing slopes on either side. The soil productivity rating ranges from site class II to III. The unit likely regenerated naturally following a clearcut harvest in the early 1900s. Total stocking is approximately 228 TPA. The overstory contains approximately 145 TPA and is primarily composed of western redcedar and Douglas-fir, with a small component of bigleaf maple. Overstory Douglas-fir average 18 inches DBH and 118 ft tall, and redcedar average 19 inches DBH and 124 ft tall. The midstory contains approximately 83 TPA and is primarily composed of western hemlock and western redcedar. Midstory redcedar average 9 inches DBH and 58 ft tall, and hemlock average 8 inches DBH and 60 ft tall. Per the earlier discussion of mixed conifer and hardwood forests with no forest health concerns, no management activities are recommended. The north side of the unit is accessible from North Shore Road, and the south side of the unit is accessible from Wickersham Truck Trail.

FMU A3 - Unforested

This FMU is an unforested field on the west side of the property near the shoreline of Lake Whatcom. It has a soil productivity rating of site class II. The exact history of this field is unknown, but it's possible that grass colonized the site following a disturbance and prevented the regeneration of trees, or that it was intentionally converted to a field. In addition, infestations of invasive species, particularly Himalayan blackberry, cutleaf blackberry, and English ivy, are present near the road and edges of this unit, and treatment and restoration of these areas is recommended. To regain forest cover at this site, this plan recommends planting trees across the unit at 250 to 300 TPA. This unit is easily accessible from the North Shore Road.

FMU A4 - Conifer Plantation - Large DBH

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	BM	64	29	15	60	2	4	6	40
		DF	252	181	309		6	11	18	62
	All	All	315	210	324		2	10	18	58
Midstory	Major	BM	5	0	1	0	2	4	6	10
Total	All	All	320	210	325	60	2	10	18	57

Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.

This FMU is located on the lower slopes of the west side of the property. It has moderate to steep west-facing slopes and a soil productivity rating of site class III. It was clearcut around 1993 and replanted with Douglas-fir. Total stocking is approximately 320 TPA. The overstory contains approximately 315 TPA and is primarily composed of bigleaf maple and Douglas-fir. Overstory Douglas-fir average 11 inches DBH and 62 ft tall, and maple average 4 inches DBH and 40 ft tall. The midstory contains approximately 5 TPA and is primarily composed of bigleaf maple that average 4 inches DBH and 10 ft tall. The unit is currently overstocked with low species and structural diversity common to plantations.

Per the earlier discussion of overstocked, large-diameter plantations, a two-part sequence of variable density thinning is recommended, and potential underplanting once density has been sufficiently reduced. Much of the terrain should enable ground-based logging operations aside from steeper terrain on the southwest and southeast side of the unit which will require cable yarding or tethering. This unit is accessible from the Wickersham Truck Trail, and most of the stand is within 800 ft of the road.

FMU A5 - Mixed Conifer and Hardwood

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	DF	88	149	242	56	12	19	36	127
	Minor	BM	20	43	50		12	18	24	160
	All	All	114	206	304		12	18	36	134
Midstory	Major	RC	33	11	31	9	4	10	14	56
		WH	33	11	31		4	10	14	56
	All	All	73	27	67		4	9	14	54
Total	All	All	187	233	370	65	4	15	36	103

Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.

This FMU is located on the west side of the property along the shoreline of Lake Whatcom. It has moderate to steep west-facing slopes and a soil productivity rating of site class III. Based on historic inventory data, it is estimated that the unit regenerated naturally following clearcut harvesting around 1917. Total stocking is approximately 187 TPA. The overstory contains approximately 114 TPA and is primarily composed of Douglas-fir, with a small component of bigleaf maple. Overstory Douglas-fir average 19 inches DBH and 127 ft tall. The midstory contains approximately 73 TPA and is primarily composed of western hemlock and western redcedar that both average 10 inches DBH and 56 ft tall. Per the earlier discussion of mixed conifer and hardwood forests with no forest health concerns, no management activities are recommended. There is no current road access to this stand as the previous orphaned road spur, H-3300F, has been converted to a hiking trail.

FMU A6 - Mixed Conifer and Hardwood

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	DF	105	155	224	60	10	16	28	120
		RA	40	52	73		10	14	20	115
	Minor	RC	13	13	18		10	12	18	110
	All	All	164	232	326		10	15	28	119
Midstory	Major	RC	24	8	13	5	2	7	12	38
		WH	39	14	19		2	6	12	39
	Minor	DF	10	4	5		4	6	8	40
	All	All	74	26	37		2	6	12	39
Total	All	All	238	258	363	64	2	12	28	94

Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.

This FMU is located on the middle slopes of the west side of the property on southwest-facing terrain. The upper zone has moderate slopes and the lower zone has steep slopes. The unit has a soil productivity rating of site class III. Based on historic inventory data, it is estimated that the unit regenerated naturally following clearcut harvesting around 1935. Total stocking is approximately 238 TPA. The overstory contains approximately 164 TPA and is primarily composed of red alder and Douglas-fir, with a small component of western redcedar. Overstory Douglas-fir average 16 inches DBH and 120 ft tall, and alder average 14 inches DBH and 115 ft tall. The midstory contains approximately 74 TPA and is primarily composed of western hemlock and western redcedar, with a small component of Douglas-fir. Midstory western redcedar average 7 inches DBH and 38 ft tall, and hemlock average 6 inches DBH and 39 ft tall.

This is a mixed conifer and hardwood stand that is moderately overstocked, particularly in areas that are dominant to Douglas-fir. In conifer-dominated portions, the forest appears to be in late Stem Exclusion or early Mature I stages of development. A commercial thinning in the accessible portions of this stand is recommended to address the conifer overstocking. The upper part of the stand is accessible from the Wickersham Truck Trail and contains moderate slopes that should enable ground-based logging operations. The lower slopes on the south side are very steep and are part of a hazard zone, so thinning will likely need to be non-commercial or avoided entirely in this zone.

FMU A7 - Conifer Plantation - Small DBH

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	DF	408	58	94	32	2	4	6	20

		RA	189	27	44		2	4	6	20
	Minor	CH	117	16	27		2	4	6	20
	All	All	714	101	164		2	4	6	20
Total	All	All	714	101	164	32	2	4	6	20
Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.										

This FMU is located on the middle slopes of the west side of the property. It has mostly moderate west-facing slopes and a soil productivity rating that ranges from site class II to III. It was clearcut around 2009 and replanted with Douglas-fir. No management has occurred in the intervening years and extensive infilling by red alder and other hardwoods has greatly increased stocking. Total stocking is approximately 714 TPA. The overstory is primarily composed of red alder and Douglas-fir, with a small component of bitter cherry. Overstory Douglas-fir average 4 inches DBH and 20 ft tall, and red alder average 4 inches DBH and 20 ft tall. No midstory is currently present in this stand. This plantation is overstocked and currently in the Stem Exclusion phase of development.

Per the earlier discussion of overstocked small-diameter plantations, an initial pre-commercial thinning is recommended, followed by a two-part sequence of variable density thinnings in the future, and potential underplanting once density has been sufficiently reduced. The unit is accessible from the Wickersham Truck Trail and the active H-3300E spur that provides access to the Chanterelle Trail Overlook. In addition, 1,000 ft of the abandoned spur known as CC-82 should be temporarily restored to provide better access into this unit in the coming years.

FMU A8 - Mixed Conifer - Stem Exclusion / Mature-I

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	DF	116	179	275	65	10	17	28	138
		WH	46	70	87		8	15	24	135
	Minor	RC	27	36	46		8	14	18	129
	All	All	189	284	408		8	16	28	136
Midstory	Major	RC	33	7	13	4	2	6	10	26
		WH	38	8	15		2	6	10	30
	All	All	75	17	30		2	6	10	30
Total	All	All	264	301	438	69	2	13	28	106
Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.										

This FMU is located on middle slopes in the central area of the property. It has southwest-facing slopes that are generally moderate at the upper elevations and steep at the lower elevations. The soil productivity rating ranges from site class III to IV. Based on historic inventory data, it is estimated that the unit regenerated naturally following clearcut harvesting around 1945-1952. Total stocking is approximately 280 TPA. The overstory contains approximately 140 TPA and is primarily composed of Douglas-fir, with small components of bigleaf maple, red alder, western redcedar and western hemlock. Overstory Douglas-fir average 18 inches DBH and 140 ft tall. The midstory contains approximately 140 TPA and is primarily composed of western hemlock and western redcedar that average 6 inches DBH and 60 ft tall. This is a moderately overstocked mixed conifer stand in the late stages of Stem Exclusion and early Mature-I stage of development with a cohort of trees developing in the understory and midstory.

Per the earlier discussion of this forest type at these stocking levels, a variable density thinning is recommended. The upper part of this unit is currently accessible from the Wickersham Truck Trail, though short, temporary spurs may need to be extended past the powerline easement to provide operational access to this unit. Hazard zones are present in this unit that appear to identify convergent headwalls and inner gorges along streams. These will need to be avoided during operations and further assessment is needed. Ground-based logging operations may be possible near the road, but much of this unit will likely require cable-yarding for commercial operations due to the steep slopes.

FMU A9 - Mixed Conifer and Hardwood

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	DF	70	100	180	49	12	18	28	140
	Minor	BM	14	20	24		10	14	20	140
		RA	14	20	24		10	14	20	140
		RC	21	30	36		10	14	20	140
		WH	21	30	36		10	14	20	140
	All	All	140	200	300		10	16	28	140
Midstory	Major	RC	70	20	31	8	2	6	10	60
		WH	70	20	31		2	6	10	60
	All	All	140	40	62		2	6	10	60
Total	All	All	280	240	362	56	2	11	28	100

Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.

This FMU is located in the central area of the property and contains steep north-facing slopes above a stream channel. The soil productivity rating is site class III. Based on historic inventory data, it is estimated that the unit regenerated naturally following clearcut harvesting around 1938. Total stocking is approximately 280 TPA. The overstory contains approximately 140 TPA and is primarily composed of Douglas-fir, with small components of bigleaf maple, red alder, western redcedar and western hemlock. Overstory Douglas-fir average 18 inches DBH and 140 ft tall. The midstory contains approximately 140 TPA and is primarily composed of western hemlock and western redcedar. Midstory redcedar and hemlock both average 6 inches DBH and 60 ft tall. This is a mixed conifer and hardwood stand with no health concerns, and most of the unit is in an identified hazard zone. Per the earlier discussion of this forest type, no management activities are recommended. There is no current road access to this stand.

FMU A10 - Conifer Plantation - Small DBH

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	DF	302	102	279	52	4	9	14	51
	Minor	RC	53	18	12		2	4	6	44
		WH	53	18	12		2	4	6	44
	All	All	408	138	304		2	8	14	49
Midstory	Major	CH	4	2	2	1	4	6	8	20
		DF	4	2	2		4	6	8	20
		RA	4	2	2		4	6	8	20
	All	All	12	6	5		4	6	8	20
Total	All	All	420	144	309	53	2	8	14	49

Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.

This FMU is located near the top of the ridgeline in the east-central area of the property next to the powerlines. It has mostly steep west-facing slopes and a soil productivity rating of site class IV. It was clearcut in the early 2000s and replanted with Douglas-fir. NO management has occurred in the following years. Total stocking is approximately 420 TPA. The overstory contains approximately 408 TPA and is primarily composed of Douglas-fir, with small components of western redcedar and western hemlock. Overstory Douglas-fir average 9 inches DBH and 51 ft tall. The midstory contains approximately 12 TPA and is primarily composed of red alder, bitter cherry and Douglas-fir. All three midstory species average 6 inches DBH and 20 ft tall. This plantation is overstocked and currently in the Stem Exclusion phase of development.

Per the earlier discussion of overstocked small-diameter plantations, an initial pre-commercial thinning is recommended, followed by a two-part sequence of variable density thinnings in the future, and potential underplanting once density has been sufficiently reduced. This unit is accessible from the Wickersham Truck Trail and from the top via the CC-60 road currently being used to access the powerline easement. The steep terrain will likely require cable-yarding for commercial operations. Minor hazard zones are present that appear to identify inner gorges along streams and may require additional assessment, but these can be easily avoided during thinning operations.

FMU B1 - Mixed Conifer and Hardwood

Stand Composition Summary

Canopy	Cohort	Species	TPA	BAA	SDI	RD	Min	Avg	Max	Avg

Position	Type						DBH	DBH	DBH	HT
Overstory	Major	DF	77	139	270	68	8	22	32	125
		RA	29	49	60		8	16	28	114
	Minor	RC	13	31	31		8	17	32	108
		WH	10	17	16		8	13	20	81
	All	All	135	248	389		8	19	32	116
Midstory	Major	RC	17	6	7	5	2	6	10	45
		WH	65	28	32		2	6	12	46
	All	All	84	35	41		2	6	12	46
Total	All	All	219	283	429	71	2	14	32	89

Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.

This FMU is located in the southern part of the property and stretches from the shores of Lake Whatcom on the west side to the upper slopes on the east side. It contains a series of west-facing terraces that alternate with moderate and steep slopes. A steep stream channel runs through the center of the unit, and the soil productivity rating ranges from site class II to III. Based on historic inventory data, it is estimated that the unit regenerated naturally following clearcut harvesting around 1933-1956. Total stocking is approximately 219 TPA. The overstory contains approximately 135 TPA and is primarily composed of red alder and Douglas-fir, with small components of western redcedar and western hemlock. Overstory Douglas-fir average 22 inches DBH and 125 ft tall, and alder average 16 inches DBH and 114 ft tall. The midstory contains approximately 84 TPA and is primarily composed of western hemlock and western redcedar. Midstory redcedar average 6 inches DBH and 45 ft tall, and hemlock average 6 inches DBH and 46 ft tall. This is a mixed conifer and hardwood stand with no health concerns. Per the earlier discussion of this forest type, no management activities are recommended. There is no current road access to this stand.

FMU B2 - Mixed Conifer - Mature-II

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	DF	70	120	213	58	12	20	36	180
		RC	70	120	149		8	16	36	180
	All	All	140	240	362		8	18	36	180
Midstory	Major	RC	50	20	35	9	4	8	12	60
		WH	50	20	35		4	8	12	60
	All	All	100	40	70		4	8	12	60
Total	All	All	240	280	432	67	4	14	36	130

Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.

This FMU is located in the southwest part of the property on steep southwest-facing slopes. The soil productivity rating is site class III. There is limited evidence of logging in this unit and based on historic inventory data, it is estimated that the unit regenerated naturally following a wildfire around 1896. While most trees are over 100 years old, a small cohort of Douglas-fir and western redcedar survived the fire and are even older. Total stocking is approximately 240 TPA. The overstory contains approximately 140 TPA and is primarily composed of western redcedar and Douglas-fir. Overstory Douglas-fir average 20 inches DBH and 180 ft tall, and redcedar average 16 inches DBH and 180 ft tall. The midstory contains approximately 100 TPA and is primarily composed of western hemlock and western redcedar that both average 8 inches DBH and 60 ft tall. This unit is a mixed conifer forest in the later Mature-II stage of development, with established midstory and understory cohorts. Per the earlier discussion of conifer forests in this stage, no management activities are recommended. There is no current road access to this unit.

FMU B3 - Mixed Conifer and Hardwood

This FMU is located in the southwest corner of the property near the shoreline of Lake Whatcom. It has mostly steep north-facing slopes and a soil productivity rating of site class III. Based on historic inventory data, it is estimated that the unit regenerated naturally following multiple landslides around 1940-1970. There is currently no road or trail access to this stand. This unit was not visited during the assessment due to challenging access. Based on remote sensing, this unit has similar forest conditions to nearby unit A9, where no management is recommended. In addition, this unit is on very steep slopes that include hazard zones and historic landslide activity. For these reasons, no management is recommended in this unit.

FMU B4 - Mixed Conifer and Hardwood

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	DF	31	69	167	52	16	28	Over 48	153
		RA	49	28	34		4	8	12	100
	Minor	BM	16	35	37		10	17	32	140
		RC	20	45	47		10	17	32	140
	All	All	124	200	313		4	16	Over 48	127
Midstory	Major	RC	31	20	30	5	4	9	16	60
		WH	15	4	8		4	7	12	60
	All	All	46	25	38		4	9	16	60
Total	All	All	170	225	350	57	4	14	Over 48	109

Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.

This FMU is in the southwest corner of the property along the shoreline of Lake Whatcom. It has steep west-facing slopes and a soil productivity rating of site class III. There is limited evidence of logging in this unit and based on historic inventory data, it is estimated that the unit regenerated naturally following a wildfire around 1908-1910. While most trees are over 100 years old, a small cohort of Douglas-fir survived the fire and are even older, with one fallen tree counted to be over 400 years old. This cohort measured four to five feet in diameter with extremely thick and fire-scarred bark as well as large diameter epicormic branches and reiterated tops.

Total stocking is approximately 170 TPA. The overstory contains approximately 124 TPA and is primarily composed of red alder and Douglas-fir, with small components of bigleaf maple and western redcedar. In the overstory, post-fire Douglas-fir average 28 inches DBH and 153 ft tall, and alder average 8 inches DBH and 100 ft tall. The midstory contains approximately 46 TPA and is primarily composed of western hemlock and western redcedar. Midstory redcedar average 9 inches DBH and 60 ft tall, and hemlock average 7 inches DBH and 60 ft tall. This is a mixed conifer and hardwood stand with no health concerns.

The 2023 Blue Canyon Fire burned 30-40 acres in the southern tip of this unit. While many smaller diameter trees died in this blaze, most of the medium to large-sized trees are still alive two years later and ground-cover has re-established in many areas. Per the earlier discussion of this forest type, no management activities are recommended and the recently burned areas are expected to continue developing naturally. There is no current road access to this stand but the Hertz Trail passes through the lower sections of this unit.

FMU B5 - Mixed Conifer - Mature-I

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	DF	60	168	245	54	16	24	32	120
	Minor	RC	15	42	26		10	14	24	120
		WH	15	42	26		10	14	24	120
	All	All	100	280	322		10	20	32	120
Midstory	Major	RC	30	3	7	2	2	4	8	20
		WH	30	3	7		2	4	8	20
	All	All	60	5	14		2	4	8	20
Total	All	All	160	285	336	56	2	14	32	82

Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.

This FMU is located on the south side of the property. The terrain is mostly steep west-facing slopes but there is a flatter plateau on the west side. The soil productivity rating is site class III on the steep slopes and site class II on the plateau. Based on historic inventory data, it is estimated that the unit regenerated naturally following clearcut harvesting around 1940-1951. Total stocking is approximately 160 TPA. The overstory contains approximately 100 TPA and is primarily composed of Douglas-fir, with small components of western redcedar and western hemlock. Overstory Douglas-fir average 24 inches DBH and 120 ft tall. The midstory contains approximately 60 TPA and is primarily composed of western hemlock and western redcedar. Midstory redcedar average 4 inches DBH and 20 ft tall, and hemlock average 4 inches DBH and 20 ft tall. This stand is in the Mature-I stage of development with a cohort of trees developing in the understory and midstory. The stand is not overstocked, and the overstory density is already below the initial target density for this forest type. Given these factors, no management is recommended. There is no current road access to this stand.

FMU B6 - Mixed Conifer - Mature-I

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	DF	80	151	276	61	12	22	32	137
		WH	52	90	112		8	16	28	132
	All	All	136	250	393		8	19	32	134
Midstory	Major	RC	16	12	11	5	4	8	12	40
		WH	52	24	32		2	7	12	40
	All	All	68	36	43		2	7	12	40
Total	All	All	204	286	436	66	2	15	32	103

Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.

This FMU is located in the southern area of the property on the middle to upper slopes. It contains mostly steep northwest-facing slopes and has a soil productivity rating of site class III. Based on historic inventory data, it is estimated that the unit regenerated naturally following clearcut harvesting around 1945-1951. Total stocking is approximately 204 TPA. The overstory contains approximately 136 TPA and is primarily composed of western hemlock and Douglas-fir. Overstory Douglas-fir average 22 inches DBH and 137 ft tall, and hemlock average 16 inches DBH and 132 ft tall. The midstory contains approximately 68 TPA and is primarily composed of western hemlock and western redcedar. Midstory redcedar average 8 inches DBH and 40 ft tall, and hemlock average 7 inches DBH and 40 ft tall. This stand is in the Mature-I stage of development with a cohort of trees developing in the understory and midstory. The stand is not overstocked and the overstory density is already below the initial target density for this forest type. Given these factors, no management is recommended. There is no current road access to this stand.

FMU B7 - Mixed Conifer - Stem Exclusion / Mature-I

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	WH	237	219	343	75	8	13	18	104
	Minor	DF	85	86	181		10	16	24	118
		RC	19	16	26		10	12	14	120
		SF	14	14	19		8	12	16	80
	All	All	356	336	569		8	13	24	107
Midstory	Major	WH	70	10	20	3	2	5	8	16
	Minor	RC	14	1	3		2	4	6	11
	All	All	88	12	24		2	4	8	15
Total	All	All	444	348	593	78	2	12	24	89

Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.

This FMU is located in the southwest area of the property near the upper ridgeline. The stand contains moderate slopes on the upper portion surrounded by steep west- and southwest-facing slopes. The soil productivity rating is site class IV. Based on historic inventory data and aerial imagery, it is estimated that the unit regenerated naturally following clearcut harvesting between the 1930s and 1950s. There is some evidence portions of this unit uphill of the road have been pre-commercially thinned in the past, potentially as part of the nearby harvest of unit A10 in the early 2000s. Total stocking is approximately 444 TPA. The overstory contains approximately 356 TPA and is primarily composed of western hemlock, with small components of Douglas-fir, western redcedar and Pacific silver fir. Overstory western hemlock average 13 inches DBH and 104 ft tall. The midstory contains approximately 88 TPA and is primarily composed of western hemlock, with a small component of western redcedar. Midstory western hemlock average 5 inches DBH and 16 ft tall. Though this unit has a varied history, it is currently overstocked and in the late Stem Exclusion and early Mature-I phases of development.

Per the earlier discussion of overstocked mixed conifer forests in this phase, a sequence of variable density thinnings is recommended. Given the current high density of this stand, two thinnings will be required to hit the initial density target. This unit can be accessed from the Wickersham Truck Trail. The moderate upper slopes should enable ground-based commercial thinning activities, while the steeper lower slopes may require cable-yarding for commercial operations. Hazard zones are present that appear to identify inner gorges along streams and may require additional assessment, but these can be avoided during thinning operations.

FMU B8 - Mixed Conifer - Stem Exclusion

Stand Composition Summary

Canopy	Cohort	Species	TPA	BAA	SDI	RD	Min	Avg	Max	Avg

Position	Type						DBH	DBH	DBH	HT
Overstory	Major	WH	270	233	378	80	6	12	20	115
	Minor	DF	64	59	125		10	15	24	117
		SF	72	66	136		10	15	24	117
	All	All	406	358	639		6	13	24	116
Total	All	All	406	358	639	80	6	13	24	116

Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.

This FMU is located in the southwest area of the property near the upper ridgeline. The stand contains an upper plateau surrounded by mostly moderate south- and west-facing slopes. The soil productivity rating is site class IV. Based on historic inventory data, it is estimated that the unit regenerated naturally following clearcut harvesting around 1942-1949. Total stocking is approximately 406 TPA. The overstory is primarily composed of western hemlock, with small components of Douglas-fir and pacific silver fir. Overstory western hemlock average 12 inches DBH and 115 ft tall. No midstory is currently present in this stand. This stand is overstocked and in the Stem Exclusion phase of development.

Per the earlier discussion of overstocked mixed conifer forests in this phase, a sequence of variable density thinnings is recommended. Given the current high density of this stand, two thinnings will be required to hit the initial density target. This unit can be accessed from the Wickersham Truck Trail. Ground-based commercial thinning should be possible on the flatter upper plateau with cable-yarding used on the steeper edges of the unit.

FMU B9 - Mixed Conifer - Mature-I

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	DF	90	190	319	75	12	22	32	120
		WH	72	152	153		8	16	24	120
	Minor	RC	18	38	31		8	14	24	120
	All	All	180	380	503		8	19	32	120
Midstory	Major	WH	100	20	44	5	2	6	8	40
Total	All	All	280	400	547	80	2	14	32	91

Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.

This FMU is in the southeast corner of the property and contains mostly moderate to steep south-facing slopes that curve around two stream channels. The soil productivity rating ranges from site class II to IV. Based on historic inventory data, it is estimated that the unit regenerated naturally following clearcut harvesting around 1936-1949. Total stocking is approximately 280 TPA. The overstory contains approximately 180 TPA and is primarily composed of western hemlock and Douglas-fir, with a small component of western redcedar. Overstory Douglas-fir average 22 inches DBH and 120 ft tall, and hemlock average 16 inches DBH and 120 ft tall. The midstory contains approximately 100 TPA and is primarily composed of western hemlock that average 6 inches DBH and 40 ft tall. This stand is in the Mature-I stage of development with a cohort of trees developing in the understory and midstory. Given the current overstory diversity and presence of regeneration, per the earlier discussion of overstocked mixed conifer forests in this phase, no management is recommended. There is no current road access to this stand.

FMU B10 - Conifer Plantation - Small DBH

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	DF	194	80	157	44	4	9	14	40
		RA	135	26	52		2	5	8	40
	Minor	CH	36	10	8		2	4	8	40
		RC	18	5	4		2	4	6	40
		SF	18	5	4		2	4	6	40
		WH	62	23	32		2	6	12	40
	All	All	464	148	258		2	7	14	40
Midstory	Major	DF	16	1	4	2	2	4	6	10
		RC	16	1	4		2	4	6	10
		WH	16	1	4		2	4	6	10
	All	All	48	4	11		2	4	6	10
Total	All	All	512	152	269	45	2	6	14	37

Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.

This FMU is located on the southeast side of the property. It has mostly mild northwest-facing slopes and a soil productivity rating of site class IV. This unit was clearcut in 2006 and replanted with Douglas-fir, but natural regeneration of red alder and other minor species also occurred. Total stocking is approximately 512 TPA. The overstory contains approximately 464 TPA and is primarily composed of Douglas-fir and red alder, with small components of bitter cherry, western redcedar, pacific silver fir and western hemlock. Overstory Douglas-fir average 9 inches DBH and 40 ft tall, and alder average 5 inches DBH and 40 ft tall. The midstory contains approximately 48 TPA and is primarily composed of Douglas-fir, western redcedar and western hemlock, which all average 4 inches DBH and 10 ft tall. This stand is at the end of the Canopy Closure phase of development and current stocking densities are not sustainable long term. Per the earlier discussion of overstocked small-diameter plantations, an initial pre-commercial thinning is recommended, followed by a two-part sequence of variable density thinnings in the future, and potential underplanting once density has been sufficiently reduced. Underplanting may not be necessary, however, due to the current minor presence of several other species. The unit is accessible from the Wickersham Truck Trail and CC-57 spur, though short, temporary spurs may need to be extended past the powerline easement to provide operational access to this unit. The moderate terrain should enable ground-based commercial operations.

FMU C1 - Mixed Conifer - Mature-I/II

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	DF	47	88	137	45	10	19	32	152
	Minor	RC	19	38	87		10	25	42	135
		WH	18	30	31		8	14	20	144
	All	All	99	181	282		8	19	42	143
Midstory	Major	RC	22	12	13	5	2	7	14	51
		WH	32	14	19		2	7	20	40
	All	All	58	27	37		2	7	20	47
Total	All	All	157	208	320	50	2	15	42	108
Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.										

This FMU is located in the central part of the property on steep north-facing slopes above Smith Creek. The soil productivity rating is site class III. Based on historic inventory data, it is estimated that the unit regenerated naturally following clearcut and high-grade harvesting around 1918-1942. Some large older cedar that likely originated before this time range were observed on the lower slopes near large cut stumps, suggesting that parts of the stand were high-grade harvested rather than clearcut. Total stocking is approximately 157 TPA. The overstory contains approximately 99 TPA and is primarily composed of Douglas-fir, with small components of western redcedar and western hemlock. Overstory Douglas-fir average 19 inches DBH and 152 ft tall. The midstory contains approximately 58 TPA and is primarily composed of western hemlock and western redcedar. Midstory redcedar average 7 inches DBH and 51 ft tall, and hemlock average 7 inches DBH and 40 ft tall. The high-grade harvest that likely occurred in parts of this mixed conifer stand make it difficult to identify an exact phase of development, but most of it is likely in the late Mature-I and early Mature-II phase. Per the earlier discussion of stands in these stages of development, and given the healthy stocking density and presence of regeneration, no management activities are recommended for this unit. There is no current road access to this stand, but the Wickersham Truck Trail runs through part of the adjacent powerlines.

FMU C2 - Mixed Conifer - Stem Exclusion

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	DF	128	146	194	54	8	13	24	123

		WH	153	158	182		6	11	18	126
	All	All	281	304	376		6	12	24	125
Midstory	Major	WH	32	13	19	3	4	7	10	40
	All	All	39	20	24		4	7	10	40
Total	All	All	320	324	400	58	4	11	24	114

Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.

This FMU is located on the upper slopes of the central part of the property and runs adjacent to the powerline easement. It contains moderate to steep north-east facing slopes leading down to the south fork of Smith Creek. It has a soil productivity rating that ranges from site class III to IV. Based on historic inventory data, it is estimated that the unit regenerated naturally following clearcut harvesting around 1936-1946. Total stocking is approximately 320 TPA. The overstory contains approximately 281 TPA and is primarily composed of western hemlock and Douglas-fir. Overstory Douglas-fir average 13 inches DBH and 123 ft tall, and hemlock average 11 inches DBH and 126 ft tall. The midstory contains approximately 39 TPA and is primarily composed of western hemlock that average 7 inches DBH and 40 ft tall. This stand is overstocked and in the Stem Exclusion phase of development.

Per the earlier discussion of overstocked mixed conifer forests in this phase, a sequence of variable density thinnings is recommended. This stand is accessible from active powerline easement roads, including the CC-70. Ground-based logging may be feasible on the mild terrain on the north side, but the steep slopes elsewhere in the unit may require cable-yarding for commercial operations. Hazard zones are present that appear to identify inner gorges along streams that flow on the lower slopes of this unit. These may require additional assessment, but can be avoided during thinning operations.

FMU C3 - Mixed Conifer and Hardwood

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	DF	37	69	149	41	12	24	44	152
		RA	21	30	31		8	13	20	127
		WH	28	42	62		10	16	22	132
	All	All	89	144	254		8	19	44	139
Midstory	Major	RC	25	14	21	7	6	9	22	61
		WH	33	17	24		6	8	12	61
	Minor	DF	11	8	8		6	8	12	63
	All	All	69	40	53		6	8	22	61
Total	All	All	158	184	306	47	6	14	44	105

Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.

This FMU is in the central area of the property and is part of the Smith Creek drainage. Smith Creek and one of its tributaries flows along the northern and southern boundaries of the unit. The terrain consists of mostly steep northwest- and southwest-facing slopes and the soil productivity rating is site class III. This site likely has variable harvest and disturbance history. It is estimated that a fire swept through parts of this stand in the late 1800s, burning some trees and leaving some pockets of remnant old trees. In the 1940s and 1950s, parts of this unit were logged near the road that was built, likely removing some of the easily accessible large trees that survived the fire. Other areas were not logged likely due to having mostly small low-value trees at the time that regenerated after the fire. These areas that were not logged contained some pockets of the old trees that survived the original fire.

Total stocking is approximately 158 TPA. The overstory contains approximately 89 TPA and is primarily composed of western hemlock, red alder and Douglas-fir. Overstory Douglas-fir average 24 inches DBH and 152 ft tall, hemlock average 16 inches DBH and 132 ft tall, and alder average 13 inches DBH and 127 ft tall. The midstory contains approximately 69 TPA and is primarily composed of western hemlock and western redcedar, with a small component of Douglas-fir. Midstory redcedar average 9 inches DBH and 61 ft tall, and hemlock average 8 inches DBH and 61 ft tall. The complex disturbance history of this stand has resulted in a mixed forest with multiple cohorts of trees. Per the earlier discussion of mixed conifer and hardwood stands with no health concerns, no management activities are recommended for this unit. There is no current road access to this stand since the 1983 storm event destroyed the road system that used to provide access.

FMU C4 - Mixed Conifer - Mature-I

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	WH	162	198	416	53	8	18	22	120
	Minor	SF	18	22	31		8	14	20	120
	All	All	180	220	447		8	18	22	120
Total	All	All	180	220	447	53	8	18	22	120

Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.

This FMU consists of two separate areas on the east side of the property that are part of the Smith Creek drainage. The northern area consists of steep north-facing terrain, and the southern area consists of steep west–facing terrain. The soil productivity rating ranges from site class III on the lower slopes to site class IV on the upper slopes. Based on historic inventory data, it is estimated that the unit regenerated naturally following clearcut harvesting around 1950. While some adjacent stands were only partially harvested during these times, historical aerial imagery from 1951 shows that the two areas that make up this unit were likely clearcut harvested.

Total stocking is approximately 180 TPA. The overstory is primarily composed of western hemlock, with a small component of pacific silver fir. Overstory western hemlock average 18 inches DBH and 120 ft tall.

No midstory is currently present in this stand. This stand is in the early Mature-1 phase of development, with regeneration occurring in the understory. The current stocking is near the initial target density for mixed conifer stands in this phase. The unit is mostly north and northwest facing slopes where more abundant soil moisture is suitable for drought-intolerant western hemlock and silver fir. Per the earlier discussion of mixed conifer forests in the Mature-I stage with healthy stocking levels, no management activities are recommended. There is no current road access to this stand.

FMU C5 - Mixed Conifer - Stem Exclusion/Mature-I

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	DF	69	55	108	50	8	13	24	95
		WH	262	208	280		6	10	24	99
	All	All	332	264	389		6	11	24	98
Midstory	Major	RC	14	7	8	3	4	7	12	53
		WH	42	13	15		2	5	10	48
	All	All	56	20	24		2	6	12	50
Total	All	All	388	284	412	53	2	10	24	91

Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.

This FMU is located on the upper slopes of the east side of the property. It consists of an upper plateau in the center surrounded by moderate to steep terrain the slopes to the north, west, and south. The soil productivity rating is site class IV. Based on historic inventory data and aerial imagery, it is estimated that parts of this unit regenerated naturally following a wildfire in the late 1800s and parts regenerated naturally following harvest activities in the 1920s-1940s. Despite the variable disturbance history, the unit has been delineated based on the presence of overstocked forests with slow-growth rates throughout.

Total stocking is approximately 388 TPA. The overstory contains approximately 332 TPA and is primarily composed of western hemlock and Douglas-fir. Overstory Douglas-fir average 13 inches DBH and 95 ft tall, and hemlock average 10 inches DBH and 99 ft tall. The midstory contains approximately 56 TPA and is primarily composed of western hemlock and western redcedar. Midstory redcedar average 7 inches DBH and 53 ft tall, and hemlock average 5 inches DBH and 48 ft tall. This stand is overstocked and mostly in the Stem Exclusion phase of development, but some areas with slightly lower stocking have started to enter the Mature-I phase. The unit is mostly ridgeline and southwest facing slopes and western hemlock is likely poorly suited to future growing conditions. Per the earlier discussion of overstocked mixed conifer forests in this phase, a sequence of variable density thinnings is recommended. Due to the lack of road access, the thinning will need to be non-commercial unless 0.5 miles of new road is constructed.

FMU C6 - Mixed Conifer - Stem Exclusion/Mature-I

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	WH	236	161	220	41	4	9	28	85
	Minor	DF	14	38	66		16	27	34	140
	All	All	255	218	318		4	11	38	89
Midstory	Major	WH	144	18	33	5	2	4	6	40
	All	All	154	21	40		2	4	12	41
Total	All	All	409	239	358	46	2	8	38	71

Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.

This FMU is located on the upper slopes of the east side of the property. It contains mostly moderate west-facing slopes and has a soil productivity rating of site class IV. Based on historic inventory data, it is estimated that most of this unit regenerated naturally following clearcut harvesting around 1950. Based on field observations and historical aerial imagery, it appears that some portions of this stand were left during this harvest, and today contain slightly older trees than the areas that were harvested. It is possible that a wildfire swept through parts of this stand in the late 1800s, so the trees that regenerated post-fire were small and low-value when the harvest occurred, and therefore retained.

Total stocking is approximately 409 TPA. The overstory contains approximately 255 TPA and is primarily composed of western hemlock, with a small component of Douglas-fir. Overstory western hemlock average 9 inches DBH and 85 ft tall. The midstory contains approximately 154 TPA and is primarily composed of western hemlock that average 4 inches DBH and 40 ft tall. The forest in this stand is overstocked and a mix of areas in the Stem Exclusion phase and areas in the Mature-I phase of development. While the unit's northwest facing slopes are suitable for drought-intolerant western hemlock, the overstory is over 90% hemlock and lacks diversity. Per the earlier discussion of overstocked mixed conifer forests in this phase, a sequence of variable density thinnings is recommended. There is no current road access to this stand, but the SH-2000 road runs near the eastern border of the stand. The thinning will likely be non-commercial unless a new road is constructed into the stand.

FMU D1 - Mixed Conifer - Mature-II

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	DF - Cohort 1	62	166	237	69	10	23	42	169
		WH	35	90	102		10	19	30	164
	Minor	DF - Cohort 2	8	24.5	73		32	40	> 48	180
	All	All	116	312	441		10	22	> 48	169

Midstory	Major	RC	40	22	39	12	4	10	16	64
		WH	64	28	55		4	9	16	63
	All	All	104	50	94		4	9	16	63
Total	All	All	220	362	534	81	4	16	> 48	119

Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.

This stand consists of three separate areas on the north side of the property that are part of the Smith Creek drainage. Two areas are on the north side of Smith Creek and contain steep south- and east-facing slopes, while the third area is on the south side of Smith Creek and contains steep northwest-facing slopes. There is limited evidence of logging in this unit and based on historic inventory data, it is estimated that the unit regenerated naturally following a wildfire around 1880. While most trees are over 125 years old, a small cohort of Douglas-fir survived the fire and are even older, possibly several hundred years old. This cohort measured three to five feet in diameter with extremely thick bark as well as large-diameter epicormic branches.

Total stocking is approximately 220 TPA. The overstory contains approximately 116 TPA and is primarily composed of western hemlock and Douglas-fir. Overstory Douglas-fir average 23 inches DBH and 169 ft tall, and hemlock average 19 inches DBH and 164 ft tall. The midstory contains approximately 104 TPA and is primarily composed of western hemlock and western redcedar. Midstory redcedar average 10 inches DBH and 64 ft tall, and hemlock average 9 inches DBH and 63 ft tall. This mixed conifer forest is in the Mature-II phase of development with healthy stocking levels and midstory and understory cohorts of trees. Per the earlier discussion of mixed conifer forests in this phase, no management activities are recommended. Parts of this unit can be accessed via the SH-94 road, but access is otherwise limited.

FMU D2 - Mixed Conifer and Hardwood

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	RA	66	100	139	55	10	16	24	122
	Minor	DF	26	59	88		10	21	32	130
		RC	19	44	54		10	19	32	118
		WH	21	49	60		10	19	32	123
	All	All	132	252	341		10	18	32	123
Midstory	Major	WH	92	32	56	7	4	7	12	44
Total	All	All	224	284	397	62	4	14	32	91

Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.

This is a large FMU spread out across the lower and middle slopes of the Smith Creek drainage on the north side of the property. It contains mostly steep terrain on both sides of Smith Creek and one of its major tributaries. Based on historic inventory data, it is estimated that most of this unit regenerated naturally following clearcut harvesting around 1950-1953. Total stocking is approximately 224 TPA. The overstory contains approximately 132 TPA and is primarily composed of red alder, with small components of Douglas-fir, western redcedar and western hemlock. Overstory red alder average 16 inches DBH and 122 ft tall. The midstory contains approximately 92 TPA and is primarily composed of western hemlock that average 7 inches DBH and 44 ft tall. This stand regenerated as a mixed forest following the harvest. This unit will undergo a transition as the alder declines, but there is no concern about the future forest cover of the unit due to the presence of long-lived overstory conifer species and current regeneration in the understory. Therefore, there are no management recommendations for this mixed conifer and hardwood unit. Parts of this unit can be accessed via the SH-94 road, but access is otherwise limited since the 1983 storm event destroyed the road system that used to provide access.

FMU D3 - Mixed Conifer - Stem Exclusion

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	WH	248	180	267	45	6	10	22	91
	Minor	DF	50	37	62		6	11	22	97
		RC	22	17	22		8	10	14	87
	All	All	324	239	355		6	11	22	92
Midstory	Major	RC	45	18	25	7	4	7	10	55
		WH	61	21	30		4	6	10	47
	All	All	106	39	56		4	7	10	50
Total	All	All	430	278	410	52	4	10	22	82
Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.										

This unit consists of two separate areas on the upper slopes along the eastern boundary of the property. It has moderate to steep west- and south-facing slopes and a soil productivity rating that ranges from site class III to IV. Based on historic inventory data, it is estimated that the area regenerated following a clearcut harvest around 1950. Total stocking is approximately 430 TPA. The overstory contains approximately 324 TPA and is primarily composed of western hemlock, with small components of Douglas-fir and western redcedar. Overstory western hemlock average 10 inches DBH and 91 ft tall. The midstory contains approximately 106 TPA and is primarily composed of western hemlock and western redcedar. Midstory redcedar average 7 inches DBH and 55 ft tall, and hemlock average 6 inches DBH and 47 ft tall. Even though there is a slightly different disturbance history, both areas are overstocked mixed conifer forests in the Stem Exclusion phase of development.

Per the earlier discussion of overstocked mixed conifer forests in this phase, a sequence of variable density thinnings is recommended. This stand is generally accessible from the Sultan Hill Mainline road, though short temporary spurs would need to be built or restored to provide access. Aside from the plateau on the southern side, the unit contains mostly steep slopes that will likely require cable-yarding for commercial operations. Hazard zones are present that appear to identify inner gorges along streams and a convergent headwall and will require additional assessment.

FMU D4 - Mixed Conifer - Stem Exclusion

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	DF	88	64	88	31	8	10	12	80
		WH	132	96	132		8	10	12	80
	All	All	220	160	220		8	10	12	80
Midstory	Major	DF	160	60	70	21	4	6	8	60
		WH	160	60	70		4	6	8	60
	All	All	320	120	141		4	6	8	60
Total	All	All	540	280	361	51	4	8	12	68

Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.

This FMU is located on the upper slopes along the eastern boundary of the property. It contains mostly steep west-facing slopes and has a soil productivity rating of site class IV. Based on historic inventory data, it is estimated that the stand was planted with Douglas-fir following a clearcut harvest around 1991 and filled in naturally with western hemlock. Total stocking is approximately 540 TPA. The overstory contains approximately 220 TPA and is primarily composed of western hemlock and Douglas-fir. Overstory Douglas-fir average 10 inches DBH and 80 ft tall, and hemlock average 10 inches DBH and 80 ft tall. The midstory contains approximately 320 TPA and is primarily composed of western hemlock and Douglas-fir. Midstory Douglas-fir and hemlock both average 6 inches DBH and 60 ft tall. This stand is overstocked and in the Stem Exclusion phase of development. Per the earlier discussion of overstocked mixed conifer forests in this phase, a sequence of variable density thinnings is recommended. This stand is accessible from the Sultan Hill mainline road and the short, abandoned SH-112 spur road. The upper part of the stand contains mild slopes that may enable ground-based commercial operations, but much of the stand will likely require cable-yarding. A couple hazard zones are present that will need further assessment before operations.

FMU D5 - Mixed Conifer - Late Seral

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	DF	10	60	124	36	42	48	> 48	180
		RC	10	60	100		38	42	> 48	180

	All	All	20	120	224		38	45	> 48	180
Midstory	Major	RC	16	32	49	15	16	20	24	120
		WH	24	48	73		16	20	24	100
	All	All	40	80	122		16	20	24	108
Total	All	All	60	200	346	50	16	28	> 48	132

Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.

This FMU is located on the northeast side of the property and is part of the Smith Creek drainage. It has steep northwest facing slopes and a soil productivity rating that ranges from site class III to IV. This stand was not harvested and contains remnant old-growth Douglas-fir and western redcedar in the overstory and complex midstory and understory cohorts. This stand has experienced natural disturbances over the years, including a windstorm and likely a wildfire that swept through this area in the late 1800s. These disturbances have reduced the density of the original overstory cohort.

Total stocking is approximately 60 TPA. The overstory contains approximately 20 TPA and is primarily composed of Douglas-fir and western redcedar. Overstory Douglas-fir average 48 inches DBH and 180 ft tall, and redcedar average 42 inches DBH and 180 ft tall. The midstory contains approximately 40 TPA and is primarily composed of western hemlock and western redcedar. Midstory redcedar average 20 inches DBH and 120 ft tall, and hemlock average 20 inches DBH and 100 ft tall. Regeneration of redcedar, hemlock, and Pacific silver fir is occurring at a density of greater than 50 TPA. This is a late seral stand, which is rare in the Lake Whatcom watershed. Per the earlier discussion of old mixed conifer forests, no management activities are recommended. There is no current road access to this stand.

FMU D6 - Mixed Conifer - Stem Exclusion/Mature-I

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	DF	136	118	253	88	8	15	24	95
		WH	254	222	398		8	13	24	110
	All	All	390	340	651		8	14	24	104
Midstory	Major	WH	65	16	22	4	2	5	12	40
	Minor	RC	15	6	10		4	8	12	40
	All	All	80	22	32		2	6	12	40
Total	All	All	470	362	683	92	2	12	24	94

Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.

This FMU consists of two separate areas on the north side of the property. The west-most area consists of mostly southwest-facing slopes, and the east-most area consists of mostly moderate southeast-facing slopes. The soil productivity rating is site class IV. Based on historic inventory data, it is estimated that the stand regenerated naturally following a clearcut harvest around 1962-1963. Total stocking is approximately 470 TPA. The overstory contains approximately 390 TPA and is primarily composed of western hemlock and Douglas-fir. Overstory Douglas-fir average 15 inches DBH and 95 ft tall, and hemlock average 13 inches DBH and 110 ft tall. The midstory contains approximately 80 TPA and is primarily composed of western hemlock, with a small component of western redcedar. Midstory hemlock average 5 inches DBH and 40 ft tall.

No management is recommended in the western area of this unit as it is a riparian zone and unstable convergent headwall that was not logged during recent DNR activities in 2011. In the eastern area, a sequence of variable density thinnings is recommended, per the earlier discussion of overstocked mixed conifer forests in this phase of development. The eastern stand is accessible from the SH-94 road and operations would benefit from restoring 0.25 miles of abandoned road bed to provide access deeper into the stand. The eastern unit contains mild slopes which should enable ground-based commercial operations. A historic landslide may be present in the southern half of the eastern unit which will require further assessment.

FMU D7 - Mixed Conifer - Stem Exclusion

Stand Composition Summary

<table>
<tr><th>Canopy Position</th><th>Cohort Type</th><th>Species</th><th>TPA</th><th>BAA</th><th>SDI</th><th>RD</th><th>Min DBH</th><th>Avg DBH</th><th>Max DBH</th><th>Avg HT</th></tr>
<tr><td rowspan="4">Overstory</td><td rowspan="2">Major</td><td>DF</td><td>130</td><td>121</td><td>143</td><td rowspan="4">44</td><td>6</td><td>11</td><td>18</td><td>64</td></tr>
<tr><td>WH</td><td>151</td><td>118</td><td>124</td><td>4</td><td>9</td><td>18</td><td>74</td></tr>
<tr><td>Minor</td><td>RC</td><td>23</td><td>26</td><td>36</td><td>8</td><td>13</td><td>18</td><td>80</td></tr>
<tr><td>All</td><td>All</td><td>304</td><td>265</td><td>304</td><td>4</td><td>10</td><td>18</td><td>70</td></tr>
<tr><td rowspan="3">Midstory</td><td>Major</td><td>WH</td><td>123</td><td>60</td><td>28</td><td rowspan="3">4</td><td>2</td><td>4</td><td>6</td><td>36</td></tr>
<tr><td>Minor</td><td>RC</td><td>23</td><td>5</td><td>5</td><td>2</td><td>4</td><td>6</td><td>25</td></tr>
<tr><td>All</td><td>All</td><td>148</td><td>68</td><td>34</td><td>2</td><td>4</td><td>6</td><td>35</td></tr>
<tr><td>Total</td><td>All</td><td>All</td><td>452</td><td>333</td><td>338</td><td>47</td><td>2</td><td>8</td><td>18</td><td>58</td></tr>
<tr><td colspan="11">Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.</td></tr>
</table>

This FMU is located on the north side of the property, near the headwaters of Smith Creek. It contains an upper plateau with mild slopes and a section with steep south-facing slopes. The soil productivity rating is site class IV. Based on historic inventory data, it is estimated that the stand was replanted following a clearcut harvest around 1962-1967. It was likely planted with Douglas-fir but other conifer species have also naturally regenerated. Total stocking is approximately 452 TPA. The overstory contains approximately 304 TPA and is primarily composed of western hemlock and Douglas-fir, with a small component of western redcedar. Overstory Douglas-fir average 11 inches DBH and 64 ft tall, and hemlock average 9 inches DBH and 74 ft tall. The midstory contains approximately 148 TPA and is primarily composed of western hemlock, with a small component of western redcedar. Midstory western hemlock average 4 inches DBH and 36 ft tall. This stand is overstocked and in the Stem Exclusion phase of development. Per the earlier discussion of overstocked mixed conifer forests in this phase, a sequence of variable density thinnings is recommended. This stand is accessible from the Sultan Hill Mainline road. The mild terrain on the upper plateau should enable ground-based commercial thinning, but the lower steep slopes will likely require cable-yarding techniques. Hazard zones are present along the edges of this stand that appear to identify inner gorges along streams, but these can be avoided during thinning operations.

FMU D8 - Mixed Conifer - Stem Exclusion/Mature-I

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	DF	104	171	285	83	8	19	28	140
		WH	149	190	268		8	14	22	112
	All	All	270	380	576		8	16	28	122
Midstory	Major	RC	55	20	24	6	4	6	10	40
		WH	55	20	24		4	6	10	40
	All	All	110	40	48		4	6	10	40
Total	All	All	380	420	624	89	4	13	28	98

Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.

This FMU is located on the north side of the property, near the headwaters of Smith Creek. It has steep south-facing slopes and a soil productivity rating that ranges from site class III to IV. Based on historic inventory data, it is estimated that the stand regenerated naturally following a wildfire around 1900. Total stocking is approximately 380 TPA. The overstory contains approximately 270 TPA and is primarily composed of western hemlock and Douglas-fir. Overstory Douglas-fir average 19 inches DBH and 140 ft tall, and hemlock average 14 inches DBH and 112 ft tall. The midstory contains approximately 110 TPA and is primarily composed of western hemlock and western redcedar that both average 6 inches DBH and 40 ft tall. This forest is overstocked and largely in the Stem Exclusion phase of development with some lower-density areas beginning to enter the Mature-I phase.

Per the earlier discussion of overstocked mixed conifer forests in this phase, a sequence of variable density thinnings is recommended. Restoring 800ft of the abandoned SH-98 spur will be necessary to reach this stand. Commercial thinning may be possible using cable-yarding techniques, but will likely need to avoid several steep inner gorge systems so the total treatable area will be lower.

FMU D9 - Mixed Conifer - Stem Exclusion

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT

Overstory	Major	WH	314	181	220	48	4	8	12	77
	Minor	DF	62	39	43		4	8	10	78
		RA	38	20	27		6	8	10	80
		RC	80	39	77		6	10	16	77
	All	All	495	279	367		4	8	16	78
Midstory	Major	WH	180	8	45		2	4	8	42
	Minor	RC	18	2	8		4	6	8	60
	All	All	197	11	53		2	4	8	43
Total	All	All	692	290	420	55	2	7	16	68
Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.										

This FMU is located in the northeast corner of the property and is part of the headwaters for Smith Creek. It contains moderate to steep slopes on both sides of Smith Creek and one of its tributaries, so slope direction varies but generally curves around the streams that flow to the southwest. The soil productivity rating is site class IV. Based on historic inventory data, it is estimated that the stand naturally regenerated following a clearcut harvest around 1984-1985. Douglas-fir was likely replanted following the harvest, but survival was low and the stand naturally regenerated with mostly western hemlock. Total stocking is approximately 692 TPA. The overstory contains approximately 495 TPA and is primarily composed of western hemlock, with small components of Douglas-fir, red alder and western redcedar. Overstory western hemlock average 8 inches DBH and 77 ft tall. The midstory contains approximately 197 TPA and is primarily composed of western hemlock, with a small component of western redcedar. Midstory hemlock average 4 inches DBH and 42 ft tall. This stand is overstocked and in the Stem Exclusion phase of development. Per the earlier discussion of overstocked mixed conifer forests in this phase, a sequence of variable density thinnings is recommended. This stand is very accessible from the Sultan Hill Mainline road. Most of the steep terrain will likely require cable-yarding for commercial operations. Hazard zones are present that appear to identify inner gorges along streams and may require additional assessment, but these can be avoided during thinning operations.

FMU E1 - Mixed Conifer and Hardwood

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	DF	35	83	120	54	12	21	32	134
		RA	23	54	53		12	17	24	129
		RC	35	83	120		12	21	32	134
	Minor	WH	15	35	38		10	18	24	135
	All	All	112	264	341		10	20	32	133
Midstory	Major	RC	36	20	29	7	4	9	14	60
		WH	36	20	29		4	9	14	60

	All	All	72	40	58		4	9	14	60
Total	All	All	184	304	399	61	4	16	32	104

Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.

This FMU is located in the northwest corner on the lower slopes of the property. It has mostly south-facing slopes and a soil productivity rating of site class II. Based on historic inventory data, it is estimated that the stand naturally regenerated following a clearcut harvest around 1920-1924. Total stocking is approximately 184 TPA. The overstory contains approximately 112 TPA and is primarily composed of red alder, Douglas-fir and western redcedar, with a small component of western hemlock. Overstory Douglas-fir and redcedar both average 21 inches DBH and 134 ft tall, and alder average 17 inches DBH and 129 ft tall. The midstory contains approximately 72 TPA and is primarily composed of western hemlock and western redcedar that both average 9 inches DBH and 60 ft tall. This is a mixed conifer and hardwood forest with red alder that is beginning to decline.

Per the earlier discussion of mixed conifer and hardwood forests with healthy stocking, no large-scale management activities are recommended in this forest, but it is recommended to monitor the presence of invasive species. Gaps will form in the canopy of this stand as the red alder declines which creates the possibility of Himalayan blackberry infestation due its presence in nearby stands. Monitoring will ensure any potential infestations are caught early and treated before they become a major forest health concern. The lower portion of this stand is currently accessible from a powerline access road and an orphaned road system continues up into the stand which is now being used as a hiking and biking trail.

FMU E2 - Mixed Conifer and Hardwood

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	DF	26	70	108	39	16	24	32	120
	Minor	BM	13	34	37		8	19	28	120
		RA	13	34	37		8	19	28	120
		RC	11	29	29		8	18	24	120
		WH	11	29	29		8	18	24	120
	All	All	76	196	240		8	20	32	120
Midstory	Major	RA	8	3	4	4	2	6	10	60
		RC	14	9	12		2	9	16	60
		WH	14	9	12		2	9	16	60
	All	All	36	20	27		2	8	16	60
Total	All	All	112	216	267	42	2	16	32	101

Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.

This FMU is located in the northwest corner on the lower slopes of the property. It has mostly south-facing slopes and a soil productivity rating of site class II. Based on historic inventory data, it is estimated that the stand naturally regenerated following a clearcut harvest around 1941. Total stocking is approximately 112 TPA. The overstory contains approximately 76 TPA and is primarily composed of Douglas-fir, with small components of bigleaf maple, red alder, western redcedar and western hemlock. Overstory Douglas-fir average 24 inches DBH and 120 ft tall. The midstory contains approximately 36 TPA and is primarily composed of western hemlock, red alder and western redcedar. Midstory redcedar and hemlock average 9 inches DBH and 60 ft tall, and alder average 6 inches DBH and 60 ft tall.

This mixed conifer and hardwood forest has low stocking, likely as a result of red alder die-off in the overstory. Some of the canopy gaps have been colonized by invasive Himalayan blackberry, which is preventing the regeneration of trees in the understory. Invasive species removal and planting are recommended in affected areas of this stand to ensure long-term forest cover. There is no current road access to this stand.

FMU E3 - Mixed Conifer and Hardwood

This FMU is located on the north side of the property. It has moderate to steep south-facing slopes and a soil productivity rating that ranges from site class II to IV. Based on historic inventory data, it is estimated that the unit regenerated naturally following clearcut harvesting around 1915. There is currently no road or trail access to this stand. This unit was not visited during the assessment due to challenging access. Based on remote sensing, this unit has similar forest conditions to nearby unit E1, where no largescale management is recommended. In addition, parts of this unit include hazard zones and historic landslide activity. For these reasons, no management is recommended in this unit.

FMU E4 - Mixed Conifer - Mature-II

Stand Composition Summary

<table>
<tr><th>Canopy Position</th><th>Cohort Type</th><th>Species</th><th>TPA</th><th>BAA</th><th>SDI</th><th>RD</th><th>Min DBH</th><th>Avg DBH</th><th>Max DBH</th><th>Avg HT</th></tr>
<tr><td rowspan="5">Overstory</td><td rowspan="2">Major</td><td>DF</td><td>29</td><td>89</td><td>117</td><td rowspan="5">71</td><td>12</td><td>24</td><td>32</td><td>140</td></tr>
<tr><td>RC</td><td>53</td><td>163</td><td>243</td><td>12</td><td>26</td><td>36</td><td>140</td></tr>
<tr><td rowspan="2">Minor</td><td>BM</td><td>12</td><td>37</td><td>31</td><td>12</td><td>18</td><td>30</td><td>140</td></tr>
<tr><td>WH</td><td>19</td><td>60</td><td>71</td><td>12</td><td>22</td><td>32</td><td>140</td></tr>
<tr><td>All</td><td>All</td><td>120</td><td>372</td><td>480</td><td>12</td><td>24</td><td>36</td><td>140</td></tr>
<tr><td rowspan="3">Midstory</td><td rowspan="2">Major</td><td>RC</td><td>46</td><td>16</td><td>32</td><td rowspan="3">8</td><td>4</td><td>8</td><td>12</td><td>47</td></tr>
<tr><td>WH</td><td>46</td><td>16</td><td>32</td><td>4</td><td>8</td><td>12</td><td>47</td></tr>
<tr><td>All</td><td>All</td><td>92</td><td>32</td><td>64</td><td>4</td><td>8</td><td>12</td><td>47</td></tr>
<tr><td>Total</td><td>All</td><td>All</td><td>212</td><td>404</td><td>545</td><td>80</td><td>4</td><td>17</td><td>36</td><td>100</td></tr>
<tr><td colspan="11">Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.</td></tr>
</table>

This FMU is located in the northwest part of the property on mostly moderate northwest-facing slopes. The soil productivity rating is site class III. Based on historic inventory data, it is estimated that the stand naturally regenerated following a clearcut harvest around 1923. Total stocking is approximately 212 TPA. The overstory contains approximately 120 TPA and is primarily composed of Douglas-fir and western redcedar, with small components of bigleaf maple and western hemlock. Overstory Douglas-fir average 24 inches DBH and 140 ft tall, and redcedar average 26 inches DBH and 140 ft tall. The midstory contains approximately 92 TPA and is primarily composed of western hemlock and western redcedar that both average 8 inches DBH and 47 ft tall. This unit is a mixed conifer forest in the Mature-II stage of development, with established midstory and understory cohorts. Per the earlier discussion of conifer forests in this stage, no management activities are recommended. There is no current road access to this unit.

FMU E5 - Conifer Plantation - Large DBH

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	DF	283	173	329	63	6	11	16	75
	All	All	298	179	333		2	11	16	73
Total	All	All	298	179	333	63	2	11	16	73
Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.										

This FMU is in the northwest area of the property. It has steep west- and south-facing slopes that curve around a ridgeline. The soil productivity rating is site class III. The unit was clearcut around 1990 and replanted with Douglas-fir. Total stocking is approximately 298 TPA. The overstory is primarily composed of Douglas-fir that average 11 inches DBH and 75 ft tall. No midstory is currently present in this stand. The unit is currently overstocked with low species and structural diversity common to plantations.

Per the earlier discussion of overstocked, large-diameter plantations, a two-part sequence of variable density thinning is recommended starting in 5-10 years, and potential underplanting once density has been sufficiently reduced. The stand is currently accessible from the neglected SH-94 road and management activity in this unit is a good chance to meet maintenance obligations on this road system. The steep terrain will likely require cable-yarding for commercial operations but the southern half of the unit is likely inaccessible to cable-thinning operations and will need to be non-commercially thinned. A large hazard zone extends across the steep northwest slopes, and further assessment is necessary before operations begin in this area.

FMU E6 - Conifer Plantation - Large DBH

Stand Composition Summary

Canopy	Cohort	Species	TPA	BAA	SDI	RD	Min	Avg	Max	Avg

Position	Type						DBH	DBH	DBH	HT
	Major	DF	376	206	412		4	10	16	67
Overstory	Minor	WH	48	10	11	79	2	4	8	60
	All	All	424	216	423		2	10	16	66
Total	All	All	424	216	423	79	2	10	16	66

Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.

This FMU is on the north side of the property. It contains mostly steep west- and southeast-facing terrain on either side of the north fork of Smith Creek. The soil productivity rating is mostly site class IV, with a small area on the south side having a rating of site class III. The unit was clearcut around 1990 and replanted with Douglas-fir. Total stocking is approximately 424 TPA. The overstory is primarily composed of Douglas-fir, with a small component of western hemlock. Overstory Douglas-fir average 10 inches DBH and 67 ft tall. No midstory is currently present in this stand. The unit is currently overstocked with low species and structural diversity common to plantations.

Per the earlier discussion of overstocked, large-diameter plantations, a two-part sequence of variable density thinning is recommended starting in 5-10 years, and potential underplanting once density has been sufficiently reduced. There are pockets of this stand that are highly overstocked with hemlock and may be pre-commercially thinned at this time as well. The east side of the stand is currently accessible from the SH-94 and SH-9404 roads. Several short, abandoned spurs as well as 0.5 miles of the partially abandoned SH-9404 road should be restored to provide additional access. The SH-94 road is currently active but neglected and management activity in this unit is a good chance to meet maintenance obligations on this road system. A large hazard zone extends across much of the east side of this stand on the steep northwest-facing slopes. Further assessment is necessary before operations, and non-commercial thinning may be necessary in this zone.

FMU E7 - Conifer Plantation - Small DBH

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	DF	360	100	252	48	4	8	12	40
Total	All	All	360	100	252	48	4	8	12	40

Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.

This FMU consists of three small separate areas on the north side of the property. It has mostly steep south-facing slopes and a soil productivity rating of site class IV. The unit was clearcut around 2011 and replanted with Douglas-fir. Total stocking is approximately 360 TPA. The overstory is primarily composed of Douglas-fir. Overstory Douglas-fir average 8 inches DBH and 40 ft tall. No midstory is currently present in this stand.

Per the earlier discussion of overstocked small-diameter plantations, an initial pre-commercial thinning is recommended, followed by a two-part sequence of variable density thinnings in the future, and potential underplanting once density has been sufficiently reduced. This road is accessible via the neglected SH-94 and SH-9404 road system and management activity in this unit is a good chance to meet maintenance obligations on this road system.

Management Activity Schedule

Timeline	Activity	Priority	FMU	Prescription
2025 to 2030	Thinning (PCT)	1	A10, A7, B10, E7	Pre-commercially thin to a target density of 250 to 300 TPA.
	Thinning (CT / NCT)	1	B7, B8, D6, D9	Thin to an interim target density of 250 to 300 TPA.
			A4, E5, E6	Thin to an initial target density of 140 to 170 TPA.
		2	C2, C5, C6, D3, D4, D7, D8	Thin to an initial target density of 140 to 170 TPA.
		3	A8	Thin to an initial target density of 140 to 170 TPA.
		3 or 4	A6	Thin to an initial target density of 140 to 170 TPA.
	Planting	1	A3	Plant with 250-300 TPA of a mix of species suitable to site conditions.
		3	E2	Plant in gaps after invasive species removal with 150-250 TPA of a mix of species suitable to the site conditions.
	Invasive Species	3	A1, A3, E2	Remove invasive species.
			E1	Monitor for invasive species and remove if they pose a forest health risk.
2035 to 2040	Thinning (CT / NCT)	1	A7, B10	Thin to an initial target density of 140 to 170 TPA within 10-15 years after the last thinning entry.
		2	B7, B8, D6, D9	Thin to an initial target density of 140 to 170 TPA within 10-15 years after the last thinning entry.
			A4	Thin to a final target density of 80 to 110 TPA within 10-15 years after the last thinning entry.
	Planting	3	A4	Underplant after thinning with 150 TPA shade-tolerant conifers suitable to site conditions or wait 5-10 years and assess natural regeneration, planting if necessary.
2040 to 2045	Thinning (CT / NCT)	1	A10, E7	Thin to an initial target density of 140 to 170 TPA within 15-20 years after the last thinning entry.

Timeline	Activity	Priority	FMU	Prescription
		2	E5	Thin to a final target density of 80 to 110 TPA within 10-15 years after the last thinning entry.
		3	C2, C5, C6, D3, D4, D7, D8	Evaluate the stand for a second thinning and, if necessary, thin to a final target density 80 to 110 TPA within 15-20 years after the last thinning entry.
	Planting	3	E5	Underplant after thinning with 150 TPA shade-tolerant conifers suitable to site conditions or wait 5-10 years and assess natural regeneration, planting if necessary.
2045 to 2050	Thinning (CT / NCT)	2	A7, B10, E6	Thin to a final target density of 80 to 110 TPA within 10-15 years after the last thinning entry.
	Planting	3	A7, B10, E6	Underplant after thinning with 150 TPA shade-tolerant conifers suitable to site conditions or wait 5-10 years and assess natural regeneration, planting if necessary.
2050 to 2055	Thinning (CT / NCT)	3	B7, B8, D6, D9	Evaluate the stand for a second thinning and, if necessary, thin to a final target density 80 to 110 TPA within 15-20 years after the last thinning entry.
	Planting	3	B7, B8, D9	Monitor the stand for natural regeneration, and, if necessary, underplant with 150 TPA of shade-tolerant conifers suitable to site conditions.
2055 to 2060	Thinning (CT / NCT)	2	A10, E7	Thin to a final target density of 80 to 110 TPA within 15-20 years after the last thinning entry.
	Planting	3	A10, E7	Underplant after thinning with 150 TPA shade-tolerant conifers suitable to site conditions or wait 5-10 years and assess natural regeneration, planting if necessary.
Notes: PCT - Pre-commercial Thinning, CT - Commercial Thinning, NCT - Non-commercial Thinning. Priority Levels: 1 - High, 2 - Moderately High, 3 - Moderate, 4 - Low. Additional thinning and planting considerations are identified in Section 1 of this document as well as in the FMU-specific section above.				

Parcel Table

Owner	Parcel ID	Year Acquired	Previous Owner
County	3704020662650000	2014	DNR
County	3704020662650001	2014	DNR
County	3704030640540000	2014	DNR
County	3704033210540000	2014	DNR
County	3704034634540000	2014	DNR
County	3704034660660000	2014	DNR
County	3704044640570000	2014	DNR
County	3704044653060000	2014	DNR
County	3704044654320000	2014	DNR
County	3704093710660000	2014	DNR
County	3704094613010000	2014	DNR
County	3704104573270000	2014	DNR
County	3704104680540000	2014	DNR
County	3704110920480000	2014	DNR
County	3704154613240000	2014	DNR
County	3704164663240000	2014	DNR
County	3704164980630000	2014	DNR
County	3804260630680000	2014	DNR
County	3804260662650000	2014	DNR
County	3804271471500000	2014	DNR
County	3804274081490000	2014	DNR
County	3804274083300000	2014	DNR
County	3804284610660000	2014	DNR

Owner	Parcel ID	Year Acquired	Previous Owner
County	3804325171800000	2014	DNR
County	3804332663250000	2014	DNR
County	3804334080700000	2014	DNR
County	3804342013650000	2014	DNR
County	3804343281980000	2014	DNR
County	3804344143370000	2014	DNR
County	3804351330650000	2014	DNR
County	3804351333950000	2014	DNR
County	3804351341980000	2014	DNR
County	3704040704100000	1998	Trillium
County	3704055105250000	Unknown	Unknown
County	3704093252550000	1998	Trillium
County	3804325100750000	Unknown	Unknown
County	3804331910670000	Unknown	Unknown

Lookout Mountain Forest Preserve

Overview

Site Description

Lookout Mountain Forest Preserve (afterward identified as Lookout Mountain) is a large, 4,554-acre, property on the southwest side of Lake Whatcom. It is mostly owned by Whatcom County, except for two parcels on the northeast side near the Lookout Mountain Forest Preserve Trailhead which are jointly owned by the County and the City of Bellingham. The preserve stretches from Lake Whatcom Boulevard near the shoreline of Lake Whatcom up eastern slopes to the ridgeline containing Lookout Mountain and down southern slopes to Cain Lake. It borders the community of Sudden Valley to the north and Glenhaven to the south.

Property Information

This forest is located in Sections 01, 02, 11, 12, 13 and 24 of Township 37N, Range 03E, and Sections 06, 07, 17, 18, 19, 20, 29, 30, and 31 of Township 37N, Range 04E of the US Public Land Survey System and includes the parcels listed at the end of this section. Property corners and boundaries are not regularly marked.

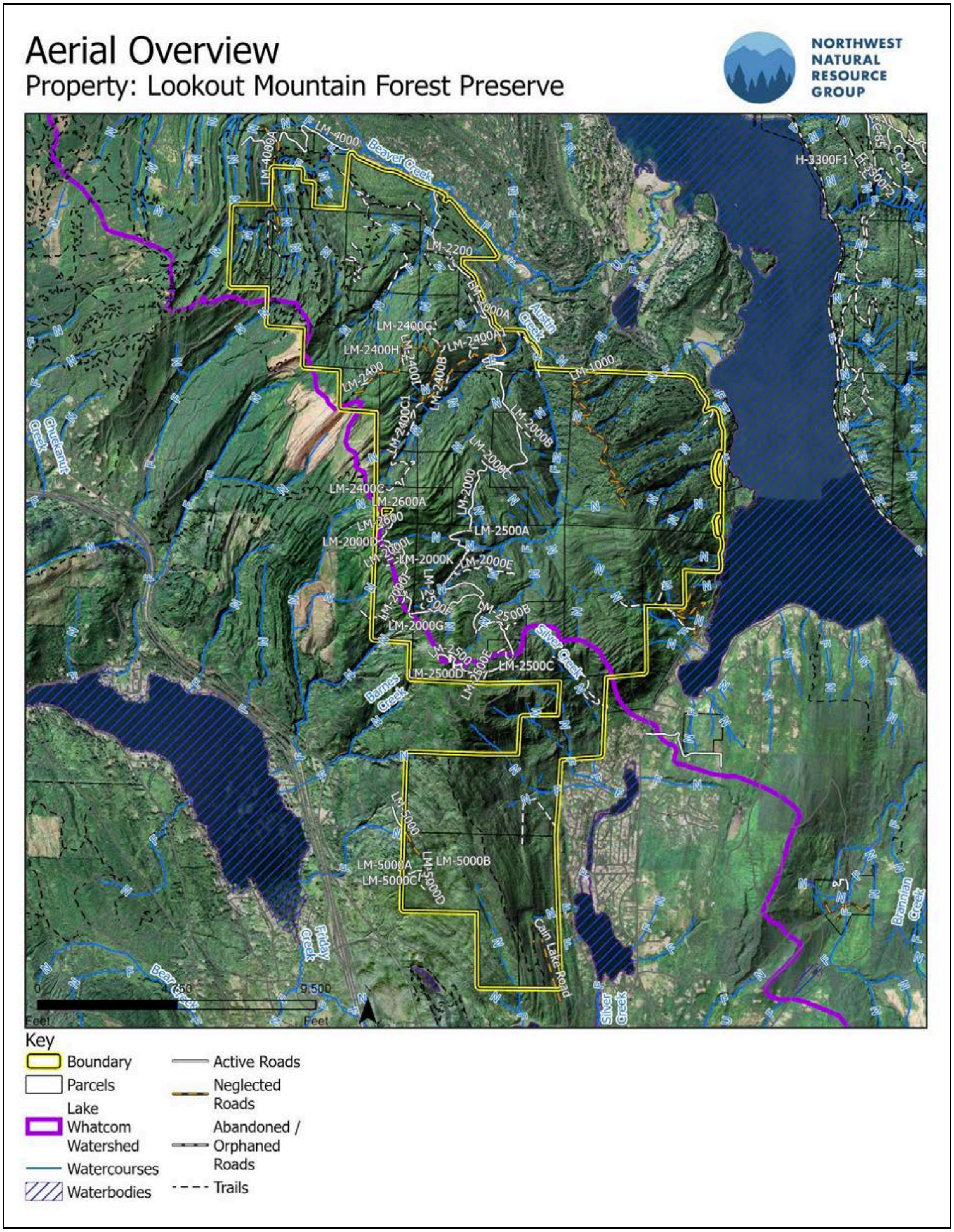
Management History

The forestland at Lookout Mountain was originally logged by early settlers during the late 19th and early 20th century, and large timber companies would eventually come to own most of the land in the watershed. Logging likely started lower on the mountain and in easy-to-access locations, before progressing upslope onto steeper and less accessible terrain. For a time, post-logging broadcast burning was commonly employed to reduce logging slash, and many older hand-cut stumps bear the mark of these fires. At higher elevations, the stands are younger, frequently cut with power saws, and fire marks are infrequent. Logging continued at Lookout Mountain through the early 1950s. In time, the last old growth stands were harvested and these forests were left to regenerate naturally. While many timberlands remained in private hands throughout the 20th century, some timber companies stopped paying property taxes after cutting the lucrative timber, and the properties were foreclosed upon by Whatcom County, which in turn transferred them in trust to the State of Washington Department of Natural Resources (DNR).

The second growth forests on Lookout Mountain began to be harvested again in the early 1990s and were replanted with conventional Douglas-fir plantations. Growing concern about forest management activities in the Lake Whatcom watershed spurred the creation of the 2004 Lake Whatcom Landscape Plan, which was created to guide forest management activities on state-owned forestlands in the watershed. In 2012 the County began the process of reconveying these lands back to county ownership, taking over title in early 2014 to all of the parcels included in the Lookout Mountain Reconveyance property.

Not all of these parcels had been under continuous, decades-long DNR management, as many parcels were previously owned by the Trillium Corporation and its predecessor, industrial timberland owner Georgia Pacific, prior to a large land swap in 1994 that consolidated DNR holdings into contiguous blocks around Lake Whatcom. Today, these forestlands are managed by the Whatcom County Parks and Recreation Department. In addition, the two jointly-owned parcels on the northeast side near the Lookout Mountain Forest Preserve Trailhead were not part of the 2014 reconveyance. These parcels were previously owned by a local family which logged their property sporadically over the decades prior to the properties being purchased by the City and County in 2002.

Property Overview Map



Assessment

Topoclimate

The property spans a large elevation range, from the summit of Lookout Mountain at 2,700 feet down to near the shores of Lake Whatcom. Predominantly east-facing, the site receives slightly less precipitation than the windward west slopes of Lookout Mountain. The terrain descends from the summit but briefly rises again to a secondary ridgeline, the location of Repeater Road, before continuing downward toward the lake. This elevation gradient creates distinct microclimates. The upper elevations are cooler and can receive occasional snowfall in winter, while the lower slopes benefit from the lake's moderating influence, resulting in milder temperatures. During the winter, storm fronts moving inland from the Pacific collide with the ridges of Lookout Mountain, leading to intense winter storms that can deliver large volumes of precipitation in short time spans.

Vegetation Zone

According to vegetation zone maps for North America, the following Ecological Systems were likely present prior to Euro-American settlement. More information on these maps and full descriptions of each system can be found in the discussion of Vegetation Zones in Section 2 of this document.

- North Pacific Hypermaritime Western Red-cedar-Western Hemlock Forest
- North Pacific Maritime Mesic-Wet Douglas-fir-Western Hemlock Forest
- North Pacific Mesic Western Hemlock-Silver Fir Forest
- North Pacific Maritime Dry-Mesic Douglas-fir-Western Hemlock Forest

Soils

Data from the USDA Natural Resource Conservation Service (NRCS) Soil Surveys were used to identify the major soil types that underlay this forest, which are described in more detail in the discussion of Soil Productivity in Section 2. Information about specific soil units likely present at this property, including depth, drainage, productivity, and relevant management concerns are listed in the table below. The location of these soil units can be found in the accompanied map packet for this property.

Forest Soil Units Summary Table

Soil Unit	Productivity		Management Concerns					Acres (Pct)
	Site Class	Max Growth	Drought Stress Hazard	Wind Throw Hazard	Mass Wasting Hazard	Logging Rutting Hazard	Logging Compact Hazard	
Andic Xerochrepts-Rock outcrop Complex Ashy Loam on 60-90% Slopes Mod. Deep (24in) Well Drained	DF-3	143 ft3/ac/yr	High	High	High	High	High	1,092 (24%)
Revel-Welcome-Rock outcrop Complex Ashy Loam on 30-60% Slopes Mod. Deep (37in) Well Drained	DF-3 / DF-4	126 ft3/ac/yr	Mod. High	High	High	High	High	911 (20%)
Chuckanut Series Gravelly Medial Loam on 30-65% Slopes Deep (56in) Well Drained	DF-2	186 ft3/ac/yr	Mod. High	Low	High	High	Mod.	679 (15%)
Nati Series Ashy Loam on 15-30% Slopes Mod. Deep (31in) Well Drained	DF-2 / DF-3	172 ft3/ac/yr	Mod. High	Medium	High	High	High	664 (15%)
Nati Series Ashy Loam on 30-60% Slopes Mod. Deep (38in) Well Drained	DF-3	129 ft3/ac/yr	Mod. High	High	High	High	High	296 (7%)
Revel Series Loam on 5-30% Slopes Mod. Deep (39in) Well Drained	DF-4	114 ft3/ac/yr	Mod. High	High	High	High	High	295 (6%)
Nati Series Ashy Loam on 5-15% Slopes Mod. Deep (37in) Well Drained	DF-2 / DF-3	172 ft3/ac/yr	Mod. High	Medium	High	High	High	292 (6%)
Revel Series Loam on 30-60% Slopes Mod. Deep (35in) Well Drained	DF-4	114 ft3/ac/yr	Mod. High	High	High	High	High	117 (3%)

Soil Unit	Productivity		Management Concerns					Acres (Pct)
	Site Class	Max Growth	Drought Stress Hazard	Wind Throw Hazard	Mass Wasting Hazard	Logging Rutting Hazard	Logging Compact Hazard	
Chuckanut Series Gravelly Medial Loam on 5-15% Slopes Deep (56in) Well Drained	DF-2	186 ft3/ac/yr	Mod. High	Low	Mod.	High	Mod.	99 (2%)
Chuckanut Series Gravelly Medial Loam on 15-30% Slopes Deep (56in) Well Drained	DF-2	186 ft3/ac/yr	Mod. High	Low	High	High	Mod.	93 (2%)

Slope Stability

As previously described in Section 2, this plan utilizes remotely mapped topographic data as well as hazard zones and historic landslides identified by the DNR to gauge the likelihood that unstable slopes will be found within a proposed management area. The presence of a mapped hazard zone or historic landslide does not preclude management, but indicates that further investigation is required.

Steep slopes are present across Lookout Mountain, but are most prominent along the banks of Austin Creek, on the eastern facing slopes off Repeater Ridge, and on the southwest and southeast facing slopes along the southern ridgeline leading down from Lookout Mountain. Hazard zones are present across Lookout Mountain, including the steep gorges of Austin Creek which include rule-identified inner gorges as well as potentially other unstable landforms. The headwaters of the northern fork of Austin Creek as well as other unnamed drainages contain likely rule-identified convergent headwalls. The southeast facing upper slopes leading down from Lookout Mountain are also a potential hazard zone as are the steep stream channels flowing east off Repeater Ridge. A large, historic landslide was mapped in the middle of Lookout Mountain, but this landslide is considered prehistoric and no active sliding was observed during field investigations. Other historic landslides are thought to have occurred on the southeast facing slopes of Silver Creek as well as the upper headwaters of Beaver Creek and along Repeater Ridge. During field investigations, a small landslide was observed originating from the road on Repeater Ridge.

Hydrology and Water Quality

The majority of this property falls within the Lake Whatcom watershed. The most prominent stream system, Austin Creek, originates in several tributaries along Lookout Mountain’s eastern slopes and flows east and northeast into Lake Whatcom. Additional streams from the Repeater Road ridge flow directly east into the lake. The streams on the northernmost part of the property flow north into Beaver Creek which eventually merges with Austin Creek before flowing into the lake. The southern portion of the property lies within the Friday Creek basin. Water drains primarily to the southeast into Silver Creek and tributaries which eventually flow into Friday Creek. This basin is part of the Lower Skagit-Samish Water Resource Inventory Area (WRIA), while the rest of the Lookout Mountain property is part of the Nooksack WRIA.

The majority of the streams are identified as non-fish-bearing in the DNR's hydrography database. The terrain quickly climbs from the shore of Lake Whatcom, creating cliffs that act as natural barriers to fish passage. Austin Creek is identified as a fish-bearing stream by DNR until about 1.5 miles upstream from the lower property boundary. Additionally, the west fork of Austin Creek is fish-bearing for about 0.25 miles upstream from its confluence with the main fork until a cliff blocks fish passage; the south fork of Silver Creek is identified as fish-bearing for about 500 feet within the property boundary; and the south fork of Beaver Creek is identified as fish-bearing for about 0.5 miles from the lower property boundary near the Lookout Mountain Forest Preserve Trailhead.

A handful of forested wetlands can be found across the property, but no waterbodies are present. The folding pattern of the Chuckanut formation, which shaped the geology of Lookout Mountain, influences the hydrology by creating wet sites between the small ridges that were created by this folding. As a result, more forested wetlands are likely present but not currently delineated.

Roads and Access

The primary access point to the property is through a gate at the Lookout Mountain Forest Preserve Trailhead, located off Lake Louise Road. From there the "mainline" (LM-2000) road proceeds uphill, traversing tributaries of Austin Creek along the eastern slopes of Lookout Mountain. Eventually the road forks, with the northern fork terminating at two communication towers at the northern peak on Lookout Mountain and the southern fork (LM-2500) continuing up a series of sharp switchbacks to a communication tower at the southern peak on the ridgeline. The communication tower leases at the top of Lookout Mountain require the County to maintain the road in drivable condition. Current maintenance has focused on brush management and some ditch shaping, but many of the ditch segments along this roadway are in need of restoration.

Additional roads include the LM-2400 which branches off the mainline around one mile from the trailhead, providing access up the northern fork of Austin Creek. The LM-1000, also known as Repeater Ridge Road, provides access up Repeater Ridge. In the north, a spur of the LM-4000 road provides access into the northwest corner of the property. In the south, the Cain Lake Road provides access to the southeast corner and a private forest road in the Barnes Creek drainage provides access to the southwest corner.

Small spur roads once ran off these main roads at several locations but have either been formally abandoned or, in cases of roads dating before 1975, orphaned. Notable orphaned roads include the LM-2400C which branches off the LM-2400 road after 0.8 miles and runs parallel to the northern fork of Austin Creek for another half mile and the LM-2000E, which branches off the LM-2000 road after 3.7 miles, cutting across Austin Creek and holds a steady contour east for approximately 1.5 miles. Smaller orphaned roads can be found at miles 1.0, 2.2, 3.7, and 4.5 of the LM-2000 road as well as miles 0.4 and

0.7 of the LM-2600 road and are identified in a map at the end of this section. Previously, at least three roads led off the LM-2000 road and provided access for logging operations on the two jointly-owned parcels near the trailhead, but these road beds have been converted to recreational trail use.

Forest roads were assessed to determine their status and suitability for management activities as well as to identify any potential maintenance or design issues. Notable findings of this assessment are summarized below.

Neglected and/or Improperly Abandoned Roads. Several roads were identified that, having not been officially abandoned, are theoretically “active” but maintenance has been neglected for many years. At Lookout Mountain, this includes the LM-2400, LM-1000, and a long spur off the LM-4000 road, and Cain Lake Road. No other improperly abandoned roads were identified.

Existing Orphan Roads. This assessment did not identify any major concern with existing orphan roads that warrant a management recommendation. As discussed in Section 2, the RMAP process undertaken by the DNR at Lookout Mountain Forest Preserve prior to reconveyance included a thorough investigation of these orphaned road systems. Spot checks of these roads concurred with the DNR findings that these orphaned roads currently pose a limited risk.

Fish Passage Issues. The current Rufus Creek Trail repurposes a defunct forest road and uses an existing culvert to pass over a fish-bearing stream. This culvert is currently failing to contain the stream flow and lacks natural streambed material posing a potential barrier to fish passage.

Drainage Control Issues on Active Roads. Several active roads were identified as suffering from deferred maintenance of their drainage control structures, primarily road grades, ditches, and cross-draining culverts. In some situations, this has caused water to enter the roadway resulting in minor channelization on the road surface. These issues were most pronounced on the Lookout Mountain “mainline” and include:

- **Inoperable Cross-Draining Culverts.** Over time culvert inlets can become obstructed by large woody debris or buried under sediment if not properly maintained. Steel culverts are also prone to rusting and culvert outfalls may cause erosion if energy dissipation devices, such as rock armoring or downflumes are not properly installed and maintained. Of the 89 drainage culverts surveyed, 17 were partially plugged, 2 had energy dissipation issues, and 1 was completely failed. In addition, one ditchout structure was compromised by sloughing hillside and unsanctioned recreational use.
- **Obstructed Ditches.** Ditches become obstructed or otherwise inoperable for many reasons, including sloughing hillsides, large debris, and unsanctioned recreational use. Obstructed ditches force water onto the roadway, where it bypasses well designed cross-draining culverts and uncontrollably exits the roadway, causing erosion and/or delivering sediment into nearby streams. Over 28 observations of obstructed ditches were identified.
- **Improperly Maintained Road Grades**. When water does enter the road a properly maintained road grade ensures the water is shed quickly. The steep slopes at Lookout Mountain’s mainline have restricted the road width and left insufficient room to maintain a continuous ditch. As a

result, past road engineers created a delicate drainage control system that utilizes the road's surface and a sharply insloping grade to transport water around intermittent interruptions in the ditch system. In these systems, maintaining property road grading is necessary to ensure that water exits the road system as designed and does not continue down the road system, leading to channelization, erosion, and potential slope instability issues. Over 10 observations of water on the roadway were identified.

Culvert Condition. Culvert diameter, material, and condition were noted during this assessment and the bankfull width measured for stream crossings. As described earlier, though culverts inlets were partially obstructed as a result of deferred maintenance, the culverts themselves were generally in good condition. Though two crossdrains were flagged as undersized according to Forest Practices Act requirements, the majority of culverts were 18 inches or larger as required by state regulations. Of the 26 stream-crossing culverts identified during this assessment, 17 had diameters less than the bankfull width of the stream they carried. While this does imply they are functionally undersized, additional analysis is required to determine if these culverts are appropriately sized to meet current WA DNR requirements. As previously discussed in Section 2, the majority of culverts at Lookout Mountain are galvanized steel, which has a serviceable life from 20-40 years. Many of these culverts date from the RMAP process from the early 2000s and are likely around 20 years old, though some may be considerably older. During this assessment the majority of steel culverts surveyed were in good condition and only two steel culverts were identified as having rusted out and an additional two showed signs of ongoing corrosion. Still, culvert failures are predicted to increase in the future as steel culverts reach the end of their serviceable life.

Road Failures. Several historic road failures and one active failure were identified during this assessment which are important guides to the types of future issues that this road system may experience.

- In 2018, a large storm saturated the roadway and surrounding soils, causing uncontrolled water on the roadway and extensive erosion at the intersection of the LM-2000 and LM-2400 road at Lookout Mountain Forest Preserve, closing the LM-2400 road to vehicle traffic ever since. Repairs of the failed section, including upgraded drainage control systems, are currently underway with construction projected to finish in early 2026.
- Another recent failure also occurred on the LM-2000 road where the northern fork of Austin Creek passes under the road in a large 6ft culvert. During a storm in 2021, this culvert became plugged and the creek overtopped the road, eroding some of the road bed but leaving the culvert in place. Notably, the current culvert is considered appropriately sized to pass the volume of water calculated to occur during the 100-year flood event, but was unable to pass the large woody debris transported by this flood. Though repairs have been made, this failure indicates that this water crossing needs to be upgraded to handle future storm events and the County is planning to undertake this upgrade in 2026.
- During this assessment an acute issue was identified with another water crossing at the Lookout Mountain Forest Preserve. This crossing is on the current Rufus Creek Trail where a defunct forest road has been repurposed as a biking and hiking trail. The trail crosses over an existing road culvert on a fish-bearing stream that has rusted out, failing to contain the stream and

causing erosion of the overlying road surface. Though this location is on very flat topography it has the potential to deliver sediment into the local watershed in the future.

Health and Resiliency

Invasive species pressure was remarkably low across the forests of Lookout Mountain. Himalayan blackberry was observed in limited locations along road edges but is not nearly as prevalent as elsewhere in the watershed. English holly was also found in the understory of many stands but is not affecting forest development.

Overstocking is the most important forest health problem facing the forests at Lookout Mountain where many stands are overstocked and/or growing at unsustainable densities. This includes naturally regenerated stands that are in the Stem Exclusion stage of development as well as previously-established plantations that have experienced extensive infilling by natural regenerating hemlock and alder, thus increasing their densities to unsustainable levels. In some cases, stocking exceeds 600 trees per acre and relative densities of 75 or even higher are fairly common. At these densities, competition-induced mortality is rampant, stands are increasingly unstable, and dead material is accumulating as potential wildfire fuel.

In addition, localized pockets of laminated root-rot were observed sporadically across the forest but are operating within normal levels. Most notably, at Lookout Mountain, several large patches of hemlock dwarf mistletoe were sporadically observed across the FMUs on the upper mountain, with large patches in FMUs B4 and B6. While mistletoe infestations reduce growth and can limit commercial timber value, they have the benefit of creating dense branching brooms similar to epicormic branching that occurs later in stand development. Mistletoe infestations spread slowly from tree to tree and can be stopped by unvegetated barriers and the absence of suitable host species.

Finally, insect activity was observed sporadically in the oldest mixed-conifer forests at Lookout Mountain. Small to large (1-acre) pockets of dead and dying large-diameter Douglas-fir were observed with frass suggesting the outbreak is likely the result of Douglas-fir beetle which prefers larger diameter trees.

The upper slopes of Lookout Mountain include stands dominated primarily by drought-intolerant western hemlock but also silver fir. Stands growing on sites with low moisture potential, such as top of ridgelines and south-facing aspects, are at particular risk of drought stress, which is expected to increase under future hotter and drier climates.

Wildlife Habitat

A review of the Washington State Department of Fish and Wildlife Priority Species Database identified Townsend's big-eared bat, little brown bat, and myotis bat as having been documented somewhere within the 23,000-acre township containing Lookout Mountain Reconveyance. The base of Austin Creek is also habitat for cutthroat trout. The property is identified as a large biodiversity area and corridor that spans Lookout Mountain and is a priority area for terrestrial habitat.

Much of the forest on the property is in the Stem Exclusion stage, characterized by dense stands of tall, thin trees. However, some forest stands are beginning to transition into more structurally complex stages, with larger trees and developing understories that support greater biodiversity. Additionally, the numerous stream channels across Lookout Mountain and their associated riparian zones offer valuable wildlife habitat, with increased species diversity, structural complexity, and reliable water sources. The lower sections of the streams offer important habitat for fish species that are found in Lake Whatcom.

Wildfire Susceptibility

The risk of wildfire ignition is high at Lookout Mountain. The close proximity of residential development in Sudden Valley, Glenhaven, and other locations increases the risk of wildfire ignition and though recreational use is entirely non-motorized and day-use, the extensive recreational use of this property introduces additional ignition risks. While ignitions are likely, the developed road network both on this property and adjacent forestlands as well as extensive trail access ensures a rapid firefighting response, and, as long as strong winds aren't blowing, can likely be contained with the help of local topography.

As discussed in Section 2, overstocked, mixed-conifer stands and Douglas-fir plantations in Stem Exclusion are more susceptible to high-severity fire as they have high levels of fine woody debris, lack larger trees that are more resistant to fire, and have low canopies and many potential ladder fuels. Older mixed conifer forests in the Mature-I and Mature-II stages of development have lower densities, taller crowns, and reduced fuel loads which reduce their susceptibility to high-severity fire. Mixed conifer and hardwood forests are also less susceptible to fire because hardwood species have large water-laden leaves and lower content of resin and pitch that makes them less likely to burn in a fire, and their low-density crowns can reduce the chance of a crown fire spreading. These stand types are further identified below, but approximately one third of the forestland at Lookout Mountain consists of overstocked stands in Stem Exclusion which are susceptible to high-severity fire. These stands are common across most of the upper slopes of the mountain. Most notably, overstocked plantations can be found along the property's northern boundary in relatively close proximity to residential development.

Carbon Storage

The conifer dominance on most of the property provides excellent long-term carbon storage potential due to the long lifespan of the trees, but many stands are currently overstocked and in the Stem Exclusion phase, limiting growth and reducing carbon sequestration rates. As the upper mountain is primarily dominated by western hemlock, there is some concern about the long-term suitability of this species, and carbon storage may be reduced if growth slows or mortality increases under future drier and warmer conditions. Thinning suppressed trees would result in a short-term reduction in stored carbon but would enhance growth of the remaining trees, accelerating sequestration and improving long-term carbon storage capacity.

Cultural Resources

The Lake Whatcom watershed is a landscape rich with cultural significance for Indigenous peoples—particularly the Lummi Nation and the Nooksack and Swinomish Tribes—who have maintained deep spiritual, cultural, and subsistence connections to the landscape. Although a review of the Washington State Department of Archaeology and Historic Preservation Wisaard online database did not identify any known historical sites on this property and none were encountered while developing this plan, this property has a long history of human use and artifacts may be present. Please see the previous discussion about cultural use practices in the Lake Whatcom watershed for a more detailed assessment of best management practices moving forward.

Recreation

The property experiences high levels of non-motorized recreational use, particularly by mountain bikers, hikers, and runners, on both sanctioned and unsanctioned trails spread throughout the forestland. The primary access point to the property is the Lookout Mountain Preserve Trailhead, located off Lake Louise Road, but access points are also possible from Cain Lake and the LM-1000 road, frequently known as Repeater Road, near Sudden Valley. The LM-2000 road is the mainline carrying uphill hikers and bikers, seeking to access the northern and southern peaks of Lookout Mountain. The currently non-drivable LM-2400 spur provides recreational access to portions of Lookout Mountain directly adjacent to the Galbraith Tree farm, and many trails connect with this more extensive trail system. Repeater Road provides uphill access to the ridge running along the eastern edge of the property.

All sanctioned trails are located near the Lookout Mountain Preserve Trailhead in the northeast area which receive high levels of recreational use. There are also an enormous number of unsanctioned bike trails on this property, seemingly able to facilitate the descent of mountain bikes down almost every ridgeline. Notable trail systems descend from the northern communication towers down the ridgeline running NE towards Sudden Valley, down ridgelines to the NW leading into Galbraith Mountain as well as down the southern ridgeline towards the town of Alger and Cain Lake. An extensive downhill trail system is accessible from the top of Repeater Road where trails descend the northeastern, eastern, and southeastern ridgeline spurs toward South Lake Whatcom Boulevard.

As previously mentioned, unsanctioned trail building and use can often create unintentional erosion hazards that reduce water quality. Most of the trails observed during this assessment were constructed along ridgelines and not causing sediment delivery. Occasionally, when a trail attempted to find a way off the ridgeline and back onto main roads, it would enter terrain prone to erosion. Notable examples of trail-induced erosion are found at the second switchback turn after crossing the northern fork of Austin Creek where an unsanctioned bike trail has been re-routed several times to avoid ongoing slope instability.

Recommendations

Roads and Access

This plan recommends the following actions be taken to improve the maintenance and function of the existing road system at Lookout Mountain:

- **Neglected and/or Improperly Abandoned Roads.** Restoring access on the LM-2400 and Cain Lake Roads will provide critical access to the majority of young plantations at Lookout Mountain. These stands are in need of thinning interventions over several decades, and maintaining access on this road spur will be critical to enacting the recommendations outlined in this plan. Once repairs are completed on the LM-2400 road, both of these road grades are in good condition and can be easily restored to active condition. This plan also recommends restoring access on the LM-1000 road and the long spur off LM-4000 road in order to enact the management recommendations outlined in this plan, but this access only needs to be maintained for the next decade or less, after which these roads can be formally decommissioned. If management recommendations are not followed, these neglected roads should be formally decommissioned to ensure no long-term hydrological effects.
- **Drainage Control Issues on Active Roads.** The Lookout Mountain mainline needs ditch cleanouts, culvert clearing, and regrading across numerous sections to ensure proper drainage. After this has been done, implement a maintenance plan for ditches, culverts, and road grades to ensure all active roads maintain a high standard of function. See the best management practices identified in Section 2.
- **Culvert Condition.** Replace failed culverts and rectify energy dissipation issues by placing additional rock or using down flumes to carry water safely downhill. Upgrade undersized cross-draining culverts and evaluated stream-crossing culverts to confirm they are sized appropriately for their respective basins. Future culvert installation, particularly of cross-draining culverts, should prioritize modern, longer lasting HDPE plastic culverts.
- **Fish Passage & Current Failures.** Evaluate and rectify the ongoing stream-crossing culvert failure identified on the Rufus Creek Trail which is also a potential barrier to fish passage. This culvert should be replaced, potentially with a footbridge to maintain hiking and biking access.

Without road access, heavy equipment cannot be used in forest management activities, and thinning recommendations must be implemented as non-commercial cut and drop. This greatly increases the cost of forest management and likely reduces the amount of the landscape that can be actively managed to reach its desired future condition. Given the challenges of properly maintaining roads on steep terrain, the decision to build new roads requires careful planning and should follow the guidelines identified in Section 2. Specific recommendations for creating temporary spur roads to facilitate forest management activities are given by FMU below.

Health and Resiliency

Though continued treatment and monitoring of Himalayan blackberry would be a prudent decision to prevent its spread, it does not currently present a significant management concern at this property.

Recommendations for addressing observed overstocking are given at the management unit level below.

The currently observed levels of dwarf mistletoe at Lookout Mountain, specifically in the B-series FMUs on the upper mountain, warrant periodic monitoring given the high proportion of suitable host species (western hemlock and silver fir), but this infestation is not of major concern given current management objectives.

The observed level of insect activity is not excessively impacting the forest's growth and development. Newly created overstory gaps are already being colonized by vigorously growing new seedlings, highlighting how natural disturbance processes can increase stand complexity.

Wildfire Susceptibility

Shaded fuel breaks are recommended within 100 feet of public roads and existing structures, which are designed to keep fires on the ground and slow their spread until firefighting resources can arrive. For additional details on implementation, see the description of a shaded fuel break given in the discussion of Wildfire Susceptibility in Section 2 of this document.

Forest Types

Summarized below are the general forest types present at Lookout Mountain and their management recommendations.

Forest Types Summary Table

Forest Type	Acres	Proportion
Conifer Plantation - Small DBH	92	2%
Conifer Plantation - Large DBH	298	7%
Mixed Conifer - Stem Exclusion	775	17%
Mixed Conifer - Stem Exclusion/Mature-I	258	6%
Mixed Conifer - Mature-I	371	8%
Mixed Conifer - Mature-I/II	112	2%
Mixed Conifer - Mature-II	1,259	28%
Mixed Conifer - Late Seral	0	0%
Mixed Hardwood - Young	43	1%
Mixed Hardwood - Mature	0	0%
Mixed Hardwood - Old	105	2%
Mixed Conifer and Hardwood	1,241	27%

Forest Type	Acres	Proportion
Unforested	0	0%
Non-Forest	0	0%
Total	**4,554**	**100%**

Mixed Conifer Stands

Mixed conifer stands are very common at Lookout Mountain, representing about 61% of the property. These stands regenerated following clearcut harvests between 75 to 125 years ago. After clearcutting, the forest was left to regenerate naturally, and in most cases, no intervening management has occurred. Today, these stands are primarily dominated by a mixture of conifers, primarily Douglas-fir and western hemlock, though western redcedar and pacific silver fir are also present. Douglas-fir is more common at lower elevations, while hemlock is more common at higher elevations. A majority of the mixed conifer stands at Lookout Mountain are in Stem Exclusion or Mature-I stage of development, where density remains relatively high to very high. There are some early Mature-II stands that have begun to develop as well as some older fire origin stands that exhibit later seral characteristics, but these are a minority.

As previously described in Section 3, the management of mixed conifer stands is best delineated by stand development stage, and recommendations follow the general discussion earlier in this document. For stands in Stem Exclusion, this plan recommends variable density commercial thinning, with priority varying from moderate (level 3) to high (level 1) depending on stocking. Given their generally high priority, when commercial access is not possible, non-commercial thinning should be utilized in the most overstocked stands. This plan recommends variable density thinning in Mature-I stands, but assigns these stands priority varying from low (level 4) to moderate (level 3) depending on stocking. Finally, this plan generally does not recommend management in Mature-II stands at Lookout Mountain.

Plantations

Around 9% of Lookout Mountain forestland are Douglas-fir plantations. These stands are typically third generation forests, having been established after clearcut harvests of the naturally regenerated second growth forests over the last 15 to 40 years. These plantations were established at high densities of primarily Douglas-fir but in many cases have experienced significant infilling by western hemlock and red alder. Subsequent pre-commercial thinning operations have not occurred since reconveyance, and many of these stands are currently growing at extremely high levels of stocking.

A more complete description and assessment of plantation silviculture and recommendations for these stands is provided earlier in this document. Broadly, all plantations at Lookout Mountain require management interventions to accelerate the transition of these stands towards forests with more complex stand structures, thereby improving resiliency, reducing fire risk, increasing hydrological maturity, and providing additional wildlife habitat. As previously described in Section 3, this plan recommends pre-commercial thinning in overstocked, small diameter stands and variable density commercial thinning in overstocked, large-diameter stands. Given high-levels of homogeneity and the likelihood that multiple entries are needed to restore forest function, thinning plantations is one of the highest priority management recommendations made in this plan. Broadly, access to these stands is good and thinning can be primarily commercial. Additional details are provided in each management unit below.

Mixed Hardwoods

Stands of pure mixed hardwoods are uncommon at Lookout Mountain, occurring on only approximately 3% of the property. These stands are primarily composed of red alder and bigleaf maple. As previously described in Section 3, the management of these stands is most concerned with ensuring a smooth seral transition towards more conifer-dominated forests. Recommendations follow the general discussion earlier in this document, delineated by stand development stage. For young stands, this plan recommends pre-commercial thinning and underplanting. For mature stands, this plan recommends commercial thinning and underplanting. For older stands, this plan recommends solely underplanting. Planting should be 150 TPA of shade-tolerant conifers under the existing canopy and up to 250 TPA into more open canopy gaps.

Mixed Conifer and Hardwoods

Mixed conifer and hardwood stands are common at Lookout Mountain, representing about 27% of the property. These stands regenerated all across the property following clearcut harvests between 75 to 125 years ago. Unlike other conifer-dominated stands, these stands either initiated with a large component of hardwoods or have grown at lower densities, allowing new hardwood species to establish in subsequent years. In either case, these stands now include a wide range of species growing in multiple canopy positions.

As previously described in Section 3, the management of these stands can follow either more mixed-conifer recommendations or mixed-hardwood recommendations depending on the proportion of species present, but in well-mixed stands typically focuses on forest health issues. At Lookout Mountain, because these stands are generally in good health, exhibiting high diversity, and growing at sustainable densities, this plan does not recommend management in most cases.

Management Units

Forest cover was delineated into the forest management units (FMUs) using both remotely sensed data, historic inventory units, and field inventory data. The forestland within these management units share similar forest characteristics and management recommendations. For each FMU, this plan describes the geophysical attributes and forest conditions and assesses the unit against the plans management objectives using the previously described framework by forest type. Recommendations are then given by FMU, typically referencing general recommendations by forest type, but more information is given as needed. Finally, a schedule of management activities by year and FMU is given at the end of this section.

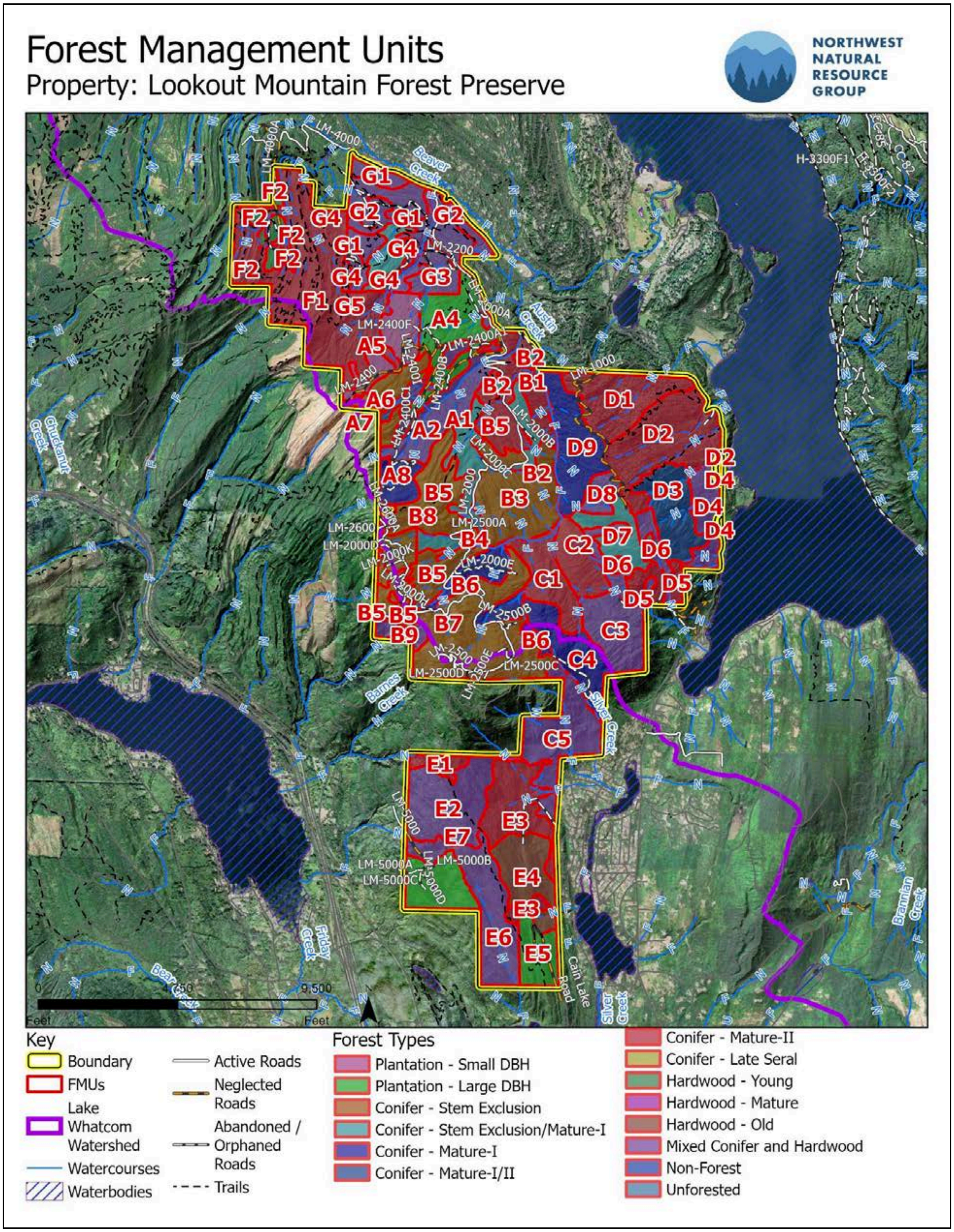
Because this property is so large, it is also delineated into sub-areas based on the principal routes used to access different portions of the property. The letter at the beginning of the FMU label represents the area or “series” to which it belongs. Series A FMUs are reached by the LM-2400 road, series B FMUs by the LM-2000 road, series D FMUs by the Repeater Road, and series E FMUs by the southern ridgeline. Series C FMUs include the middle of the property, while series F FMUs are located in the northwest corner. An overview of these units is available in the table and maps below.

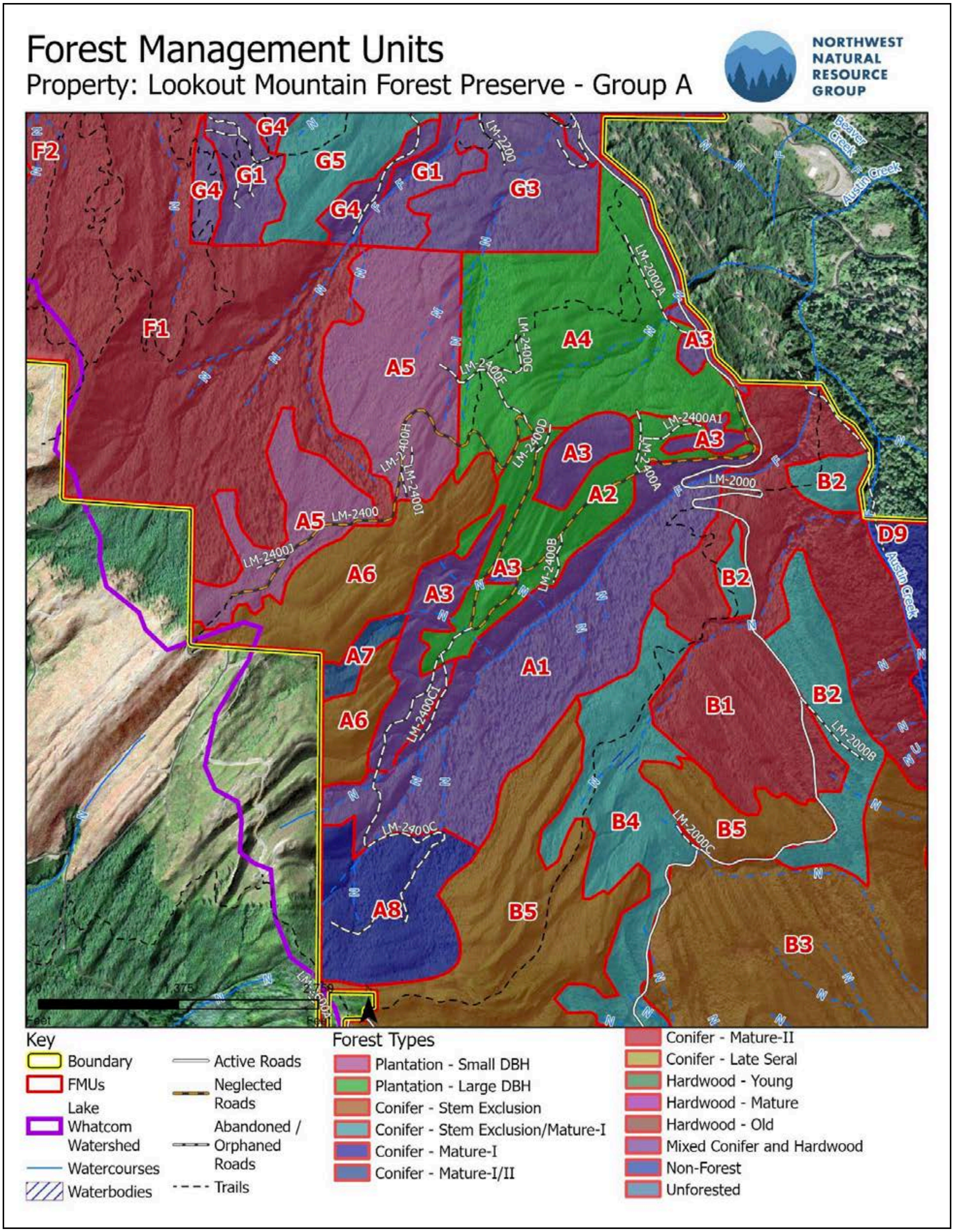
Summary of Forest Management Units

FMU	Acres	Forest Type	Management
A1	112	Mixed Conifer and Hardwood	None
A2	47	Conifer Plantation - Large DBH	Thinning
A3	44	Mixed Conifer and Hardwood	None
A4	102	Conifer Plantation - Large DBH	Thinning
A5	92	Conifer Plantation - Small DBH	Thinning
A6	61	Mixed Conifer - Stem Exclusion	Thinning
A7	6	Mixed Conifer - Mature-I/II	None
A8	44	Mixed Conifer - Mature-I	Thinning
B1	138	Mixed Conifer - Mature-II	None
B2	46	Mixed Conifer - Stem Exclusion / Mature-I	Thinning
B3	158	Mixed Conifer - Stem Exclusion	Thinning
B4	97	Mixed Conifer - Stem Exclusion / Mature-I	Thinning
B5	222	Mixed Conifer - Stem Exclusion	Thinning
B6	91	Mixed Conifer - Mature-I	Thinning
B7	260	Mixed Conifer - Stem Exclusion	Thinning
B8	74	Mixed Conifer - Stem Exclusion	Thinning
B9	24	Mixed Conifer and Hardwood	None
C1	92	Mixed Conifer - Mature-II	None
C2	71	Mixed Conifer - Mature-II	None
C3	101	Mixed Conifer and Hardwood	None
C4	104	Mixed Conifer - Mature-I	None
C5	144	Mixed Conifer and Hardwood	None
D1	132	Mixed Conifer - Mature-II	None
D2	201	Mixed Conifer - Mature-II	None
D3	106	Mixed Conifer - Mature-I/II	None
D4	68	Mixed Conifer and Hardwood	None
D5	39	Mixed Conifer - Mature-II	None
D6	80	Mixed Conifer and Hardwood	None
D7	70	Mixed Conifer - Stem Exclusion / Mature-I	Thinning
D8	33	Mixed Conifer and Hardwood	None
D9	132	Mixed Conifer - Mature-I	Thinning
E1	25	Mixed Conifer - Mature-II	None
E2	158	Mixed Conifer and Hardwood	None

FMU	Acres	Forest Type	Management
E3	135	Mixed Conifer - Mature-II	None
E4	105	Mixed Hardwood - Old	Monitor & Planting
E5	65	Conifer Plantation - Large DBH	Thinning
E6	159	Mixed Conifer and Hardwood	None
E7	84	Conifer Plantation - Large DBH	Thinning
F1	426	Mixed Conifer - Mature-II	None
F2	43	Mixed Hardwood - Young	Thinning
G1	128	Mixed Conifer and Hardwood	None
G2	102	Mixed Conifer and Hardwood	None
G3	48	Mixed Conifer and Hardwood	None
G4	40	Mixed Conifer and Hardwood	Thinning
G5	45	Mixed Conifer - Stem Exclusion / Mature-I	Thinning
Total	**4,554**		

Maps of Forest Management Units

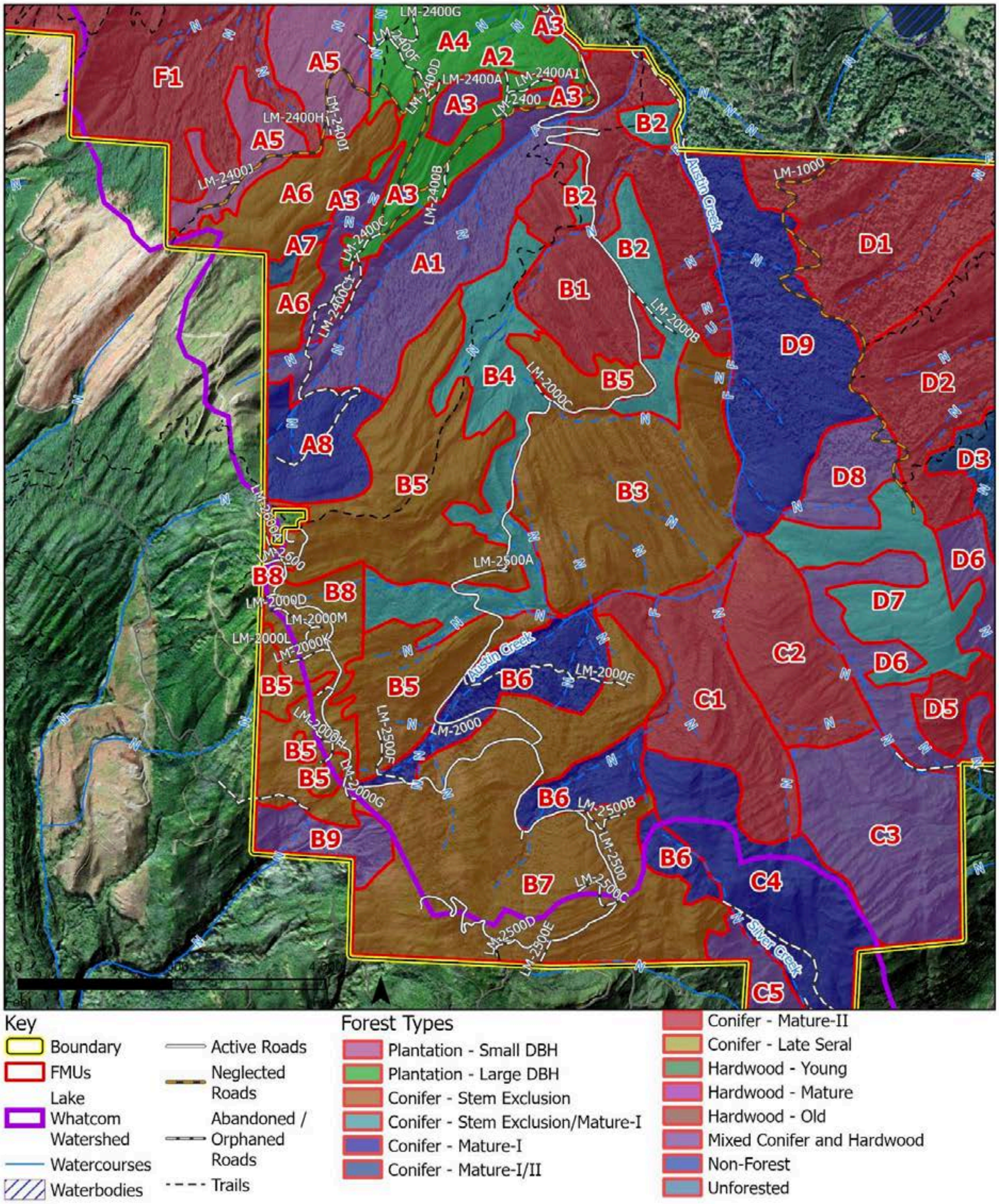



Forest Management Units
Property: Lookout Mountain Forest Preserve - Group A
NORTHWEST NATURAL RESOURCE GROUP
F1
F2
G1
G3
G4
G5
A1
A2
A3
A4
A5
A6
A7
A8
B1
B2
B3
B4
B5
D9
LM-2000
LM-2000A
LM-2000B
LM-2000C
LM-2200
LM-2400
LM-2400A
LM-2400A1
LM-2400B
LM-2400C
LM-2400D
LM-2400F
LM-2400G
LM-2400H
LM-2400I
LM-2400J
Beaver Creek
Austin Creek
Key
Boundary
FMUs
Lake Whatcom Watershed
Watercourses
Waterbodies
Active Roads
Neglected Roads
Abandoned / Orphaned Roads
Trails
Forest Types
Plantation - Small DBH
Plantation - Large DBH
Conifer - Stem Exclusion
Conifer - Stem Exclusion/Mature-I
Conifer - Mature-I
Conifer - Mature-I/II
Conifer - Mature-II
Conifer - Late Seral
Hardwood - Young
Hardwood - Mature
Hardwood - Old
Mixed Conifer and Hardwood
Non-Forest
Unforested

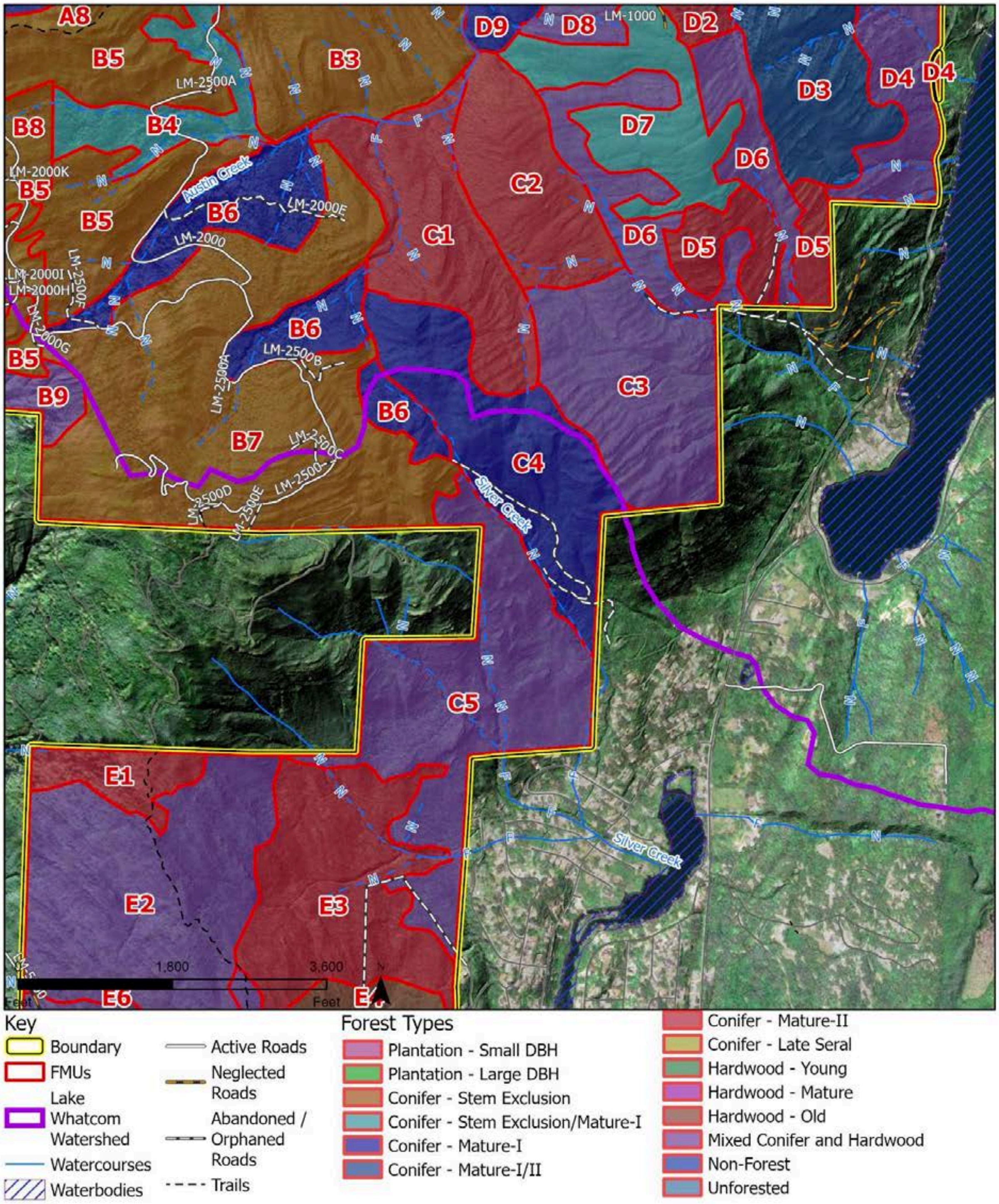
Forest Management Units

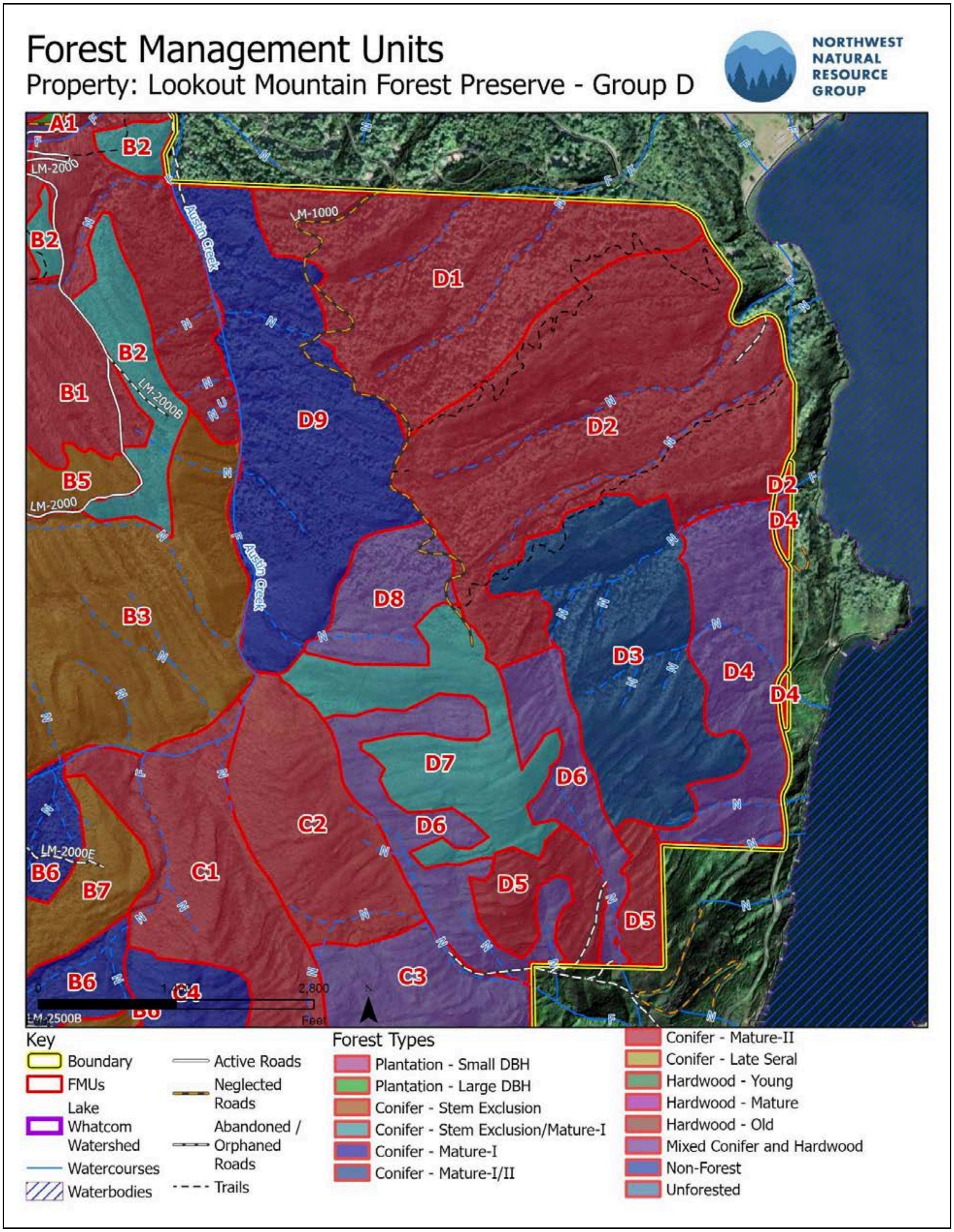
Property: Lookout Mountain Forest Preserve - Group B

NORTHWEST NATURAL RESOURCE GROUP



Forest Management Units
Property: Lookout Mountain Forest Preserve - Group C

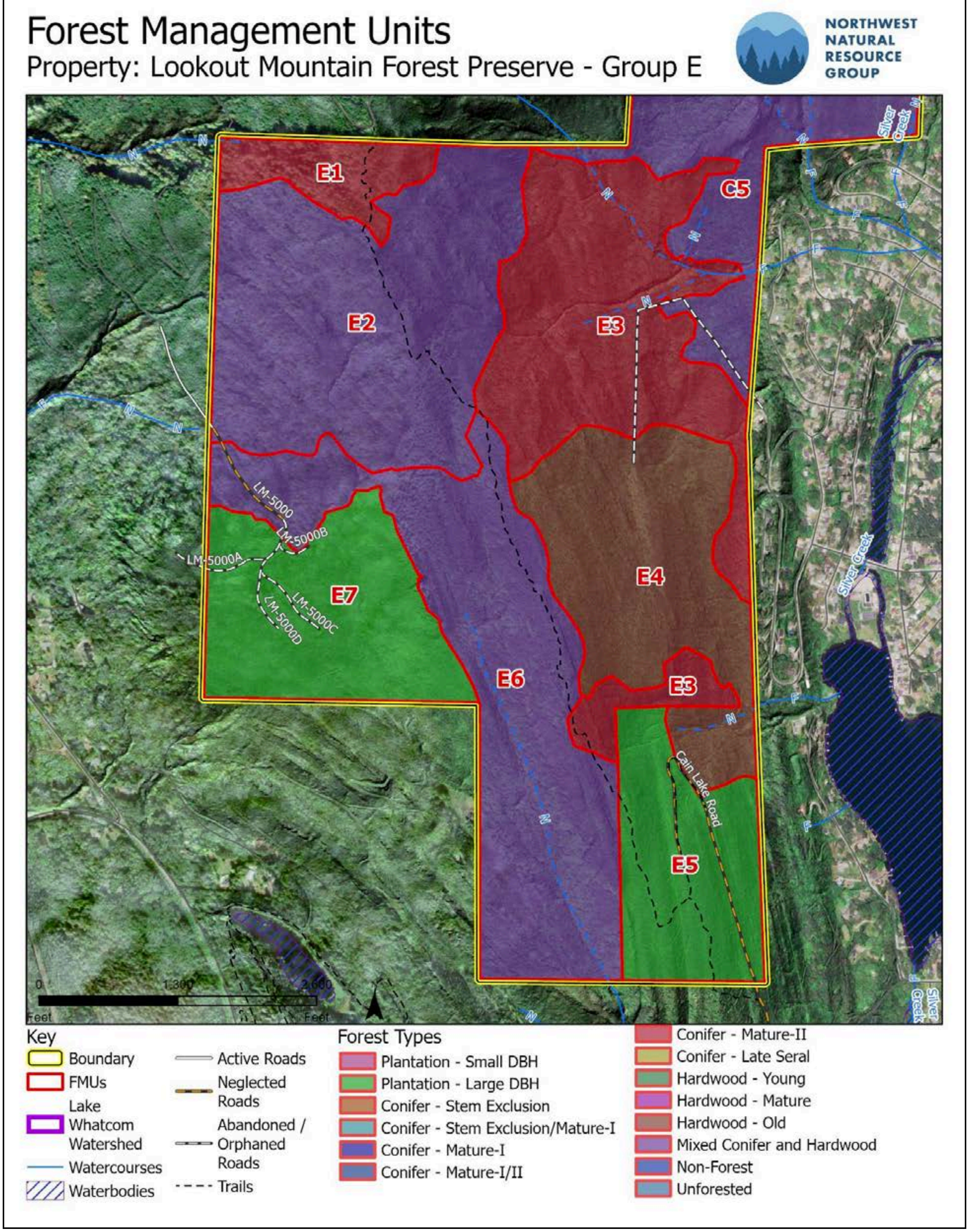


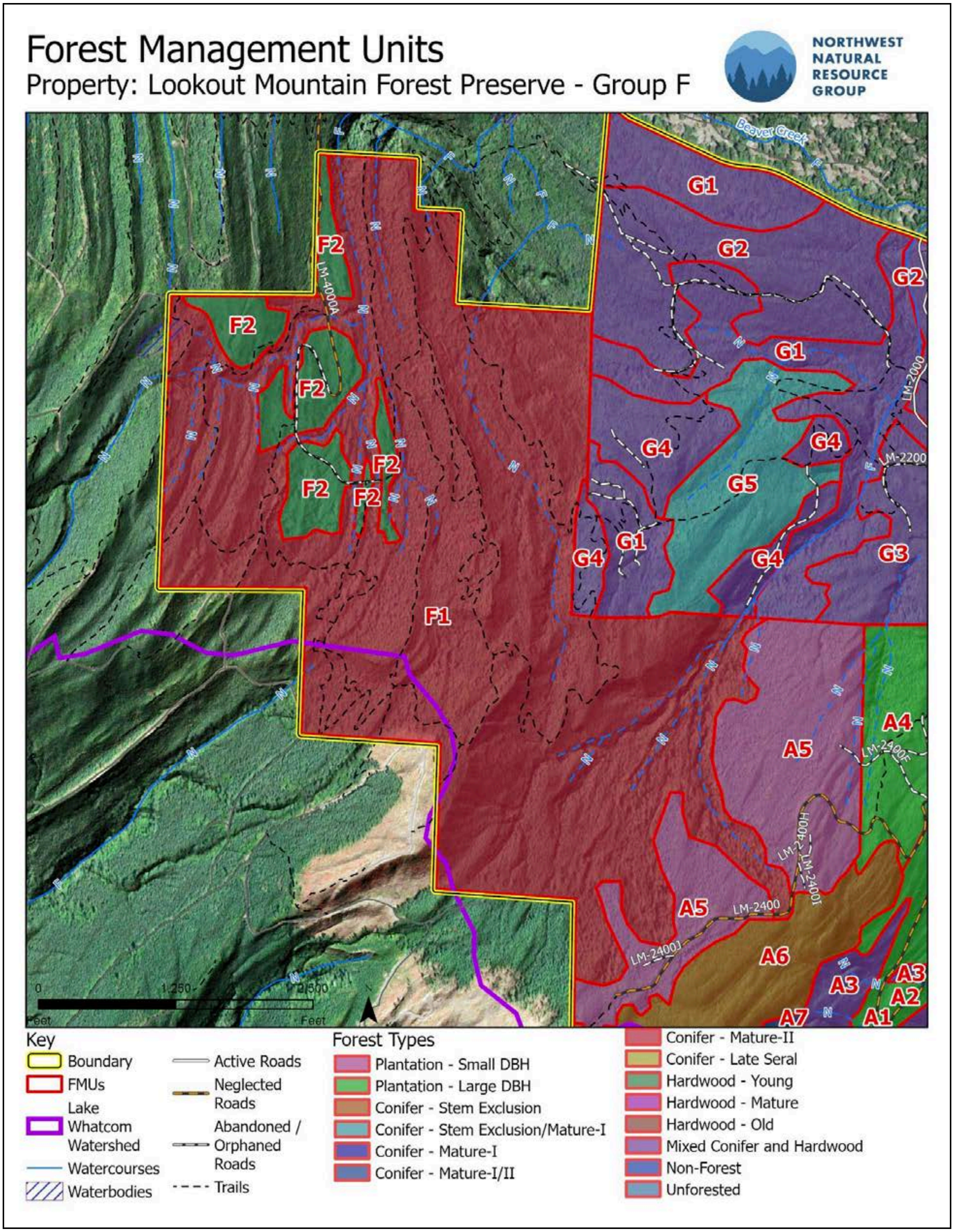


Forest Management Units
Property: Lookout Mountain Forest Preserve - Group D
NORTHWEST
NATURAL
RESOURCE
GROUP
D1
D2
D3
D4
D5
D6
D7
D8
D9
Austin Creek
LM-1000
LM-2000
LM-2000B
LM-2000E
LM-2500B
Key
Boundary
FMUs
Lake Whatcom Watershed
Watercourses
Waterbodies
Active Roads
Neglected Roads
Abandoned / Orphaned Roads
Trails
Forest Types
Plantation - Small DBH
Plantation - Large DBH
Conifer - Stem Exclusion
Conifer - Stem Exclusion/Mature-I
Conifer - Mature-I
Conifer - Mature-I/II
Conifer - Mature-II
Conifer - Late Seral
Hardwood - Young
Hardwood - Mature
Hardwood - Old
Mixed Conifer and Hardwood
Non-Forest
Unforested

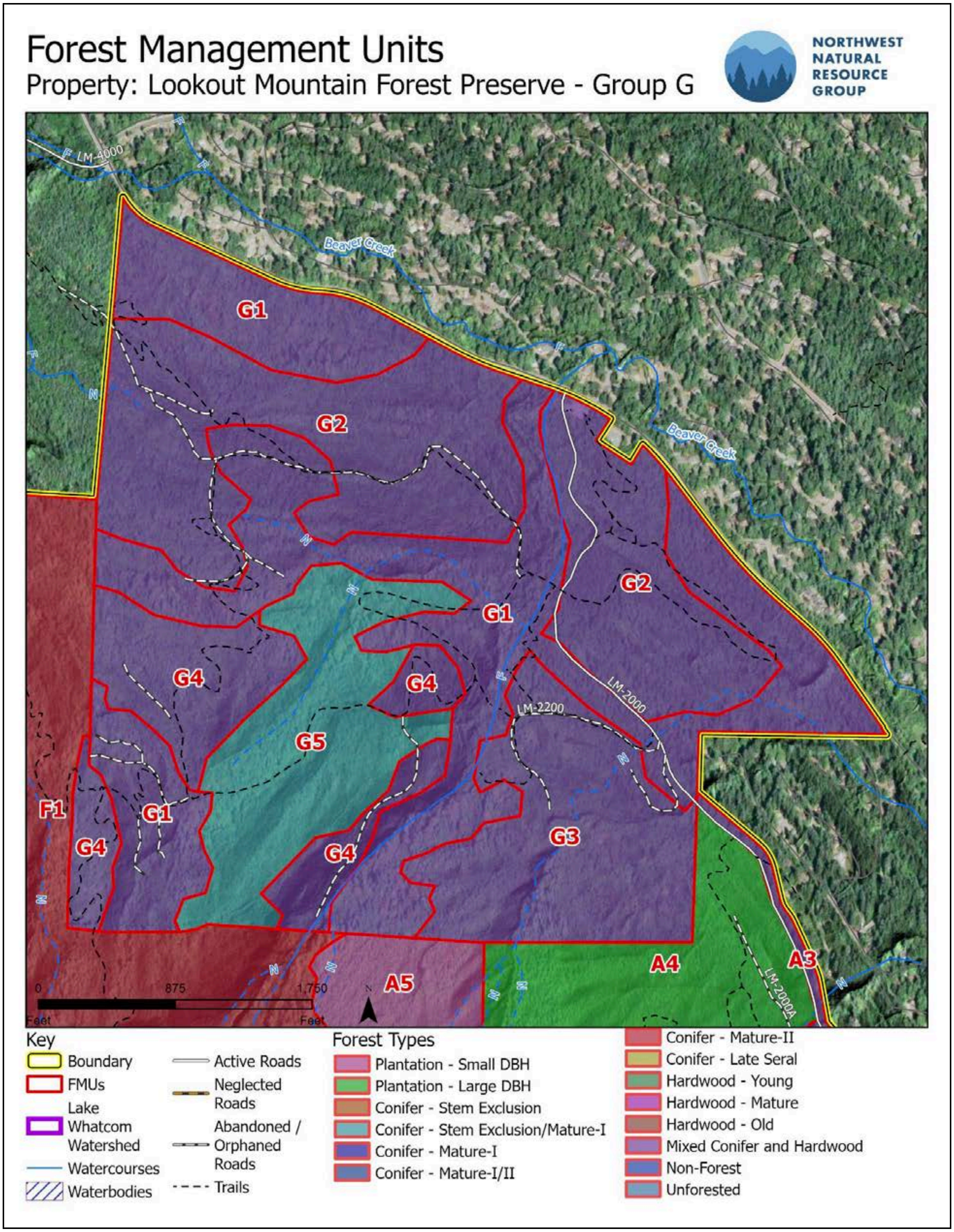
Forest Management Units

Property: Lookout Mountain Forest Preserve - Group E





Forest Management Units
Property: Lookout Mountain Forest Preserve - Group F
NORTHWEST NATURAL RESOURCE GROUP
Beaver Creek
G1
G2
G2
G1
G4
G4
G5
G1
G4
G4
G3
F2
F2
F2
F2
F2
F2
F1
A4
A5
A5
A6
A3
A3
A2
A1
A7
LM-4000A
LM-2000
LM-2200
LM-2400F
LM-2400H
LM-2400I
LM-2400
LM-2400J
0
1,250
2,500
Feet
Key
Boundary
FMUs
Lake Whatcom Watershed
Watercourses
Waterbodies
Active Roads
Neglected Roads
Abandoned / Orphaned Roads
Trails
Forest Types
Plantation - Small DBH
Plantation - Large DBH
Conifer - Stem Exclusion
Conifer - Stem Exclusion/Mature-I
Conifer - Mature-I
Conifer - Mature-I/II
Conifer - Mature-II
Conifer - Late Seral
Hardwood - Young
Hardwood - Mature
Hardwood - Old
Mixed Conifer and Hardwood
Non-Forest
Unforested


Forest Management Units
Property: Lookout Mountain Forest Preserve - Group G
NORTHWEST NATURAL RESOURCE GROUP
LM-4000
Beaver Creek
Beaver Creek
G1
G2
G2
G1
G4
G4
G5
LM-2200
LM-2000
F1
G1
G4
G4
G3
A4
A3
A5
LM-2000A
0
875
1,750
Feet
Key
Boundary
FMUs
Lake Whatcom Watershed
Watercourses
Waterbodies
Active Roads
Neglected Roads
Abandoned / Orphaned Roads
Trails
Forest Types
Plantation - Small DBH
Plantation - Large DBH
Conifer - Stem Exclusion
Conifer - Stem Exclusion/Mature-I
Conifer - Mature-I
Conifer - Mature-I/II
Conifer - Mature-II
Conifer - Late Seral
Hardwood - Young
Hardwood - Mature
Hardwood - Old
Mixed Conifer and Hardwood
Non-Forest
Unforested

FMU A1 - Mixed Conifer and Hardwood

Stand Composition Summary

<table>
<tr><th>Canopy Position</th><th>Cohort Type</th><th>Species</th><th>TPA</th><th>BAA</th><th>SDI</th><th>RD</th><th>Min DBH</th><th>Avg DBH</th><th>Max DBH</th><th>Avg HT</th></tr>
<tr><td rowspan="4">Overstory</td><td rowspan="2">Major</td><td>DF</td><td>82</td><td>133</td><td>277</td><td rowspan="4">60</td><td>12</td><td>21</td><td>32</td><td>133</td></tr>
<tr><td>WH</td><td>26</td><td>41</td><td>37</td><td>8</td><td>13</td><td>20</td><td>129</td></tr>
<tr><td>Minor</td><td>RA</td><td>18</td><td>24</td><td>42</td><td>8</td><td>17</td><td>22</td><td>109</td></tr>
<tr><td>All</td><td>All</td><td>126</td><td>198</td><td>356</td><td>8</td><td>19</td><td>32</td><td>129</td></tr>
<tr><td rowspan="3">Midstory</td><td rowspan="2">Major</td><td>DF</td><td>9</td><td>3</td><td>6</td><td rowspan="3">3</td><td>6</td><td>8</td><td>12</td><td>80</td></tr>
<tr><td>WH</td><td>12</td><td>6</td><td>10</td><td>6</td><td>9</td><td>14</td><td>69</td></tr>
<tr><td>All</td><td>All</td><td>25</td><td>13</td><td>20</td><td>6</td><td>9</td><td>14</td><td>69</td></tr>
<tr><td>Total</td><td>All</td><td>All</td><td>151</td><td>211</td><td>375</td><td>63</td><td>6</td><td>17</td><td>32</td><td>119</td></tr>
<tr><td colspan="11">Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.</td></tr>
</table>

This FMU follows the drainage of the northern fork of Austin Creek, located in the north-central zone of the property. It mostly contains steep north-facing slopes with a soil productivity rating of site-class III and was last logged in the 1950s. Today, total stocking is approximately 151 TPA. The overstory contains approximately 126 TPA and is primarily composed of western hemlock and Douglas-fir, with a small component of red alder. Overstory Douglas-fir average 21 inches DBH and 133 ft tall, and western hemlock average 13 inches DBH and 129 ft tall. The midstory contains approximately 25 TPA and is primarily composed of western hemlock and Douglas-fir. Midstory Douglas-fir average 8 inches DBH and 80 ft tall, and western hemlock average 9 inches DBH and 69 ft tall. The stand is in good health, and per the earlier discussion of mixed conifer and hardwood forests, no management is needed.

FMU A2 - Conifer Plantation - Large DBH

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	DF	317	281	452	87	8	12	18	92
Total	All	All	317	281	452	87	8	12	18	92

Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.

This FMU is located in the north-central part of the property off the LM-2400 road on moderate southeast facing slopes near the northern fork of Austin Creek. It is more productive than much of the property, rated as site-class II. It was clearcut around 30 years ago and replanted with Douglas-fir. Total stocking is approximately 317 TPA of Douglas-fir that average 12 inches DBH and 92 ft tall. No midstory is currently present in this stand. It does not appear this stand was previously thinned, and the stand is currently overstocked with low species and structural diversity common to plantations. Per the earlier discussion of overstocked, large-diameter plantations, a two-part sequence of variable density thinning is recommended, and potential underplanting once density has been sufficiently reduced. The entire stand is within 500 feet of the LM-2400 road, and ground-based logging operations should be straightforward.

FMU A3 - Mixed Conifer and Hardwood

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	DF	56	119	170	59	12	20	28	120
		RA	66	104	139		8	16	28	97
		WH	33	47	31		4	9	18	75
	All	All	155	270	340		4	16	28	101
Midstory	Major	DF	47	28	23	10	4	6	12	57
		WH	73	37	47		2	7	14	50
	All	All	125	66	70		2	7	14	51
Total	All	All	280	336	411	68	2	12	28	79

Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.

This FMU is located in the north-central area of the property off the LM-2400 road and consists of four separate areas on moderate to steep east-facing slopes. These are the remnants of the second growth forest that naturally regenerated around 1940, before a clearcut harvest in the early 1990s created the nearby plantations. Total stocking is approximately 280 TPA. The overstory contains approximately 155 TPA and is primarily composed of Douglas-fir, western hemlock, and red alder. Overstory Douglas-fir average 20 inches DBH and 120 ft tall, hemlock average 9 inches DBH and 75 ft tall, and alder average 16 inches DBH and 97 ft tall. The midstory contains approximately 125 TPA and is primarily composed of Douglas-fir and western hemlock. Midstory Douglas-fir average 6 inches DBH and 57 ft tall, and hemlock average 7 inches DBH and 50 ft tall. The stand is a mixture of development stages - primarily Mature-I in conifer dominated pockets, but in some areas, the pioneer cohort of red alder is dying off. As the alder declines, density should continue to drop, but there are sufficient conifers growing in the midstory and understory to replace the alder. No management activities are recommended for this unit, as it supports a healthy, diverse forest with no current concerns.

FMU A4 - Conifer Plantation - Large DBH

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	DF	255	181	340	68	8	12	20	87
	Minor	RA	16	11	8		2	7	12	85
		WH	45	24	21		2	6	16	67

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
	All	All	337	229	380		2	10	20	84
Midstory	Major	WH	10	2	2	1	2	4	6	26
	All	All	16	3	4		2	4	6	28
Total	All	All	353	232	383	68	2	10	20	82
Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.										

This FMU is located in the north-central area of the property near the lower section of the LM-2000 road. It has moderate to steep northwest-facing slopes and a soil productivity rating that is primarily site classes II and III. This unit was clearcut around 1991 and replanted with Douglas-fir. Red alder and western hemlock naturally regenerated in minor amounts as well. Total stocking is approximately 353 TPA. The overstory contains approximately 337 TPA and is primarily composed of Douglas-fir, with small components of red alder and western hemlock. Overstory Douglas-fir average 12 inches DBH and 87 ft tall. The midstory contains approximately 16 TPA and is primarily composed of western hemlock that average 4 inches DBH and 26 ft tall. It does not appear this stand was previously thinned, and the stand is currently overstocked with low species and structural diversity common to plantations. Per the earlier discussion of overstocked, large-diameter plantations, a two-part sequence of variable density thinning is recommended, and potential underplanting once density has been sufficiently reduced.

The lower portions of this stand can be accessed by the LM-2000 road and decommissioned spurs off the LM-2400 road provide access to the upper southwestern corner of the stand. For commercial thinning activities, these roads will need to be restored which would require the installation of new culverts. Except for some ground-based logging on flat ground at the top of the unit, logging will be mainly cable-yarding, and as a result portions of this stand are unreachable from current landings and some thinning will need to be non-commercial. A few small hazard zones run through the unit. Further assessment of these hazard zones will be necessary, but they appear to identify inner gorges along streams which can be strategically avoided during operations.

FMU A5 - Conifer Plantation - Small DBH

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	DF	297	115	246	49	4	9	14	57
		WH	141	49	39		2	4	14	59
	Minor	RA	18	8	18		6	10	16	80
	All	All	464	175	305		2	7	16	58
Midstory	Major	WH	18	2	4	0	2	4	6	20
Total	All	All	482	177	309	50	2	7	16	57
Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.										

This FMU is in the north-central area of the property. It consists of two adjacent stands separated by a stream channel and contains moderate to steep northwest-facing slopes. The soil productivity rating varies but is primarily site-class II at lower elevations and site-class IV at the top of the ridgeline. The forest was clearcut around 2000 and replanted with Douglas-fir, but has seen substantial natural regeneration of hemlock. Total stocking is approximately 482 TPA. The overstory contains approximately 464 TPA and is primarily composed of Douglas-fir and western hemlock, with a small component of red alder. Overstory Douglas-fir average 9 inches DBH and 57 ft tall, and hemlock average 4 inches DBH and 59 ft tall. The midstory contains approximately 18 TPA and is primarily composed of western hemlock that average 4 inches DBH and 20 ft tall. This plantation is overstocked, does not appear to have been previously thinned, and is currently in the Stem Exclusion phase of development.

Per the earlier discussion of overstocked small-diameter plantations, an initial pre-commercial thinning is recommended, followed by a two-part sequence of variable density thinnings in the future, and potential underplanting once density has been sufficiently reduced. This stand can be partially accessed off the LM-2400 road and LM-2400F spur, which should provide adequate access for non-commercial thinning operations. The steep terrain will largely require cable-yarding for commercial operations, and at least 20 acres on the northern and western portions of the FMU are unlikely to be accessible for commercial harvesting without restoring a half mile of old road bed. Non-commercial thinning should be utilized in these areas if access cannot be identified. A small hazard zone runs through the northern portion of the unit. Further assessment of this hazard zone will be necessary, but it appears to identify inner gorges along streams which can be strategically avoided during operations.

FMU A6 - Mixed Conifer - Stem Exclusion

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	DF	167	171	287	84	6	14	32	106
		WH	214	158	236		6	11	20	101
	Minor	RC	45	38	41		4	9	16	100
	All	All	432	376	573		4	12	32	103
Midstory	Major	RC	34	6	8	2	2	4	8	27
		WH	34	6	8		2	4	8	27
	All	All	67	11	15		2	4	8	27
Total	All	All	499	387	589	86	2	11	32	93

Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.

This FMU is located in the north-central part of the property on a wide ridgeline and consists of two separate stands. The larger northern area has mostly moderate northeast-facing slopes, and the southern area has mostly steep northeast-facing slopes. The soil productivity rate is site-class IV, and the dry upper ridgeline position likely reduces productivity even further. Historic inventory data identified this stand as originating in 1908. No stumps were observed, and charred snags suggest this may be a naturally regenerated fire-origin stand that has experienced extremely slow growth on top of the dry ridgeline. Total stocking is approximately 499 TPA. The overstory contains approximately 432 TPA and is primarily composed of Douglas-fir and western hemlock, with a small component of western redcedar. Overstory Douglas-fir average 14 inches DBH and 106 ft tall, and hemlock average 11 inches DBH and 101 ft tall. The midstory contains approximately 67 TPA and is primarily composed of western redcedar and western hemlock. Midstory redcedar average 4 inches DBH and 27 ft tall, and hemlock average 4 inches DBH and 27 ft tall.

This unit is overstocked and, though potentially near 120 years old, is still in the Stem Exclusion phase of development. Per the earlier discussion of overstocked mixed-conifer stands in Stem Exclusion, a sequence of variable density thinnings is recommended. Given the high initial density of this stand, two thinnings will be required to hit the initial density target. Most of the unit can be accessed off the LM-2400 road, and relatively flat slopes should enable ground-based commercial thinning activities. The southern stand is likely inaccessible to commercial thinning, and non-commercial thinning entries should be used to reduce densities.

FMU A7 - Mixed Conifer - Mature-I/II

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	DF	84	216	438	93	18	28	36	160
	Minor	RC	28	72	72		12	18	24	160
		WH	28	72	72		12	18	24	160
	All	All	140	360	582		12	24	36	160
Midstory	Major	RC	30	10	21	5	4	8	12	80
		WH	30	10	21		4	8	12	80
	All	All	60	20	42		4	8	12	80
Total	All	All	200	380	624	98	4	19	36	136
Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.										

This is a small FMU located in the north-central area of the property, separating the two stands of FMU A6. The soil productivity rate is site-class IV, but the unit is situated in a shallow, northeast-facing stream channel where the availability of water has allowed this stand, which likely originated the same time as FMU A6, to grow much faster and achieve more advanced stages of stand development. Total stocking is approximately 200 TPA. The overstory contains approximately 140 TPA and is primarily composed of Douglas-fir, with a small component of western redcedar and western hemlock. Overstory Douglas-fir average 28 inches DBH and 160 ft tall. The midstory contains approximately 60 TPA and is primarily composed of western redcedar and western hemlock. Midstory western redcedar average 8 inches DBH and 80 ft tall. Midstory western hemlock average 8 inches DBH and 80 ft tall. The forest here is more developed and structurally diverse than nearby units and is likely in the late Mature-I and early Mature-II phase of development. Per the earlier discussion of stands in these stages of development, and given the advanced regeneration currently present, no management activities are recommended for this unit.

FMU A8 - Mixed Conifer - Mature-I

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	DF	50	77	154	60	12	20	30	136
		WH	166	239	305		8	15	24	135
	All	All	216	316	459		8	16	30	135
Midstory	Major	RC	8	4	4	1	4	6	10	60
		WH	8	4	4		4	6	10	60
	All	All	16	8	7		4	6	10	60
Total	All	All	232	324	466	60	4	15	30	130

Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.

This FMU is located near the north peak of Lookout Mountain on steep east- and north-facing slopes that contain the headwaters of the northern fork of Austin Creek. The soil productivity rate is site-class IV, but the north-facing site has decent soil moisture capacity, though productivity notably declines higher on the slope where less water is available. Based on historic inventory data, it is estimated that the unit regenerated naturally following clearcut harvesting around 1926. Total stocking is approximately 232 TPA. The overstory contains approximately 216 TPA and is primarily composed of western hemlock with some Douglas-fir. Overstory Douglas-fir average 20 inches DBH and 136 ft tall, and hemlock average 15 inches DBH and 135 ft tall. The midstory contains approximately 16 TPA and is primarily composed of western redcedar and western hemlock. Midstory redcedar and hemlock both average 6 inches DBH and 60 ft tall. Western hemlock regeneration is strong throughout the unit, suggesting this stand has emerged from Stem Exclusion and entered the Mature-I phase of development. Stocking remains high, and the stand contains a large component of western hemlock. However, the north-facing site likely provides decent growing conditions for this drought-intolerant species.

Per the earlier discussion of Mature-I stands, this unit could be lightly thinned, but priority is low. Given the advanced regeneration, no second entry is necessary. Access is possible to the top of this stand off the LM-2000 road, but access is no longer possible to the lower slopes without rebuilding one mile of the LM-2400C road, including a stream crossing. In addition, a hazard zone has been identified across the eastern half of this FMU, potentially because of rule-identified inner gorges and convergent headwalls at the headwaters of the creek system. If access is limited to the top, then the steep terrain and bench topography likely limits logging feasibility to around 10-acres. This makes the stand a good candidate to include with thinning operations on adjacent, highly-overstocked stands on the upper mountain, but it generally remains a lower priority.

FMU B1 - Mixed Conifer - Mature-II

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	DF	90	226	335	66	12	23	36	154
	All	All	106	265	371		8	22	36	154
Midstory	Major	RC	45	29	35	8	2	8	18	59
		WH	27	12	18		2	8	16	59
	All	All	81	44	60		2	8	18	61
Total	All	All	187	309	431	73	2	16	36	114

Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.

This FMU is located in the north-central zone of the property near the base of Lookout Mountain. It is near the start of the LM-2000 road, and Austin Creek flows along the eastern boundary. It contains a series of northeast-facing terraces that alternate with plateaus and short steep slopes. The soil productivity rate is a mixture of site class III and IV. The lower part of the unit contains continuous steep slopes over 70% above Austin Creek. Total stocking is approximately 187 TPA. The overstory contains approximately 106 TPA and is primarily composed of Douglas-fir that average 23 inches DBH and 154 ft tall. The midstory contains approximately 81 TPA and is primarily composed of western redcedar and western hemlock. Midstory western redcedar average 8 inches DBH and 59 ft tall, and western hemlock average 8 inches DBH and 59 ft tall. More developed than nearby stands, the forest in this unit is likely in the Mature-II stage of development, with larger diameter trees, canopy gaps, and structural diversity. A small to medium sized outbreak of Douglas-fir beetle is operating within normal levels in this stand, accelerating the creation of canopy gaps and recruiting a new cohort of trees into the canopy. No management activities are recommended.

FMU B2 - Mixed Conifer - Stem Exclusion/Mature-I

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	DF	192	245	418	90	8	16	30	114
	Minor	RC	24	34	38		6	13	24	114
		WH	46	54	77		6	14	24	107
	All	All	263	333	532		6	15	30	113
Midstory	Major	RC	33	8	12	3	2	5	8	53
		WH	33	8	12		2	5	8	53
	All	All	66	15	24		2	5	8	53
Total	All	All	329	348	556	92	2	13	30	101

Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.

This FMU is located in the north-central zone of the property on the lower to mid-slopes of Lookout Mountain. It contains a series of northeast-facing terraces that alternate with plateaus and short steep slopes. The soil productivity rate is site-class IV. The unit contains three stands separated by older forest types that don’t require management. Total stocking is approximately 322 TPA. The overstory contains approximately 283 TPA and is primarily composed of Douglas-fir and western hemlock, with a small component of western redcedar. Overstory Douglas-fir average 16 inches DBH and 112 ft tall, and western hemlock average 11 inches DBH and 104 ft tall. The midstory contains approximately 39 TPA and is primarily composed of suppressed western redcedar and western hemlock. Midstory western redcedar average 5 inches DBH and 54 ft tall, and western hemlock average 5 inches DBH and 54 ft tall. This unit varies between late Stem Exclusion and early Mature-I stages of development and is currently overstocked.

Per the earlier discussion of overstocked mixed-conifer stands, a sequence of variable density thinnings is recommended to reduce density and accelerate the development of late-seral characteristics in this stand. The majority of this unit can be accessed by the LM-2000 road with the exception of the most northern stand in this unit. Accessing the northern stand requires yarding about 300ft through an older stand type, which will increase logging complexity and cost. Additionally, though the road runs adjacent to the central stand, identifying a landing may be difficult and require some yarding through adjacent stands or tethering of logging equipment. All stands are sufficiently flat for ground-based logging.

FMU B3 - Mixed Conifer - Stem Exclusion

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	DF	100	117	191	65	8	15	28	110
		WH	100	138	186		6	15	24	119
	Minor	RC	41	44	73		6	14	36	105
	All	All	244	304	455		6	15	36	113
Midstory	Major	RC	26	11	14	3	4	7	14	45
		WH	20	5	10		4	6	14	40
	All	All	46	16	24		4	7	14	43
Total	All	All	290	320	479	68	4	13	36	102

Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.

This FMU is located in the central zone of the property on the mid slopes of Lookout Mountain adjacent to the LM-2000 road. Austin Creek flows along the south and east boundaries. It contains a series of northeast-facing terraces that alternate with plateaus and short steep slopes. The soil productivity rating is a mixture of site class II and IV. The eastern part of the unit contains continuous steep slopes over 70% above Austin Creek. Total stocking is approximately 290 TPA. The overstory contains approximately 244 TPA and is primarily composed of Douglas-fir and western hemlock, with a small component of western redcedar. Overstory Douglas-fir average 15 inches DBH and 110 ft tall, and overstory western hemlock average 15 inches DBH and 119 ft tall. The midstory contains approximately 46 TPA and is primarily composed of suppressed western redcedar and western hemlock. Midstory western redcedar average 7 inches DBH and 45 ft tall, and midstory western hemlock average 6 inches DBH and 40 ft tall. This stand is best characterized in the Stem Exclusion stage of stand development. Per the earlier discussion of overstocked mixed-conifer stands in Stem Exclusion, a sequence of variable density thinnings is recommended.

This unit was delineated separately from similar forest stands due to potential slope stability challenges requiring additional review before management recommendations can be implemented. Most of the unit falls within a hazard zone due to historic landslide activity and steep, potentially inner-gorge slopes leading down to Austin Creek. The historic landslide designation seems overly cautious given the local topography, but harvesting in this unit will require further investigation and may be impossible or severely restricted. Most of the stand can be accessed from the LM-2000 road, but a few short temporary spur roads may need to be built to facilitate equipment access, including utilizing the LM-2000A spur that was previously decommissioned. Harvesting, if possible, can be accomplished with a combination of ground and cable-yarding, but long yarding distances will likely increase costs.

FMU B4 - Mixed Conifer - Stem Exclusion/Mature-I

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	DF	73	131	209	63	12	19	32	141
		WH	111	185	215		10	15	24	142
	Minor	RC	11	21	25		10	16	24	143
	All	All	195	337	449		10	17	32	142
Midstory	Major	RC	10	4	6	1	2	7	12	51
		WH	4	1	2		2	6	10	40
	All	All	15	5	8		2	7	12	48
Total	All	All	210	342	457	64	2	16	32	135

Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.

This FMU is located in the central zone of the property and stretches across the mid slopes of Lookout Mountain adjacent to the LM-2000 road. It contains a mix of moderate to steep northeast- and east-facing slopes. The soil productivity rate is site-class IV, but this unit has been delineated separately from nearby stands as it has lower stocking, larger trees, and is generally more accessible.

Total stocking is approximately 210 TPA. The overstory contains approximately 195 TPA and is primarily composed of Douglas-fir and western hemlock, with a small component of western redcedar. Overstory Douglas-fir average 19 inches DBH and 141 ft tall, and hemlock average 15 inches DBH and 142 ft tall. The midstory contains approximately 15 TPA and is primarily composed of western hemlock and western redcedar. Midstory redcedar average 7 inches DBH and 51 ft tall, and hemlock average 6 inches DBH and 40 ft tall. This unit ranges between late Stem Exclusion and early Mature-I stages of development. It remains overstocked, which is restricting growth and development of the forest.

Per the earlier discussion of overstocked mixed-conifer stands, a sequence of variable density thinnings is recommended. Access is off the LM-2000 road and harvest operations will likely be a mix of ground-based equipment and cable-yarding. The northern portion of this unit is not likely accessible without building 400 ft of temporary road. The central portion of this unit has good road access but includes several hazard zones which will require additional review. The southern portion of this unit has good access and can be easily cable-yarded.

FMU B5 - Mixed Conifer - Stem Exclusion

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	DF	87	78	151	64	8	14	24	103
		WH	234	184	316		6	12	22	100
	All	All	328	270	478		6	13	24	101
Midstory	Major	RC	29	17	12	2	2	6	10	53
		WH	17	8	6		2	5	8	47
	All	All	46	25	17		2	5	10	51
Total	All	All	374	295	495	66	2	12	24	94

Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.

This FMU is located in the central zone of the property and contains several areas on the mid to upper slopes of Lookout Mountain. It mostly contains a mix of moderate to steep northeast- to east-facing slopes, but there are some steep southwest-facing slopes near the western property boundary. Total stocking is approximately 374 TPA. The overstory contains approximately 328 TPA and is primarily composed of Douglas-fir and western hemlock. Overstory Douglas-fir average 14 inches DBH and 103 ft tall, and hemlock average 12 inches DBH and 100 ft tall. The midstory contains approximately 46 TPA and is primarily composed of western hemlock and western redcedar. Midstory redcedar average 6 inches DBH and 53 ft tall, and hemlock average 5 inches DBH and 47 ft tall. This FMU is in the Stem Exclusion phase.

Per the earlier discussion of overstocked mixed-conifer stands in Stem Exclusion, a sequence of variable density thinnings is recommended. Given the high initial density of this stand and its exposed ridgeline positions, two thinnings should be used to hit the initial density target. The stand is generally free from hazard zones, except for some small areas of overlap on its eastern and southeastern border. These areas are likely rule-identified inner-gorges which can be avoided during future operations. Small stands on the unit's southwest boundary may have been left by past DNR harvests because of concerns around slope stability and will require further review. The stand is partially accessible off the LM-2000 road. Logging operations would be primarily cable-yarding and, given the topography, will likely be a complex layout of multiple small areas that can be easily accessed by equipment operating from the LM-2000 road. Much of the northern most portion of the stand is likely inaccessible to logging operations.

FMU B6 - Mixed Conifer - Mature-I

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	DF	73	89	185	57	10	18	24	142
		WH	137	161	235		8	14	20	138
	All	All	210	250	421		8	15	24	139
Total	All	All	210	250	421	57	8	15	24	139

Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.

This FMU is located in the central zone of the property on the mid slopes of Lookout Mountain. The upper section of Austin Creek flows along the northern boundary. It consists of three separate areas with moderate and steep northeast-facing slopes. It has a soil productivity rating of site class IV. Total stocking is approximately 210 TPA. The overstory is primarily composed of Douglas-fir and western hemlock. Overstory Douglas-fir average 18 inches DBH and 142 ft tall, and western hemlock average 14 inches DBH and 138 ft tall. No midstory is currently present. This unit is in the Mature-I stage of development, with a well-established cohort of western hemlock in the understory.

Per the earlier discussion on mixed conifer stands in this stage, a variable density thinning is recommended in accessible stands, but is a lower priority to thin than the adjacent stands in Stem Exclusion. Parts of this stand are accessible from the LM-2000 road and can be commercially thinned. Commercial harvesting can be accomplished using a combination of ground and cable-yarding techniques as terrain dictates. The northern stand in this unit includes hazard zones leading down to Austin Creek and will require further assessment. In addition, access to this northern stand is only possible from the northern part of the unit unless the decommissioned LM-2000E road is restored, which would require a stream crossing of Austin Creek. As a result, only a small portion of this unit near the LM-2000 road is likely a good candidate for thinning. Restoring 600 ft of an abandoned spur road (LM-2500B) would provide reasonable cable-yarding access to the middle stand and is a good candidate for thinning. Finally, the southern stand in this unit is inaccessible without new road building and is not a good candidate for thinning.

FMU B7 - Mixed Conifer - Stem Exclusion

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	RC	61	58	102	54	8	13	32	85
		WH	172	187	230		6	12	20	106
	Minor	DF	30	35	65		10	16	20	114
		SF	32	28	32		6	10	20	80
	All	All	296	307	428		6	12	32	100
Midstory	Major	RC	15	10	7	1	4	6	8	40
		WH	6	1	1		2	4	8	60
	All	All	21	11	8		2	5	8	46
Total	All	All	317	318	436	55	2	12	32	96

Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.

This FMU is located on the upper slopes of Lookout Mountain near the southern peak. It contains mostly moderate northeast-facing slopes with some terraces that alternate with plateaus and short steep slopes. There is a small area with steep southwest-facing slopes off of Lookout Mountain's southern peak. The unit has a soil productivity rating of site class IV. Based on historic inventory data, it is estimated that the unit regenerated naturally following clearcut harvesting around 1942-1950. Total stocking is approximately 317 TPA. The overstory contains approximately 296 TPA and is primarily composed of western hemlock and western redcedar, with small components of Douglas-fir and pacific silver fir. The silver fir is generally limited to the upper elevations of this unit. Overstory western redcedar average 13 inches DBH and 85 ft tall, and hemlock average 12 inches DBH and 106 ft tall. The midstory contains approximately 21 TPA and is primarily composed of western hemlock and western redcedar. Midstory western redcedar average 6 inches DBH and 40 ft tall, and western hemlock average 4 inches DBH and 60 ft tall. This stand is overstocked in the Stem Exclusion stage of development.

Per the earlier discussion on mixed conifer stands in Stem Exclusion, a sequence of variable density thinnings is recommended. This thinning should occur within the next 5 years, but stocking is slightly lower than in other stands owing to its later origination, and therefore this stand could wait up to 10 years if required. Parts of this stand are accessible from the LM-2000 road, which runs through the middle of the stand to the top of the southern peak. Accessible areas can be commercially thinned, while inaccessible areas will need to be non-commercially thinned unless new roads are constructed. Commercial harvesting can be accomplished using a combination of ground and cable-yarding techniques. Currently, logging trucks with normal length logs would be unable to navigate several hairpin turns on the way to the communication tower, so either very short logs need to be manufactured or non-commercial thinning used across these upper slopes.

FMU B8 - Mixed Conifer - Stem Exclusion

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	WH	554	110	256	48	2	6	12	50
	Minor	DF	40	6	28		6	8	12	40
		RA	118	39	60		4	7	10	60
		RC	80	13	18		2	4	8	40
	All	All	792	168	362		2	6	12	50
Total	All	All	792	168	362	48	2	6	12	50

Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.

This FMU is located along the upper ridgeline of Lookout Mountain near the northern peak. It contains some mellow slopes in the middle and steeper slopes along the edges, particularly in the southwest corner. The soil productivity rating of the unit is site class IV on the east side and site class III on the west side. After clearcutting in 1990, the stand was likely replanted with Douglas-fir and potentially other species, but has experienced high-levels of natural regenerating hemlock and alder. Total stocking is approximately 792 TPA. The overstory is primarily composed of western hemlock, with a small component of Douglas-fir, red alder, and western redcedar. Overstory western hemlock average 6 inches DBH and 50 ft tall. No midstory is currently present in this stand. The stand is in the Stem Exclusion stage of development. Per the earlier discussion of overstocked small-diameter plantations, an initial pre-commercial thinning is recommended, followed by a two-part sequence of variable density thinnings in the future, and potential underplanting once density has been sufficiently reduced. The unit is accessible from the maintained LM-2000 road, and several spurs can be easily brought back into service to access most parts of this unit.

FMU B9 - Mixed Conifer and Hardwood

This FMU is located on the western slopes of the southern peak of Lookout Mountain. It is on steep south- and southeast-facing slopes which form the headwaters of Barnes Creek, which drains west into Lake Samish. It has a soil productivity rating of site class III. Based on historic inventory data, it is estimated that the unit regenerated naturally following clearcut harvesting around 1950. This unit was not visited during the assessment due to challenging access. Based on remote sensing, this unit has characteristics similar to nearby unit E2, where no management is recommended. In addition, this unit is on steep and likely unstable slopes, most of which forms a convergent headwall. For these reasons, no management is recommended in this unit.

FMU C1 - Mixed Conifer - Mature-II

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	DF	120	240	377	73	12	20	26	160
Midstory	Major	RC	28	26	28	8	6	10	20	83
		WH	36	22	36		6	10	14	100
	All	All	64	48	64		6	10	20	92
Total	All	All	184	288	441	78	6	17	26	137

Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.

This FMU is located in the central part of the property on the mid-slopes of Lookout Mountain. It contains moderate to steep slopes that face north and east and that drain into Austin Creek at the base of the unit. The soil productivity rating is site class III on the north side and site class IV on the south side. Based on historic inventory data, it is estimated that the unit regenerated naturally following clearcut harvesting around 1934. Total stocking is approximately 184 TPA. The overstory contains approximately 120 TPA and is primarily composed of Douglas-fir. Overstory Douglas-fir average 20 inches DBH and 160 ft tall. The midstory contains approximately 64 TPA and is primarily composed of western redcedar and western hemlock. Midstory western redcedar average 10 inches DBH and 83 ft tall, and western hemlock average 10 inches DBH and 100 ft tall. This forest is in the Mature-II stage of development. Per the earlier discussion of conifer forests in this stage, no management activities are recommended. There is no current road access to this unit.

FMU C2 - Mixed Conifer - Mature-II

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	DF	24	84	125	53	22	28	40	180
		RC	38	48	136		14	22	26	120
	Minor	RA	13	16	27		12	16	22	120
		WH	13	16	33		14	18	20	120
	All	All	88	164	321		12	22	40	136
Midstory	Major	RC	89	94	111	17	6	11	18	104
	All	All	96	104	123		6	12	18	105
Total	All	All	184	268	445	67	6	17	40	120

Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.

This FMU is located in the central part of the property on the mid-slopes of Lookout Mountain. It contains a central plateau with moderate slopes to the north and south. Austin Creek runs along the north side of the unit. The soil productivity rating is site class II. Based on historic inventory data, it is estimated that the unit regenerated naturally following clearcut harvesting around 1934. Total stocking is approximately 184 TPA. The overstory contains approximately 88 TPA and is primarily composed of Douglas-fir and western redcedar, with a small component of red alder. Overstory Douglas-fir average 28 inches DBH and 180 ft tall, and western redcedar average 22 inches DBH and 120 ft tall. The midstory contains approximately 96 TPA and is primarily composed of western redcedar that average 11 inches DBH and 104 ft tall. This forest is in the Mature-II stage of development. Per the previous discussion on mixed conifer forests in this stage, no management activities are recommended. There is no current road access to this unit.

FMU C3 - Mixed Conifer and Hardwood

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	RC	96	80	129	28	8	12	22	120
	Minor	RA	24	20	62		14	18	22	120
	All	All	120	100	190		8	13	22	120
Midstory	Major	RC	20	10	14	4	6	8	10	60
		WH	20	10	14		6	8	10	60
	All	All	40	20	28		6	8	10	60
Total	All	All	160	120	218	31	6	12	22	105

Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.

This FMU is located in the south-central zone of the property on the lower slopes of Lookout Mountain. It contains east-facing slopes that are moderate at the higher elevations and increase in steepness at the lower elevations. The soil productivity rating is site class III on the east side and site class IV on the west side. Based on historic inventory data, it is estimated that the unit regenerated naturally following clearcut harvesting around 1934. Total stocking is approximately 160 TPA. The overstory contains approximately 120 TPA and is primarily composed of western redcedar, with a small component of red alder and occasional Douglas-fir. Overstory western redcedar average 12 inches DBH and 120 ft tall. The midstory contains approximately 40 TPA and is primarily composed of western redcedar and western hemlock. Midstory western redcedar and hemlock both average 8 inches DBH and 60 ft tall. This stand used to be more dominant to red alder, which has experienced significant mortality due to its short lifespan. Western redcedar and other conifers are growing to replace the red alder, so the forest is on a healthy trajectory as it undergoes a successional shift. Per the earlier discussion of mixed conifer and hardwood forests, no management activities are recommended. This unit has no current road access.

FMU C4 - Mixed Conifer - Mature-I

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	DF	60	133	154	66	10	18	32	160
		RC	60	133	154		10	18	32	160
		WH	60	133	154		10	18	32	160
	All	All	180	400	462		10	18	32	160
Midstory	Major	RC	20	4	9	2	4	6	8	60
		WH	20	4	9		4	6	8	60
	All	All	40	8	18		4	6	8	60
Total	All	All	220	408	480	69	4	16	32	142

Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.

This FMU is located in the south-central part of the property, with Silver Creek flowing along the southern boundary. The terrain includes mostly south-facing slopes that are moderate at the upper elevations and steeper at the lower elevations. The soil productivity rating is site class III on the south side and site class IV on the north side. Based on historic inventory data, it is estimated that the unit regenerated naturally following clearcut harvesting around 1934-1945. Total stocking is approximately 220 TPA. The overstory contains approximately 180 TPA and is primarily composed of Douglas-fir, western redcedar, and western hemlock. Overstory Douglas-fir average 18 inches DBH and 160 ft tall, redcedar average 18 inches DBH and 160 ft tall, and hemlock average 18 inches DBH and 160 ft tall. The midstory contains approximately 40 TPA and is primarily composed of western redcedar and western hemlock. Midstory redcedar and hemlock both average 6 inches DBH and 60 ft tall. This unit is in the Mature-I stage of development with some regeneration occurring and a limited midstory in places. The stand is not currently accessible for commercial thinning, and any new road construction would be several miles long. Though a little overstocked, the overstory density is very close to the initial target density for mixed conifer stands in this stage of development. Given these factors, no management is recommended.

FMU C5 - Mixed Conifer and Hardwood

This FMU is located on southeastern slopes leading down from Lookout Mountain's southern peak towards the community of Glenhaven. An unnamed creek runs through the middle of the unit towards Cain Lake and the soil productivity rating ranges from site class II to III. Based on historic inventory data, it is estimated that the unit regenerated naturally following clearcut harvesting around 1940. There is currently no road or trail access to this stand. Though an old road bed once likely led out of the town of Glenhaven near the current water tower, current legal access is unclear. This unit was not visited during the assessment due to challenging access. Based on remote sensing, this unit has similar forest conditions to nearby unit E6, where no management is recommended. In addition, this unit is on very steep slopes that include hazard zones and historic landslide activity. For these reasons, no management is recommended in this unit.

FMU D1 - Mixed Conifer - Mature-II

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	DF	46	102	340	85	18	35	48	195
	Minor	RC	17	49	97		16	30	48	186
		WH	17	49	97		16	30	48	186
	All	All	84	208	554		16	32	48	191
Midstory	Major	RC	34	26	70	18	8	16	24	96
		WH	34	26	70		8	16	24	96
	All	All	68	52	140		8	16	24	96
Total	All	All	152	260	694	102	8	25	48	149

Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.

This FMU is located along the eastern boundary of the property, with northeast-facing slopes descending from the north side of Repeater Road to Lake Whatcom Boulevard. It has a soil productivity rating of site class III. Based on historic inventory data, it is estimated that the unit regenerated naturally following clearcut harvesting around 1931. Total stocking is approximately 152 TPA. The overstory contains approximately 84 TPA and is primarily composed of Douglas-fir, with a small component of western redcedar. Overstory Douglas-fir average 35 inches DBH and 195 ft tall. The midstory contains approximately 68 TPA and is primarily composed of western redcedar and western hemlock. Midstory redcedar and hemlock both average 16 inches DBH and 96 ft tall. The forest in this unit is in the Mature-II stage of development. Per the earlier discussion of conifer forests in this stage, no management activities are recommended. The lower part of this unit is accessible from Lake Whatcom Boulevard, and the upper part is accessible from Repeater Ridge Road.

FMU D2 - Mixed Conifer - Mature-II

Stand Composition Summary

<table>
<tr><th>Canopy Position</th><th>Cohort Type</th><th>Species</th><th>TPA</th><th>BAA</th><th>SDI</th><th>RD</th><th>Min DBH</th><th>Avg DBH</th><th>Max DBH</th><th>Avg HT</th></tr>
<tr><td rowspan="3">Overstory</td><td>Major</td><td>DF</td><td>61</td><td>122</td><td>244</td><td rowspan="3">60</td><td>16</td><td>24</td><td>36</td><td>152</td></tr>
<tr><td>Minor</td><td>BM</td><td>19</td><td>38</td><td>78</td><td>16</td><td>24</td><td>30</td><td>120</td></tr>
<tr><td>All</td><td>All</td><td>96</td><td>192</td><td>354</td><td>8</td><td>22</td><td>36</td><td>142</td></tr>
<tr><td rowspan="3">Midstory</td><td rowspan="2">Major</td><td>RC</td><td>44</td><td>46</td><td>60</td><td rowspan="3">11</td><td>4</td><td>12</td><td>20</td><td>55</td></tr>
<tr><td>WH</td><td>30</td><td>18</td><td>21</td><td>4</td><td>8</td><td>12</td><td>60</td></tr>
<tr><td>All</td><td>All</td><td>74</td><td>64</td><td>81</td><td>4</td><td>10</td><td>20</td><td>57</td></tr>
<tr><td>Total</td><td>All</td><td>All</td><td>170</td><td>256</td><td>435</td><td>69</td><td>4</td><td>17</td><td>36</td><td>105</td></tr>
<tr><td colspan="11">Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.</td></tr>
</table>

This FMU is located along the eastern boundary of the property, with east-facing slopes descending from Repeater Road to Lake Whatcom Boulevard. It has a soil productivity rating of site class III. Based on historic inventory data, it is estimated that the unit regenerated naturally following clearcut harvesting around 1930-1941. Total stocking is approximately 170 TPA. The overstory contains approximately 96 TPA and is primarily composed of Douglas-fir, with a small component of bigleaf maple. Overstory Douglas-fir average 24 inches DBH and 152 ft tall. The midstory contains approximately 74 TPA and is primarily composed of western redcedar and western hemlock. Midstory western redcedar average 12 inches DBH and 55 ft tall, and hemlock average 8 inches DBH and 60 ft tall. The forest in this unit is at the beginning of the Mature-II stage of development. Per the earlier discussion of conifer forests in this stage, no management activities are recommended. The lower part of this unit is accessible from Lake Whatcom Boulevard, and the upper part is accessible from Repeater Ridge Road.

FMU D3 - Mixed Conifer - Mature-I/II

Stand Composition Summary

<table>
<tr><th>Canopy Position</th><th>Cohort Type</th><th>Species</th><th>TPA</th><th>BAA</th><th>SDI</th><th>RD</th><th>Min DBH</th><th>Avg DBH</th><th>Max DBH</th><th>Avg HT</th></tr>
<tr><td rowspan="3">Overstory</td><td>Major</td><td>DF</td><td>98</td><td>236</td><td>451</td><td rowspan="3">89</td><td>12</td><td>26</td><td>40</td><td>163</td></tr>
<tr><td>Minor</td><td>WH</td><td>11</td><td>24</td><td>34</td><td>10</td><td>20</td><td>30</td><td>163</td></tr>
<tr><td>All</td><td>All</td><td>112</td><td>267</td><td>494</td><td>10</td><td>25</td><td>40</td><td>164</td></tr>
<tr><td rowspan="4">Midstory</td><td rowspan="3">Major</td><td>DF</td><td>17</td><td>7</td><td>19</td><td rowspan="4">9</td><td>4</td><td>10</td><td>16</td><td>60</td></tr>
<tr><td>RC</td><td>19</td><td>11</td><td>17</td><td>4</td><td>9</td><td>16</td><td>73</td></tr>
<tr><td>WH</td><td>29</td><td>15</td><td>31</td><td>4</td><td>10</td><td>16</td><td>68</td></tr>
<tr><td>All</td><td>All</td><td>65</td><td>33</td><td>66</td><td>4</td><td>10</td><td>16</td><td>67</td></tr>
<tr><td>Total</td><td>All</td><td>All</td><td>177</td><td>300</td><td>560</td><td>98</td><td>4</td><td>19</td><td>40</td><td>128</td></tr>
<tr><td colspan="11">Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.</td></tr>
</table>

This FMU is located in the lower slopes of Lookout Mountain near the eastern boundary of the property and has a soil productivity rating of site class III. Based on historic inventory data, it is estimated that the unit regenerated naturally sometime around 1900, possibly from wildfire, as no stumps were observed. A handful of very large, old-growth trees were found growing in the steep ravines leading down to Lake Whatcom, where they likely survived the last disturbance. Total stocking is approximately 177 TPA. The overstory contains approximately 112 TPA and is primarily composed of Douglas-fir, with a small component of western hemlock. Overstory Douglas-fir average 26 inches DBH and 163 ft tall. The midstory contains approximately 65 TPA and is primarily composed of Douglas-fir, western redcedar, and western hemlock. Midstory Douglas-fir average 10 inches DBH and 60 ft tall, redcedar average 9 inches DBH and 73 ft tall, and hemlock average 10 inches DBH and 68 ft tall. This unit is generally in the Mature-II stage of development, but varies with some areas high on the ridgeline where growth has progressed slowly only beginning to exhibit early Mature-I conditions. Per the earlier discussion of conifer stands in this stage, no management activities are recommended. There is no current road access to this stand.

FMU D4 - Mixed Conifer and Hardwood

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	BM	61	108	216	55	12	22	36	120
	Minor	DF	13	26	73		24	29	40	180
	All	All	90	170	361		12	24	42	129
Midstory	Major	RC	70	80	155	22	8	16	26	89
Total	All	All	160	250	517	76	8	20	42	111

Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.

This FMU is located along the eastern boundary of the property that is adjacent to Lake Whatcom Boulevard. It contains east-facing slopes that are steep on the south side and more moderate on the north side. It has a soil productivity rating of site class III. Based on historic inventory data, it is estimated that the oldest trees in this unit regenerated naturally around 1817 following a wildfire, making it one of the oldest stands in the watershed. Many of the trees are likely younger, having originated later than the original Douglas-fir overstory and the stand broadly appears to possess well developed Mature-II and other later-seral characteristics. Total stocking is approximately 160 TPA. The overstory contains approximately 90 TPA and is primarily composed of bigleaf maple, with a small component of Douglas-fir. Overstory bigleaf maple average 22 inches DBH and 120 ft tall. The midstory contains approximately 70 TPA and is primarily composed of western redcedar that average 16 inches DBH and 89 ft tall. Per the earlier discussion of mixed conifer and hardwood stands with no health concerns, no management activities are recommended. This unit is accessible from Lake Whatcom Boulevard.

FMU D5 - Mixed Conifer - Mature-II

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	DF	60	280	388	75	24	32	40	160
Midstory	Major	RC	80	96	137	20	10	14	22	100
	Minor	WH	20	24	14		6	8	12	80
	All	All	100	120	151		6	13	22	96
Total	All	All	160	400	539	92	6	20	48	120

Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.

This FMU is located in the central zone of the property on steep southeast facing slopes near the boundary of the South Lake Whatcom Preserve. It has a soil productivity rating of site class III. It contains two separate areas divided by a stream channel. Historic inventory data suggests an origination date around 1933, but this appears unlikely as no cut stumps were identified and the stand condition is more similar to the older neighboring stands in unit D3 and D4, suggesting a likely fire origin sometime in the last 120 - 200 years. Total stocking is approximately 160 TPA. The overstory contains approximately 60 TPA and is primarily composed of Douglas-fir that average 32 inches DBH and 160 ft tall. The midstory contains approximately 100 TPA and is primarily composed of western redcedar, with a small component of western hemlock. Midstory western redcedar average 14 inches DBH and 100 ft tall. This conifer forest is in the Mature-II stage of development. Per the earlier discussions of forests in this stage, no management activities are recommended.

FMU D6 - Mixed Conifer and Hardwood

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	RA	91	141	237	59	12	18	32	94
		WH	47	74	116		10	18	28	84
	All	All	146	230	371		10	18	32	91
Midstory	Major	DF	20	12	14	7	4	8	16	60
		WH	46	27	36		4	9	16	49
	All	All	69	41	53		4	8	16	52
Total	All	All	215	271	424	66	4	15	32	79

Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.

This FMU is located in the central zone of the property, near the southern end of the Repeater Road ridge. It contains two separate areas, one with moderate west-facing slopes and the other with steep east- and southeast-facing slopes. The unit is split between soil productivity ratings of III on the lower slopes and IV on the upper slopes. Based on historic inventory data, it is estimated that the unit regenerated naturally following clearcut harvesting around 1933-1943. Total stocking is approximately 215 TPA. The overstory contains approximately 146 TPA and is primarily composed of western hemlock and red alder. Overstory western hemlock average 18 inches DBH and 84 ft tall, and red alder average 18 inches DBH and 94 ft tall. The midstory contains approximately 69 TPA and is primarily composed of Douglas-fir and western hemlock. Midstory Douglas-fir average 8 inches DBH and 60 ft tall, and hemlock average 9 inches DBH and 49 ft tall. This mixed forest is on a healthy trajectory as it undergoes a successional shift with a midstory and understory component of conifers growing to replace the declining red alder. Per the earlier discussion of healthy mixed conifer and hardwood stands, no management activities are recommended.

FMU D7 - Mixed Conifer - Stem Exclusion/Mature-I

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	DF	141	269	429	84	12	20	32	120
		WH	41	74	55		8	12	18	120
	All	All	190	360	495		8	18	32	120
Midstory	Major	RC	15	5	7	2	4	6	10	60
		WH	25	7	11		4	6	10	60
	All	All	40	12	18		4	6	10	60
Total	All	All	230	372	512	86	4	16	32	110

Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.

This FMU is located in the central part of the property, near the southern end of Repeater Road. It contains mostly moderate west-facing slopes with a soil productivity rating of site class IV. Based on historic inventory data it is estimated that the unit regenerated naturally following clearcut harvesting around 1943. Total stocking is approximately 230 TPA. The overstory contains approximately 190 TPA and is primarily composed of Douglas-fir and western hemlock. Overstory Douglas-fir average 20 inches DBH and 120 ft tall, and hemlock average 12 inches DBH and 120 ft tall. The midstory contains approximately 40 TPA and is primarily composed of western redcedar and western hemlock. Midstory western redcedar and hemlock both average 6 inches DBH and 60 ft tall. There is a small area with young red alder at an old landing near the end of Repeater Road.

This is an overstocked mixed conifer forest that is leaving the Stem Exclusion stage and entering the Mature-I stage of development. Per the earlier discussion of mixed conifer forests in these stages, a variable density thinning is recommended. The north side of the unit is accessible from Repeater Road and is suitable for commercial thinning using cable yarding methods. Accessing the south side of the unit will require building about one quarter mile of temporary road along the ridgeline. If this is not feasible, then given current density and stand development, this southern unit can be left to develop by its own processes.

FMU D8 - Mixed Conifer and Hardwood

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	DF	32	48	113	56	12	22	32	140
		RC	32	48	113		12	22	32	140
		WH	32	48	113		12	22	32	140
	Minor	RA	24	36	32		10	12	16	140
	All	All	120	180	372		10	20	32	140
Midstory	Major	RC	30	20	21	5	4	8	12	40
		WH	30	20	21		4	8	12	40
	All	All	60	40	42		4	8	12	40
Total	All	All	180	220	414	61	4	16	32	107

Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.

This FMU is located in the central part of the property on the west side of Repeater Road. It contains mostly moderate west-facing slopes with a soil productivity rating of site class IV. Based on historic inventory data, it is estimated that the unit regenerated naturally following clearcut harvesting around 1943. Total stocking is approximately 180 TPA. The overstory contains approximately 120 TPA and is primarily composed of Douglas-fir, western redcedar, and western hemlock, with a small component of red alder. Overstory Douglas-fir average 22 inches DBH and 140 ft tall, redcedar average 22 inches DBH and 140 ft tall, and hemlock average 22 inches DBH and 140 ft tall. The midstory contains approximately 60 TPA and is primarily composed of western redcedar and western hemlock. Midstory redcedar average 8 inches DBH and 40 ft tall, and hemlock average 8 inches DBH and 40 ft tall. Per the earlier discussion of mixed conifer and hardwood forests with no health concerns, no management activities are recommended. The unit is accessible from Repeater Ridge Road.

FMU D9 - Mixed Conifer - Mature-I

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	DF	165	342	501	96	12	20	32	144
Midstory	Major	DF	18	9	18	6	6	10	14	69
Midstory	Major	WH	39	16	23	6	4	7	14	38
Midstory	All	All	57	25	41	6	4	8	14	48
Total	All	All	222	367	542	101	4	17	32	120

Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.

This FMU is located in the central part of the property, with steep west-facing slopes descending down from Repeater Road to Austin Creek. It has a soil productivity rating of site class III. Based on historic inventory data, it is estimated that the unit regenerated naturally following clearcut harvesting around 1930. Total stocking is approximately 222 TPA. The overstory contains approximately 165 TPA and is primarily composed of Douglas-fir that average 20 inches DBH and 144 ft tall. The midstory contains approximately 57 TPA and is primarily composed of Douglas-fir and western hemlock. Midstory Douglas-fir average 10 inches DBH and 69 ft tall, and hemlock average 7 inches DBH and 38 ft tall. This stand is in the Mature-I stage of development. Competition remains high, and overstory species composition remains entirely Douglas-fir.

Per the earlier discussion of this forest type, a variable density commercial thinning is recommended to increase species diversity and reduce competition. There is good access from Repeater Road to the top of the stand. The steep slopes will require cable yarding methods, but operations should be straight forward. The lower half of the FMU adjacent to Austin Creek is within a known hazard zone, which requires additional assessment but is likely a rule-identified inner gorge and will be excluded from thinning operations.

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	WH	53	101	149	48	14	18	48	123
	Minor	DF1	12	34	81		14	31	48	135
		DF2	13	38	33		14	18	22	120
	All	All	91	207	345		14	22	48	126
Midstory	Major	WH	57	44	53	7	6	9	14	75
	All	All	62	48	57		6	10	14	75
Total	All	All	153	255	402	55	6	17	48	105

Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.

This FMU is located near the ridgeline in the southern zone of the property. It mostly contains steep west-facing slopes but does include a small east-facing section on the other side of the ridgeline. The soil productivity rating of the unit is site class III. Based on historic inventory data, it is estimated that the unit regenerated naturally following clearcut harvesting around 1879. Total stocking is approximately 153 TPA. The overstory contains approximately 91 TPA and is primarily composed of western hemlock. There is a small component of Douglas-fir that is growing in two distinct cohorts, with the larger one consisting of older legacy trees. Overstory western hemlock average 18 inches DBH and 123 ft tall. The midstory contains approximately 62 TPA and is primarily composed of western hemlock that average 9 inches DBH and 75 ft tall. Per the earlier discussion, this stand is in the Mature-II stage of development, and no management is recommended. There is no current road access to this stand, but a trail along the ridgeline can provide limited access.

FMU E2 - Mixed Conifer and Hardwood

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	BM	28	44	54	38	8	15	28	136
		DF	24	42	87		10	22	32	143
		RA	30	42	73		8	17	24	69
	All	All	94	148	228		8	17	32	118
Midstory	Major	BM	23	13	23	9	6	10	14	60
		RC	23	13	23		6	10	14	60
		WH	23	13	23		6	10	14	60
	All	All	70	40	70		6	10	14	60
Total	All	All	164	188	298	48	6	14	32	93

Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.

This FMU is located along the ridgeline in the southern zone of the property. It contains steep east-facing and southwest-facing slopes with a soil productivity rating of site-class III. Based on historic inventory data, it is estimated that the unit regenerated naturally following clearcut harvesting around 1937-1942. Total stocking is approximately 164 TPA. The overstory contains approximately 94 TPA and is primarily composed of Douglas-fir, red alder, and bigleaf maple. Overstory Douglas-fir average 22 inches DBH and 143 ft tall, maple average 15 inches DBH and 136 ft tall, and alder average 17 inches DBH and 69 ft tall. The midstory contains approximately 70 TPA and is primarily composed of maple, redcedar, and hemlock. Midstory redcedar average 10 inches DBH and 60 ft tall, hemlock average 10 inches DBH and 60 ft tall, and maple average 10 inches DBH and 60 ft tall. This unit is undergoing a transition as the alder declines, but long-lived overstory and midstory Douglas-fir, bigleaf maple, and other conifers, as well as new regeneration, ensures this transition will almost certainly be successful. As a result, no management is needed. Much of the unit is inaccessible by road. The eastern portion of the unit can be accessed by a privately-owned road in the Barnes Creek drainage, but the exact access arrangement is currently unclear.

FMU E3 - Mixed Conifer - Mature-II

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	DF	58	133	300	58	14	28	36	179
	Minor	RC	11	32	19		12	14	18	160
	All	All	74	180	333		12	25	36	175
Midstory	Major	BM	16	10	20	7	6	11	14	74
		RC	16	10	20		6	11	14	74
		WH	10	7	8		6	9	14	71
	All	All	46	32	52		6	11	14	72
Total	All	All	120	212	385	65	6	20	36	136

Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.

This FMU is located on the east-facing slopes of the southern zone of the property. It contains mostly steep slopes with some flatter terraces near the base and has a soil productivity rating of site class III around the edges and site class II in the middle. Based on historic inventory data, it is estimated that the unit regenerated naturally following clearcut harvesting around 1938. Total stocking is approximately 120 TPA. The overstory contains approximately 74 TPA and is primarily composed of Douglas-fir, with a small component of western redcedar. Overstory Douglas-fir average 28 inches DBH and 179 ft tall. The midstory contains approximately 46 TPA and is primarily composed of bigleaf maple, western redcedar, and western hemlock. Midstory redcedar average 11 inches DBH and 74 ft tall, hemlock average 9 inches DBH and 71 ft tall, and maple average 11 inches DBH and 74 ft tall. Understory hemlock is growing at a density of 50 TPA. This forest is in the Mature-II stage of development with no health concerns. Per the earlier discussion of mixed conifer forests in this stage, no management activities are recommended. There is no current road access to this stand.

FMU E4 - Mixed Hardwood - Old

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	BM	40	70	85	29	10	16	20	100
		RA	40	70	85		10	16	20	100
	All	All	80	140	170		10	16	20	100
Midstory	Major	BM	10	10	7	2	4	8	10	60
		WH	10	10	7		4	8	10	60
	All	All	20	20	14		4	8	10	60
Total	All	All	100	160	184	30	4	14	20	92

Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.

This FMU is located on the steep east-facing slopes of the southern zone of the property and has a soil productivity rating of site class III. Based on historic inventory data, it is estimated that the unit regenerated naturally following clearcut harvesting around 1938. Total stocking is approximately 100 TPA. The overstory contains approximately 80 TPA and is primarily composed of bigleaf maple and red alder. Overstory bigleaf maple average 16 inches DBH and 100 ft tall, and red alder average 16 inches DBH and 100 ft tall. A limited midstory contains approximately 20 TPA and is primarily composed of bigleaf maple and western hemlock. Midstory hemlock average 8 inches DBH and 60 ft tall, and maple average 8 inches DBH and 60 ft tall. Mortality of the old alder is occurring, creating canopy gaps where some hemlock and maple have established. Regeneration of western hemlock and maple is occurring in some areas, but a thick understory shrub layer poses some concerns about future regeneration at this site. This unit should be monitored over the next 10 years to ensure there is sufficient regeneration as mortality of the alder continues. If regeneration does not continue to occur, then planting should follow recommendations outlined for older mixed hardwood stands. The southern part of the unit is accessible from the neglected Cain Lake road, and a hiking trail along the ridgeline could provide access to future ground crews.

FMU E5 - Conifer Plantation - Large DBH

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	DF	248	252	377	78	8	13	18	100
	Minor	BM	16	14	16		4	10	16	100
		RA	16	14	16		4	10	16	100
	All	All	280	280	409		4	13	18	100
Total	All	All	280	280	409	78	4	13	18	100
Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.										

This FMU is located at the southern end of the property. It contains moderate north-facing slopes and steep east-facing slopes. The west side of the unit has a soil productivity rating of site class III, and the east side has a rating of site class II. This unit was clearcut around 40 years ago and replanted with Douglas-fir. Total stocking is approximately 320 TPA. The overstory is primarily composed of Douglas-fir, with a small component of bigleaf maple and red alder. Overstory Douglas-fir average 12 inches DBH and 100 ft tall. No midstory is currently present. Per the earlier discussion on overstocked, large-diameter plantations, a series of variable density commercial thinnings is recommended, and potential underplanting once density has been sufficiently reduced. Access is possible to this stand by bringing one mile of the currently neglected Cain Lake road back into service. Given road access, harvest operations would be a combination of ground and cable-yarding but should be relatively simple to lay out and execute as there are limited riparian features or known geologic hazards to navigate.

FMU E6 - Mixed Conifer and Hardwood

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	BM	26	53	63	60	12	17	34	128
		DF	55	148	217		12	23	Over 48	152
	All	All	100	259	355		12	22	Over 48	143
Midstory	Major	BM	24	14	22	9	4	9	16	62
		RC	24	14	22		4	10	16	62
	All	All	64	39	62		4	10	16	66
Total	All	All	164	298	418	69	4	17	Over 48	113
Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.										

This FMU is located at the southern end of the property. It contains a series of southwest-facing terraces that alternate with plateaus and short steep slopes. The unit has a soil productivity rating of site class III. Based on historic inventory data, it is estimated that most of the unit regenerated naturally following clearcut harvesting around 1930. There are some large legacy Douglas-fir in the stand that are older. Total stocking is approximately 164 TPA. The overstory contains approximately 100 TPA and is primarily composed of Douglas-fir and bigleaf maple. Overstory Douglas-fir average 23 inches DBH and 152 ft tall, and bigleaf maple average 17 inches DBH and 128 ft tall. The midstory contains approximately 64 TPA and is primarily composed of bigleaf maple and western redcedar. Midstory redcedar average 10 inches DBH and 62 ft tall, and maple average 9 inches DBH and 62 ft tall. This is a mixed conifer and hardwood forest with no health concerns. Per the earlier discussion of this type of forest, no management activities are recommended for this unit. There is access to the northwest part of the unit from a privately-owned road in the Barnes Creek drainage, but the exact access arrangement is currently unclear.

FMU E7 - Conifer Plantation - Large DBH

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	DF	272	123	257	62	6	10	14	60
		RA	143	52	68		2	6	10	60
	All	All	415	175	325		2	8	14	60
Total	All	All	415	175	325	62	2	8	14	60

Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.

This FMU is located at the southern end of the property and includes moderate to steep slopes, most of which face southwest. The unit has a soil productivity rating of site class III. It was clearcut around 2000 and replanted with Douglas-fir. Red alder has also naturally regenerated across the stand. Total stocking is approximately 415 TPA. Overstory Douglas-fir average 10 inches DBH and 60 ft tall, and red alder average 6 inches DBH and 60 ft tall. No midstory is currently present in this stand. This stand was not previously thinned and is currently overstocked and in the Stem Exclusion stage of development.

Per the earlier discussion of this type of forest, a sequence of commercial thinnings is recommended, and potential underplanting once density has been sufficiently reduced. Thinning should begin in 5-10 years, once the trees have grown in diameter, and two entries will be required to safely reduce density to the initial target. This stand was previously logged using a privately-owned road in the Barnes Creek drainage, but the exact access arrangement is currently unclear. Securing a road-use agreement on this road will be necessary for future management operations. Harvest operations should be relatively simple, employing primarily ground-based logging systems, though some cable-yarding may be necessary to navigate two prominent cliff-bands.

FMU F1 - Mixed Conifer - Mature-II

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	DF	58	157	193	47	14	21	44	191
	Minor	RC	11	25	31		12	20	36	180
		WH	17	41	56		12	21	36	203
	All	All	88	228	285		10	21	44	191
Midstory	Major	RC	32	26	33	10	4	10	14	88
		WH	22	17	19		4	9	16	88
	Minor	DF	13	12	14		4	10	14	96
	All	All	71	58	69		4	10	16	89
Total	All	All	159	286	354	57	4	16	44	146

Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.

This is a large FMU on the northern end of the property. The center of the unit contains a ridgeline that runs north-south with moderate slopes on either side. The southern part of the unit contains several stream drainages with moderate to steep northeast-facing slopes. The northwest corner of the unit contains a series of north-facing drainages. The majority of the unit has a soil productivity rating of site class III. A portion of the west side has a site class IV rating, and a portion on the east side has a site class II rating. Based on historic inventory data, it is estimated that the unit regenerated naturally following a series of clearcut harvests from 1906-1933. Total stocking is approximately 159 TPA. The overstory contains approximately 88 TPA and is primarily composed of Douglas-fir, with small components of western redcedar and western hemlock. Overstory Douglas-fir average 21 inches DBH and 191 ft tall. The midstory contains approximately 71 TPA and is primarily composed of western hemlock and western redcedar, with a small component of Douglas-fir. Midstory western redcedar average 10 inches DBH and 88 ft tall, and hemlock average 9 inches DBH and 88 ft tall. This unit is in the Mature-II stage of development. Per the earlier discussion of forests in this stage, no management is recommended. Part of the unit is accessible from the north on a spur off the LM-4000 road as well as through numerous hiking and biking trails connecting to adjacent properties.

FMU F2 - Mixed Hardwood - Young

Stand Composition Summary

<table>
<tr><th>Canopy Position</th><th>Cohort Type</th><th>Species</th><th>TPA</th><th>BAA</th><th>SDI</th><th>RD</th><th>Min DBH</th><th>Avg DBH</th><th>Max DBH</th><th>Avg HT</th></tr>
<tr><td rowspan="4">Overstory</td><td>Major</td><td>RA</td><td>738</td><td>54</td><td>170</td><td rowspan="4">39</td><td>2</td><td>4</td><td>6</td><td>40</td></tr>
<tr><td rowspan="2">Minor</td><td>BM</td><td>41</td><td>3</td><td>18</td><td>4</td><td>6</td><td>8</td><td>40</td></tr>
<tr><td>DF</td><td>41</td><td>3</td><td>18</td><td>4</td><td>6</td><td>8</td><td>40</td></tr>
<tr><td>All</td><td>All</td><td>820</td><td>60</td><td>206</td><td>2</td><td>4</td><td>8</td><td>40</td></tr>
<tr><td>Total</td><td>All</td><td>All</td><td>820</td><td>60</td><td>206</td><td>39</td><td>2</td><td>4</td><td>8</td><td>40</td></tr>
<tr><td colspan="11">Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.</td></tr>
</table>

This FMU is located on moderate north-facing slopes on the northern end of the property. It consists of several narrow fingers between retained riparian zones The unit has a soil productivity rating of site class III. The unit was last clearcut in 2009 and likely replanted in Douglas fir. No management of the plantation has occurred in subsequent years, and the unit has become dominated by naturally regenerated red alder. Total stocking is approximately 820 TPA. The overstory is primarily composed of red alder, with a small component of bigleaf maple and Douglas-fir. Overstory red alder average 4 inches DBH and 40 ft tall. No midstory is currently present, but western redcedar is regenerating at a density of greater than 50 TPA.

This young stand is stocked at unsustainable densities, and future red alder growth will likely overtop and outcompete other species. Given the current redcedar regeneration, it is likely that by reducing density conifers can be recruited into this stand. Therefore, it is recommended to pre-commercially thin this stand, removing alder and releasing maple and Douglas-fir, after which the stand should be monitored for successful conifer establishment. This unit is accessible from the north via a spur off the LM-4000 road.

FMU G1 - Mixed Conifer and Hardwood

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	BM	25	46	74	53	8	20	36	126
		DF	27	49	126		8	26	42	127
		WH	29	52	97		8	21	36	126
	Minor	RC	18	36	55		10	20	36	130
	All	All	104	193	361		4	21	42	127
Midstory	Major	BM	21	15	9	4	2	6	12	57
		WH	25	19	16		2	7	16	50
	Minor	RC	11	6	6		2	7	16	55
	All	All	57	40	31		2	7	16	54
Total	All	All	161	233	392	57	2	16	42	101

Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.

This FMU is located on the northeast side of the property near the Lookout Mountain Forest Preserve Trailhead. It contains second-growth forest that naturally regenerated following an initial clearcut in the early 1900s, but has not been harvested again due to being in riparian zones and steep areas. It has moderate to steep northwest facing slopes and a soil productivity rating of site class II. Total stocking is approximately 161 TPA. The overstory contains approximately 104 TPA and is primarily composed of western hemlock, bigleaf maple and Douglas-fir, with a small component of western redcedar. Overstory Douglas-fir average 26 inches DBH and 127 ft tall, hemlock average 21 inches DBH and 126 ft tall, and maple average 20 inches DBH and 126 ft tall. The midstory contains approximately 57 TPA and is primarily composed of western hemlock and bigleaf maple, with a small component of western redcedar. Midstory hemlock average 7 inches DBH and 50 ft tall, and maple average 6 inches DBH and 57 ft tall. This mixed conifer forest has no health concerns and is primarily in riparian zones and very steep terrain. For these reasons, no management is recommended. The lower section of this stand is accessible from the LM-2000 road, but most of it is not currently accessible by road as the old roads have been turned into trails.

FMU G2 - Mixed Conifer and Hardwood

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	RA	158	87	119	46	4	8	24	63
		WH	92	72	73		4	8	36	27
	Minor	CW	21	23	22		4	10	24	46
		RC	21	40	70		8	21	42	84
	All	All	304	234	307		4	9	42	53
Midstory	Major	BM	20	6	5	2	2	4	8	28
		WH	32	8	9		2	4	12	34
	All	All	67	16	18		2	4	12	31
Total	All	All	371	250	325	49	2	8	42	49

Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.

This FMU is located on the northeast side of the property near the Lookout Mountain Forest Preserve Trailhead. It has mostly moderate northeast-facing slopes and a soil productivity rating of site class II. It is estimated that the unit was high-grade harvested around 1980-1990 which removed most of the high-value Douglas-fir, leaving behind second-growth maple, redcedar, and hemlock. After this harvest, early-seral hardwoods, such as red alder and cottonwood, as well as young hemlock have filled in open canopy gaps throughout the unit. Total stocking is approximately 371 TPA. The overstory contains approximately 304 TPA and is primarily composed of western hemlock and red alder, with small components of black cottonwood and western redcedar. Overstory western hemlock average 8 inches DBH and 27 ft tall, and alder average 8 inches DBH and 63 ft tall. The midstory contains approximately 67 TPA and is primarily composed of western hemlock and bigleaf maple. Midstory hemlock average 4 inches DBH and 34 ft tall, and maple average 4 inches DBH and 28 ft tall. Regeneration is occurring in lower density pockets. As this stand continues to grow, competition will increase and mortality will begin to occur in higher-density pockets of younger red alder and western hemlock, but the retained second-growth cohort will not be affected by this competition, and long-term density will drop as red alder and cottonwood die off from old age. As a result, though management could accelerate these transitions, it is not recommended at this time. This unit is accessible from the LM-2000 road and an old road-grade converted into the Rufus Creek Trail.

FMU G3 - Mixed Conifer and Hardwood

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	BM	49	30	43	39	4	9	20	85
		RA	80	63	81		4	10	16	97
		RC	43	49	90		4	16	24	107
	Minor	CW	10	6	12		4	11	20	88
		WH	21	23	21		4	10	16	103
	All	All	211	176	254		4	11	24	96
Midstory	Major	RC	24	4	7	2	2	4	10	24
		WH	24	4	7		2	4	10	24
	All	All	49	8	14		2	4	10	24
Total	All	All	260	184	267	41	2	10	24	82

Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.

This FMU is located on the northeast side of the property near the Lookout Mountain Forest Preserve Trailhead. It has moderate to steep northeast-facing slopes and a soil productivity rating of site class II. It is estimated that this unit was mostly clearcut harvested around 1990, though second growth cedar and hemlock were retained in some areas. It is unknown if this unit was replanted after harvest. If it was, there was likely high mortality of the planted conifers as the stand is now a mix of species, primarily hardwoods, that most likely naturally regenerated. Total stocking is approximately 260 TPA. The overstory contains approximately 211 TPA and is primarily composed of bigleaf maple, western redcedar and red alder, with small components of black cottonwood and western hemlock. Overstory redcedar average 16 inches DBH and 107 ft tall, maple average 9 inches DBH and 85 ft tall, and alder average 10 inches DBH and 97 ft tall. The midstory contains approximately 49 TPA and is primarily composed of western hemlock and western redcedar that both average 4 inches DBH and 24 ft tall. Though heavy to hardwood, this unit’s conifer overstory and midstory should ensure long-term forest cover. Per the earlier discussion of this type of forest, no management activities are recommended for this unit. This unit is partially accessible from the LM-2000 Road, but was historically accessed via the now decommissioned LM-2200 road which has been turned into a hiking trail.

FMU G4 - Mixed Conifer and Hardwood

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	DF	90	40	90	60	6	10	16	80
		RA	166	109	166		4	10	14	65
		WH	90	40	90		6	10	16	80
	All	All	353	194	353		2	10	18	72
Midstory	Major	RC	10	4	2	1	2	4	8	40
		WH	20	4	4		2	4	8	40
	All	All	30	8	7		2	4	8	40
Total	All	All	383	202	360	60	2	10	18	70

Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.

This FMU consists of four separate areas located on the northeast side of the property near the Lookout Mountain Forest Preserve Trailhead. It has moderate to steep mostly northeast-facing slopes and a soil productivity rating of site class II. It is estimated that it was mostly clearcut harvested around 1990. A Douglas-fir plantation was potentially started at that time, but has mostly failed except for in the northwestern corner of this unit. Otherwise, red alder and western hemlock have naturally regenerated across the remainder of the unit. Total stocking is approximately 383 TPA. The overstory contains approximately 353 TPA and is primarily composed of western hemlock, Douglas-fir and red alder. Overstory Douglas-fir and hemlock average 10 inches DBH and 80 ft tall, and alder average 10 inches DBH and 65 ft tall. The midstory contains approximately 30 TPA and is primarily composed of western hemlock and western redcedar that both average 4 inches DBH and 40 ft tall. Given the recent disturbance history and high-levels of competition, this plan recommends pre-commercial thinning of high-density conifer and red alder pockets to reduce competition, shift species composition and accelerate the stands development. There is no current road access to this unit, as the previous road up this hillside has been converted to a hiking trail.

FMU G5 - Mixed Conifer - Stem Exclusion / Mature-I

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	DF	60	65	129	47	8	16	32	103
		WH	66	73	126		8	15	32	105
	Minor	BM	24	35	40		4	13	24	120
	All	All	158	182	324		4	15	32	107
Midstory	Major	BM	9	2	4	2	4	6	8	60
		WH	24	12	12		4	6	12	60
	All	All	38	15	19		4	6	12	60
Total	All	All	196	197	343	49	4	14	32	98

Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.

This FMU is located on the northeast side of the property near the Lookout Mountain Forest Preserve Trailhead. It has mostly moderate northeast-facing slopes and a soil productivity rating of site class II. It is estimated that this unit was mostly clearcut harvested around 1970-1980. Douglas-fir were likely planted after the harvest, but infilling by western hemlock has come to dominate most of the unit. Total stocking is approximately 196 TPA. The overstory contains approximately 158 TPA and is primarily composed of western hemlock and Douglas-fir, with a small component of bigleaf maple. Overstory Douglas-fir average 16 inches DBH and 103 ft tall. Overstory western hemlock average 15 inches DBH and 105 ft tall. The midstory contains approximately 38 TPA and is primarily composed of western hemlock and bigleaf maple. Midstory western hemlock average 6 inches DBH and 60 ft tall. Midstory bigleaf maple average 6 inches DBH and 60 ft tall. The highest density portions of this unit are dominated by western hemlock in the Stem Exclusion stage while natural regeneration is occurring in lower-density areas entering the early Mature-I stage of development. Per the earlier discussion of mixed conifer forests in these stages and given that current overstory density is within the first thinning target, a variable density thinning is recommended in 5 to 10 years. There is no current road access to this unit, as the previous road up this hillside has been converted to a hiking trail. Restoring this road will be necessary for commercial thinning otherwise this unit will need to be non-commercially thinned.

Management Activity Schedule

Timeline	Activity	Priority	FMU	Prescription
2025 to 2030	Thinning (PCT)	1	A5, B8	Pre-commercially thin to a target density of 250 to 300 TPA.
		2	F2	Pre-commercially thin to a target density of 150 to 200 TPA, removing alder and retaining maple and Douglas-fir.
			G4	Pre-commercially thin to a target density of 200 to 250 TPA, preferentially removing alder and hemlock while retaining Douglas-fir.
	Thinning (CT / NCT)	1	A6	Thin to an interim target density of 250 to 300 TPA.
			A2, E5	Thin to an initial target density of 140 to 170 TPA.
		2	B3, B5, B7, B2, B4, D7	Thin to an initial target density of 140 to 170 TPA.
		3	A8, B6	Thin to an initial target density of 140 to 170 TPA.
		4	D9	Thin to a final target density of 80 to 110 TPA.
2030 to 2035	Thinning (CT / NCT)	1	E7	Thin to an interim target density of 250 to 300 TPA.
		3	G5	Thin to a final target density of 80 to 110 TPA.
	Planting	1	E4	Monitor the stand for natural regeneration, and, if necessary, underplant with 150-250 TPA of shade-tolerant conifers suitable to site conditions.

Timeline	Activity	Priority	FMU	Prescription
		2	F2	Monitor the stand for natural regeneration, and, if necessary, underplant with 150 TPA of shade-tolerant conifers suitable to site conditions.
2035 to 2040	Thinning (CT / NCT)	1	A5	Thin to an initial target density of 140 to 170 TPA within 10-15 years after the last thinning entry.
		2	A6	Thin to an initial target density of 140 to 170 TPA within 10-15 years after the last thinning entry.
			A2, E5	Thin to a final target density of 80 to 110 TPA within 10-15 years after the last thinning entry.
		3	B3, B2	Evaluate the stand for a second thinning and, if necessary, thin to a final target density 80 to 110 TPA within 10-15 years after the last thinning entry.
	Planting	3	A2, E5	Underplant after thinning with 150 TPA shade-tolerant conifers suitable to site conditions or wait 5-10 years and assess natural regeneration, planting if necessary.
2040 to 2045	Thinning (CT / NCT)	1	E7	Thin to an initial target density of 140 to 170 TPA within 10-15 years after the last thinning entry.
		2	B8	Thin to an initial target density of 140 to 170 TPA within 15-20 years after the last thinning entry.
		3	B5, B7, B4	Evaluate the stand for a second thinning and, if necessary, thin to a final target density 80 to 110 TPA within 15-20 years after the last thinning entry.
		4	B6	Evaluate the stand for a second thinning and, if necessary, thin to a final target density 80 to 110 TPA within 15-20 years after the last thinning entry.
2045 to 2050	Thinning (CT / NCT)	2	A5	Thin to a final target density of 80 to 110 TPA within 10-15 years after the last thinning entry.

Timeline	Activity	Priority	FMU	Prescription
	Planting	3	A5	Underplant after thinning with 150 TPA shade-tolerant conifers suitable to site conditions or wait 5-10 years and assess natural regeneration, planting if necessary.
2050 to 2055	Thinning (CT / NCT)	2	E7	Thin to a final target density of 80 to 110 TPA within 10-15 years after the last thinning entry.
		3	A6	Evaluate the stand for a second thinning and, if necessary, thin to a final target density 80 to 110 TPA within 15-20 years after the last thinning entry.
	Planting	3	E7	Underplant after thinning with 150 TPA shade-tolerant conifers suitable to site conditions or wait 5-10 years and assess natural regeneration, planting if necessary.
			A6	Monitor the stand for natural regeneration, and, if necessary, underplant with 150 TPA of shade-tolerant conifers suitable to site conditions.
2055 to 2060	Thinning (CT / NCT)	3	B8	Evaluate the stand for a second thinning and, if necessary, thin to a final target density 80 to 110 TPA within 15-20 years after the last thinning entry.
Notes: PCT - Pre-commercial Thinning, CT - Commercial Thinning, NCT - Non-commercial Thinning. Priority Levels: 1 - High, 2 - Moderately High, 3 - Moderate, 4 - Low. Additional thinning and planting considerations are identified in Section 1 of this document as well as in the FMU-specific section above.				

Parcel Table

Owner	Parcel ID	Year Acquired	Previous Owner
County	3703010600550000	2014	DNR
County	3703114613960000	2014	DNR
County	3703121983300000	2014	DNR
County	3703123344670000	2002	Private

Owner	Parcel ID	Year Acquired	Previous Owner
City	3703123344670001	2002	Private
County	3703133294690000	2014	DNR
County	3703134662020000	2014	DNR
County	3703134663080000	2014	DNR
County	3703244633290000	2014	DNR
County	3704070681860000	2014	DNR
County	3704070804500000	2002	Private
City	3704070804500001	2002	Private
County	3704071851880000	2014	DNR
County	3704170650560000	Unknown	Unknown
County	3704180721810000	2014	DNR
County	3704183300630000	2014	DNR
County	3704184650600000	2014	DNR
County	3704191950520000	2014	DNR
County	3704193340530000	2014	DNR
County	3704194670570000	2014	DNR
County	3704202071830000	2014	DNR
County	3704203663670000	2014	DNR
County	3704290823780000	2014	DNR
County	3704304570580000	2014	DNR
County	3704313360620000	2014	DNR
County	3704314760680000	2014	DNR

South Lake Whatcom Park

Overview

Site Description

South Lake Whatcom Park is a 75-acre property owned by Whatcom County. It is located along South Bay Drive and the southeast shore of Lake Whatcom.

Property Information

This forest is located in Section 27, Township 37N, Range 04E of the US Public Land Survey System and includes two parcels that are listed in the table at the end of this section.

Management History

South Lake Whatcom Park consists of two parcels owned by Whatcom County. The exact history of the site is unknown, but the widespread presence of red alder suggests that a major disturbance occurred on the property 60-80 years ago. While obvious cut stumps are absent on much of the property, some are visible which suggests that the property was likely clearcut in the mid-1900s, like many of the forests around Lake Whatcom.

Property Overview Map

Assessment

Topoclimate

The site is mostly flat with gentle slopes draining north toward Lake Whatcom. Its position along the lake's south shore brings moderating effects from lake breezes, resulting in slightly higher humidity and smaller temperature fluctuations compared to surrounding higher elevations.

Vegetation Zone

According to vegetation zone maps for North America, the following Ecological Systems were likely present prior to Euro-American settlement. More information on these maps and full descriptions of each system can be found in the discussion of Vegetation Zones in Section 2 of this document.

- North Pacific Lowland Riparian Forest and Shrubland
- North Pacific Maritime Mesic-Wet Douglas-fir-Western Hemlock Forest

Soils

Data from the USDA Natural Resource Conservation Service (NRCS) Soil Surveys were used to identify the major soil types that underlay this forest, which are described in more detail in the discussion of Soil Productivity in Section 2. Information about specific soil units likely present at this property, including depth, drainage, productivity, and relevant management concerns are listed in the table below. The location of these soil units can be found in the accompanied map packet for this property.

Forest Soil Units Summary Table

Soil Unit	Productivity		Management Concerns					Acres (Pct)
	Site Class	Max Growth	Drought Stress Hazard	Wind Throw Hazard	Mass Wasting Hazard	Logging Rutting Hazard	Logging Compact Hazard	
Wickersham Series Channery Ashy Silt Loam on 0-8% Slopes Mod. Deep (21in) Well Drained	DF-2	186 ft3/ac/yr	Low.	Low	Low	High	Mod.	57 (76%)
Sehome Series Medial Loam on 8-15% Slopes Mod. Deep (26in) Moderately Well Drained	DF-2	186 ft3/ac/yr	Mod. High	Medium	High	High	Mod.	5 (7%)

Soil Unit	Productivity		Management Concerns					Acres (Pct)
	Site Class	Max Growth	Drought Stress Hazard	Wind Throw Hazard	Mass Wasting Hazard	Logging Rutting Hazard	Logging Compact Hazard	
Barneston Series Very Gravelly Ashy Loam on 0-8% Slopes Somewhat Excessively Drained	DF-3	157 ft3/ac/yr	High	Low	Low	Low	Mod.	4 (5%)
Sehome Series Medial Loam on 2-8% Slopes Mod. Deep (26in) Moderately Well Drained	DF-2	186 ft3/ac/yr	Mod. High	Medium	Mod.	High	Mod.	4 (5%)
Shalcar-Fishtrap Undifferentiated group Muck on 0-2% Slopes Very Poorly Drained	RA-4	86 ft3/ac/yr	Low.	High	Low	High	High	3 (4%)
Squalicum Series Gravelly Ashy Loam on 5-15% Slopes Deep (44in) Moderately Well Drained	DF-2	186 ft3/ac/yr	Mod.	Low	Mod.	Mod.	High	2 (3%)

Slope Stability

As previously described in Section 2, this plan utilizes remotely mapped topographic data as well as hazard zones and historic landslides identified by the State of Washington Department of Natural Resources (DNR) to gauge the likelihood that unstable slopes will be found within a proposed management area. The presence of a mapped hazard zone or historic landslide does not preclude management, but indicates that further investigation is required.

The site is mostly flat and does not contain any slopes greater than 40%. There are no known landslides or hazard zones identified in the park.

Hydrology

The park is directly adjacent to the south shore of the lake. There are a few streams that flow north through the park into Lake Whatcom. Two of them on the east side are identified as fish-bearing by the DNR’s hydrography database. Most of the northeast corner of the park is a forested wetland.

Roads and Access

The park is accessible from South Bay Drive and there are several pull-offs along this road that can be used to access public trails in the park, particularly on the northeast side. There is also a dirt road that runs along the western border of the park. Otherwise, no roads are present within the property boundaries.

Health and Resiliency

An additional health concern is a moderate infestation of English holly in the conifer dominated stand in the northwest side of the park. Many small sprouts of the invasive species are popping up and could easily spread if not contained. There is also an open field in the southwest corner of the park that is heavily infested with Himalayan blackberry around the edges. Moderate to heavy infestations of Bohemian/Japanese knotweed have been monitored and managed by County staff at South Lake Whatcom Park and along South Bay Drive for several years.

Most of the park consists of old red alder, some of which is dying off. The aging alder is susceptible to blowdown during wind events. Very little regeneration is present in the red alder stands, likely due to the thick shrub layer that is growing. There is some concern about the future forest cover of this site if regeneration does not occur as the red alder continues to die off.

Wildlife Habitat

A review of the Washington State Department of Fish and Wildlife Priority Species Database identified Townsend's big-eared bat and myotis bat as having been documented somewhere within the 23,000-acre township containing South Lake Whatcom Park. The wetland in the northeast corner of the preserve is identified as a priority area for aquatic habitat. There are also streams within the preserve that are identified as habitat for kokanee salmon and cutthroat trout.

In general, the park is lacking wildlife habitat features. There is low habitat diversity since the park is primarily red alder forest. Some areas have downed logs and snags due to the alder starting to die, but these habitat features are lacking in most of the park. As the red alder continues to die, additional dead wood will be added to the forest in the form of snags and downed wood. The snags may not stay standing long, however, as red alder often falls over quickly once dead. While habitat features are generally lacking, the shrub layer in the forest provides food sources for many wildlife species.

Wildfire Susceptibility

The park is close to a major public road and residential areas and also has high recreation use, which increases the risk of fire ignition. The proximity to a major road, however, allows for a rapid response to fire. The strong hardwood component across much of the forest makes it more resistant to fire, and while some younger stands are present, there is little buildup of fine woody debris. However, the thick shrub layer throughout parts of the forest can act as fuel sources if they become dead or drought-stressed.

Carbon Storage

Most of the park has low carbon storage potential due to being dominant to short-lived red alder, aside from the northwest corner of the park that is composed primarily of western red cedar. The site contains wet soil that is suitable for the redcedar, so it should hold the site for a long time which gives it higher carbon storage potential. Establishing more conifers in the red alder stands and reforesting the open field in the southwest corner of the park will increase the carbon storage potential of the site.

Cultural Resources

The Lake Whatcom watershed is a landscape rich with cultural significance for Indigenous peoples—particularly the Lummi Nation and the Nooksack and Swinomish Tribes—who have maintained deep spiritual, cultural, and subsistence connections to the landscape. Though a review of the Washington State Department of Archaeology and Historic Preservation Wisaard online database did not identify any known historical sites on this property and none were encountered while developing this plan, this property has a long history of human use and artifacts may be present. Please see the previous discussion about cultural use practices in the Lake Whatcom Watershed for a more detailed assessment of best management practices moving forward.

Recreation

The park provides public access to the south shore of Lake Whatcom and gets particularly heavy use in the summer by people accessing the lake for swimming and other water recreational activities. Access is dispersed across several short trails leading down from the road.

Recommendations

Roads and Access

There are no existing roads within the preserve, and no new road construction is recommended.

Health and Resiliency

This plan recommends continued monitoring and managing of knotweed regrowth to prevent its future establishment. Recommendations for addressing observed invasive species and declining alder are given at the management unit level below.

Wildfire Susceptibility

Shaded fuel breaks are recommended within 100 feet of public roads and existing structures which are designed to keep fires on the ground and slow their spread until firefighting resources can arrive. For additional details on implementation, see the description of a shaded fuel break given in the discussion of Wildfire Susceptibility in Section 2 of this document.

Forest Types

All recommendations for this property follow the previous discussion of forest-types in section 3 and are discussed by management unit below.

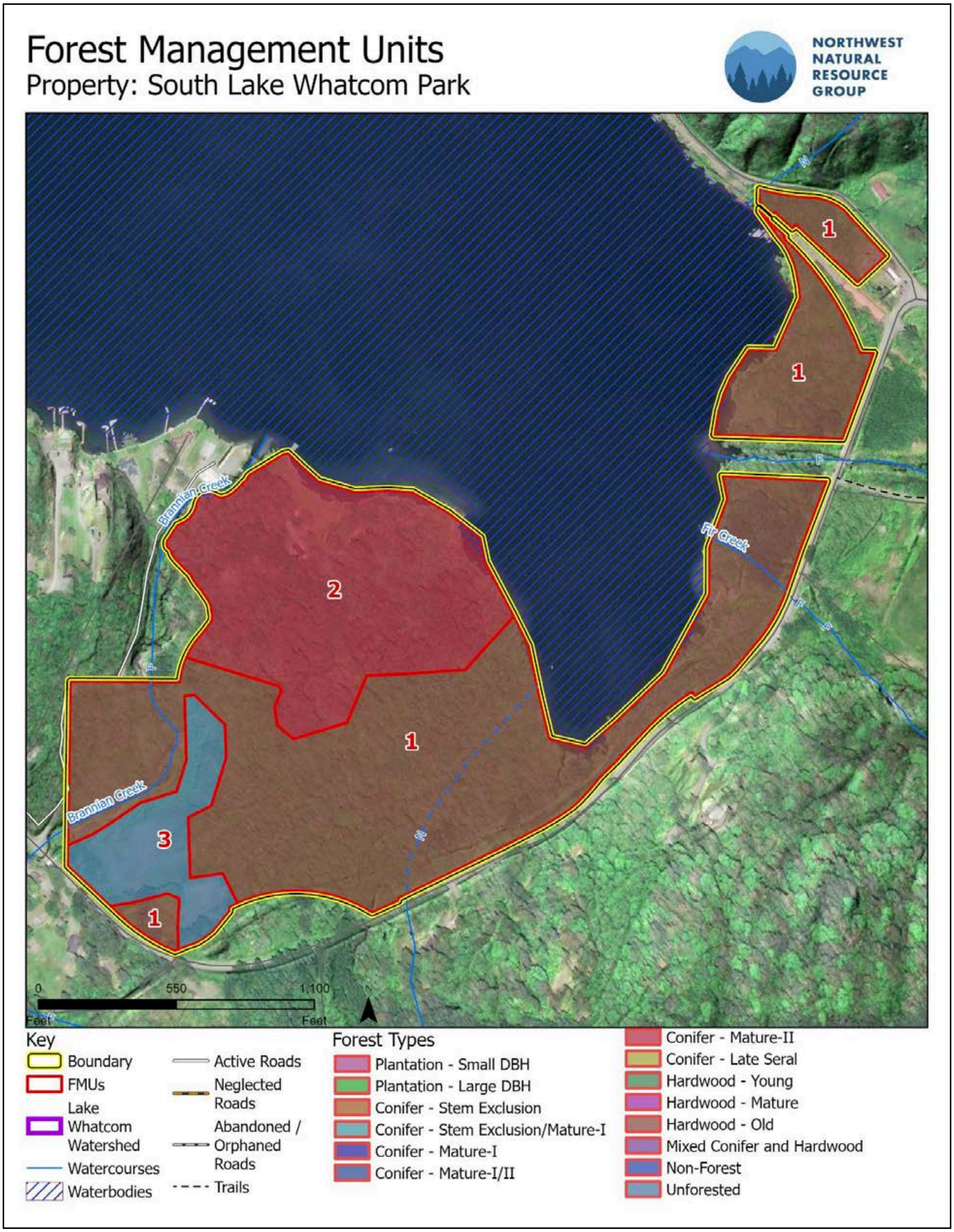
Management Units

Forest cover was delineated into the forest management units (FMUs) using both remotely sensed data, historic inventory units, and field inventory data. The forestland within these management units share similar forest characteristics and management recommendations. For each FMU, this plan describes the geophysical attributes and forest conditions and assesses the unit against the plans management objectives using the previously described framework by forest type. Recommendations are then given by FMU, typically referencing general recommendations by forest type, but more information is given as needed. Finally, a schedule of management activities by year and FMU is given at the end of this section.

Summary of Forest Management Units

FMU	Acres	Forest Type	Management
1	48	Mixed Hardwood - Old	Planting
2	22	Mixed Conifer - Mature-II	Invasive Species Management
3	6	Unforested	Invasive Species Management and Planting
Total	**75**		

Map of Forest Management Units



FMU 1 - Mixed Hardwood - Old

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	RA	88	117	269	53	12	20	24	117
	All	All	90	120	276		12	20	32	117
Total	All	All	90	120	276	53	12	20	32	117

Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.

FMU 1 represents the majority of the park, aside from a couple areas on the west side. It has a soil productivity rating of site class II. It was likely clearcut 60–80 years ago and has since naturally regenerated with red alder. In some areas, particularly on the northeast side, alder is beginning to die off with few conifers growing to replace it, resulting in low stocking. The middle of the stand is also composed of older alder that has not yet experienced major mortality, but with a dense salmonberry shrub layer and little regeneration, it is expected to follow a similar trajectory of becoming a low stocked forest. Total stocking across the stand is approximately 90 TPA. The overstory red alder average 20 inches DBH and 117 ft tall. Per the earlier discussion of old hardwood stands without regeneration, underplanting of conifers is recommended to ensure long-term forest development of the site.

FMU 2 - Mixed Conifer - Mature-II

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	RC	160	360	567	79	14	22	38	140
Midstory	Major	WH	20	20	20	2	8	10	12	60
Total	All	All	180	380	587	81	8	21	38	131

Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.

FMU 2 is on the northwest side of the property and has a soil productivity rating of site class II. It was likely harvested 80-120 years ago, but has naturally regenerated with different species than FMU 1. Total stocking is approximately 180 TPA. The overstory contains approximately 160 TPA and is primarily composed of western red cedar that average 22 inches DBH and 140 ft tall. The midstory contains approximately 20 TPA of western hemlock that average 10 inches DBH and 60 ft tall. The wet site conditions can likely continue to support the redcedar and western hemlock growing here. The stand is entering the mature II phase of development with a midstory cohort and regeneration of redcedar and hemlock. Large clumps of English holly sprouts are growing in the understory of this unit, which will likely continue to spread if not managed due to the ability for the invasive species to thrive under closed canopies. It is recommended to remove the holly in this unit while the plants are still small and before the infestation becomes more severe.

FMU 3 - Unforested

FMU 3 is an unforested field in the southwest corner of the property with a soil productivity rating of site class II. The exact history of this field is unknown, but it's possible that grass and shrubs colonized the site following a disturbance and prevented the regeneration of trees. Himalayan blackberry is abundant around the edges of the field and could easily spread into the field due to the lack of tree cover. It is recommended to remove the invasive blackberry and plant trees across the site to convert the field into a forest.

Management Activity Schedule

<table>
<tr><th>Timeline</th><th>Activity</th><th>Priority</th><th>FMU</th><th>Prescription</th></tr>
<tr><td rowspan="4">2025 to 2030</td><td rowspan="2">Invasive Species</td><td>1</td><td>3</td><td>Remove invasive species.</td></tr>
<tr><td>3</td><td>2</td><td>Remove invasive species.</td></tr>
<tr><td rowspan="2">Planting</td><td rowspan="2">1</td><td>1</td><td>Underplant with 150-250 TPA of shade-tolerant conifers suitable to site conditions.</td></tr>
<tr><td>3</td><td>After invasive species removal, plant a mix of species at 250-300 TPA.</td></tr>
<tr><td colspan="5">Notes: Priority Levels: 1 - High, 2 - Moderately High, 3 - Moderate, 4 - Low. Additional thinning and planting considerations are identified in Section 1 of this document as well as in the FMU-specific section above.</td></tr>
</table>

Parcel Table

Owner	Parcel ID	Year Acquired	Previous Owner
County	3704230400200000	Unknown	Unknown
County	3704273703800000	Unknown	Unknown

City Properties

Agate Bay Preserve

Overview

Site Description

Agate Bay Preserve is a 421-acre property owned by the City of Bellingham on the north side of Lake Whatcom. It is located along North Shore Road near the community of Agate Bay. The preserve is east of the Silver Beach Preserve and south of Agate Creek Preserve.

Property Information

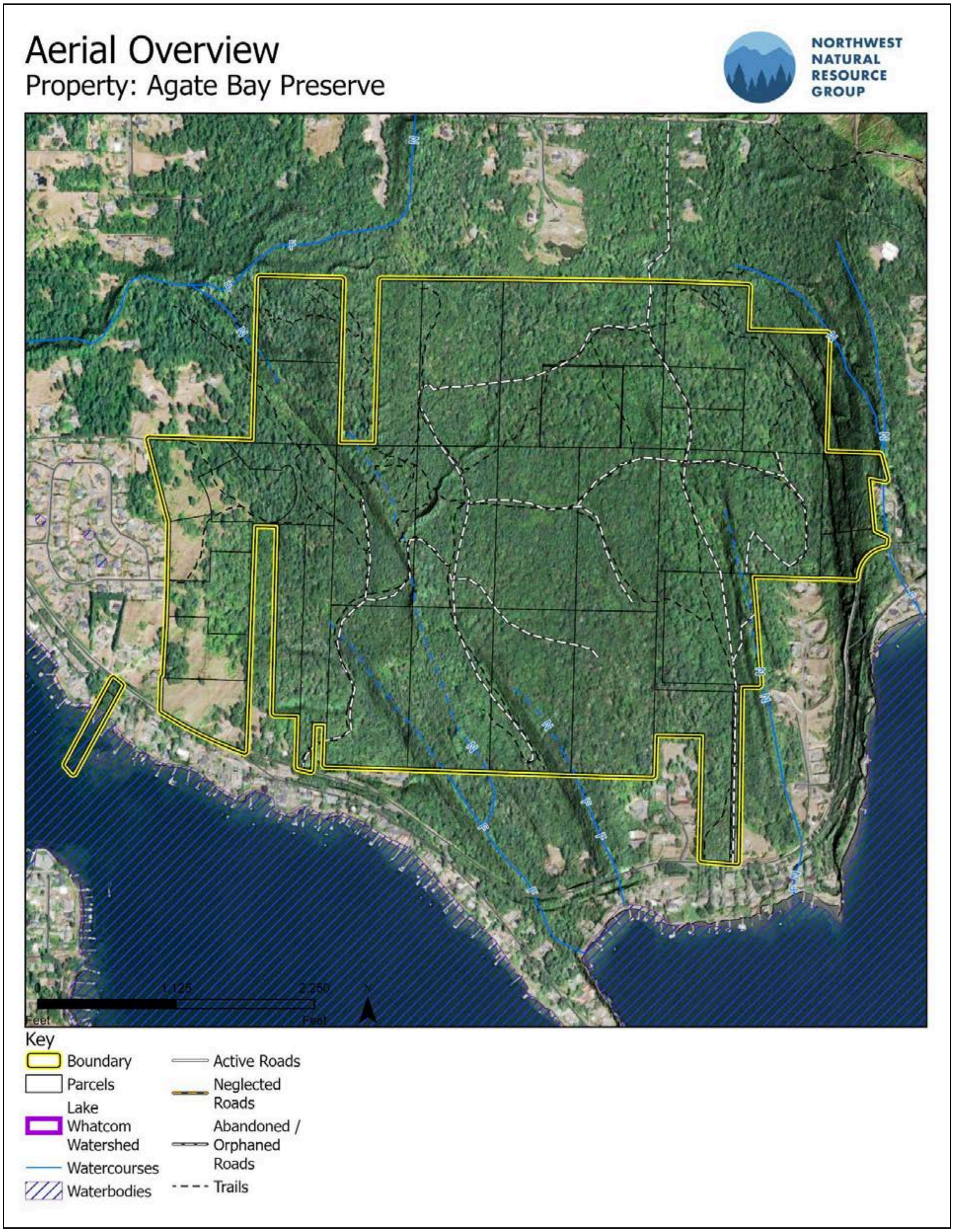
This forest is located in Sections 23, 24, 25, and 26 of Township 38N, Range 03E of the US Public Land Survey System and includes 34 parcels that are listed in the table at the end of this section.

Management History

The preserve is composed of 34 parcels acquired by the City of Bellingham over many years to limit development around the lake. Acquisitions began in 2002 and continued through 2020. The parcels were previously mostly in private ownership, and a few were owned by Trillium Corporation.

Previous management of the site varies, but the original forest was likely cleared in the late 19th and early 20th century and left to regenerate naturally. Aerial imagery indicates additional clearing occurred in the late 1960s and some high-grading began in the 1980s or early 1990s. Portions of the property were clearcut and replaced with a Douglas-fir plantation in the early 1990s and the final harvest activity occurred in 2005 when areas in the northeast were high-graded for valuable Douglas-fir. Today some of the original naturally-regenerated second-growth forest can still be found along the property edges and on steep inaccessible slopes. Recent restoration activities by the City have focused on removing invasive species and reforesting a large field on the western edge of the preserve.

Property Overview Map



Assessment

Topoclimate

This property lies at low elevation near the shores of Lake Whatcom, where the moderating influence of the lake creates relatively mild conditions with reduced temperature extremes and slightly higher humidity. The site has moderate south-facing slopes, which causes slightly warmer temperatures and drier soils. The streams and wetlands on the property create cooler microclimates.

Vegetation Zone

According to vegetation zone maps for North America, the following Ecological Systems were likely present prior to Euro-American settlement. More information on these maps and full descriptions of each system can be found in the discussion of Vegetation Zones in Section 2 of this document.

- North Pacific Maritime Mesic-Wet Douglas-fir-Western Hemlock Forest
- North Pacific Hypermaritime Western Red-cedar-Western Hemlock Forest
- North Pacific Maritime Dry-Mesic Douglas-fir-Western Hemlock Forest

Soils

Data from the USDA Natural Resource Conservation Service (NRCS) Soil Surveys were used to identify the major soil types that underlay this forest, which are described in more detail in the discussion of Soil Productivity in Section 2. Information about specific soil units likely present at this property, including depth, drainage, productivity, and relevant management concerns are listed in the table below. The location of these soil units can be found in the accompanied map packet for this property.

Forest Soil Units Summary Table

Soil Unit	Productivity		Management Concerns					Acres (Pct)
	Site Class	Max Growth	Drought Stress Hazard	Wind Throw Hazard	Mass Wasting Hazard	Logging Rutting Hazard	Logging Compact Hazard	
Squalicum Series Gravelly Ashy Loam on 30-60% Slopes Deep (44in) Moderately Well Drained	DF-2	186 ft3/ac/yr	Mod.	Low	High	Mod.	High	85 (50%)
Squalicum Series Gravelly Ashy Loam on 15-30% Slopes Deep (44in) Moderately Well Drained	DF-2	186 ft3/ac/yr	Mod.	Low	High	Mod.	High	45 (26%)

Soil Unit	Productivity		Management Concerns					Acres (Pct)
	Site Class	Max Growth	Drought Stress Hazard	Wind Throw Hazard	Mass Wasting Hazard	Logging Rutting Hazard	Logging Compact Hazard	
Andic Xerochrepts Taxon above family Ashy Loam on 60-90% Slopes Mod. Deep (27in) Well Drained	DF-3	143 ft3/ac/yr	High	High	High	High	High	29 (17%)
Andic Xerochrepts-Rock outcrop Complex Ashy Loam on 60-90% Slopes Mod. Deep (24in) Well Drained	DF-3	143 ft3/ac/yr	High	High	High	High	High	10 (6%)

Slope Stability

As previously described in Section 2, this plan utilizes remotely mapped topographic data as well as hazard zones and historic landslides identified by the State of Washington Department of Natural Resources (DNR) to gauge the likelihood that unstable slopes will be found within a proposed management area. The presence of a mapped hazard zone or historic landslide does not preclude management, but indicates that further investigation is required.

The preserve contains moderate slopes that are generally less than 40%, but there are some areas that contain short steep sections with slopes greater than 70%. No known landslides have occurred, and there are no identified hazard zones. There is the potential for small areas of rule-identified landforms to exist on the site, particularly inner gorges in steam channels, but these can be easily avoided during future operations.

Hydrology

The preserve contains several unnamed streams that flow south into Lake Whatcom. The DNR's hydrography database identifies these as non-fish-bearing within the preserve, but two of the streams are fish-bearing just outside of the preserve for a short distance before flowing into Lake Whatcom. There are also a couple small wetlands on the west side of the preserve.

Roads and Access

The property can be accessed via two gated access roads off the North Shore Road. These roads are no longer active and an extensive trail network has been established along these old road beds. Neighborhood access trails enter the property from several locations, including at Eagleridge Drive on the preserve's western edge. No road issues were identified during this assessment. While stream crossings have been removed and one converted to a pedestrian foot bridge, the overgrown nature of the road system made it difficult to determine if all drainage culverts have been removed.

Health and Resiliency

Overall health and resiliency is reduced in some areas due to overstocking and invasive species pressure. The Douglas-fir plantation on the site is overstocked, leading to high competition and slower growth rates. In hardwood stands and stands that were previously high-grade harvested, invasive Himalayan blackberry has become well established, reducing forest cover and limiting regeneration and understory diversity.

Wildlife Habitat

A review of the Washington State Department of Fish and Wildlife Priority Species Database identified little brown bat, big brown bat, and Yuma myotis bat as having been documented somewhere within the 23,000-acre township containing Agate Bay Preserve. A small wetland is identified as a priority area for aquatic habitat and one of the streams is habitat for cutthroat trout.

The preserve supports a range of forest structures and species compositions that provide diverse wildlife habitat. Younger conifer plantations offer limited structural diversity and fewer habitat features but have potential to develop greater complexity over time with management. Mixed conifer and hardwood stands across much of the preserve provide a variety of canopy layers, tree sizes, and species that support a broader range of wildlife, including cavity-nesting birds and small mammals. Hardwood-dominant areas contain canopy gaps that may offer foraging opportunities but are lacking in large woody structures like snags and downed logs.

Wildfire Susceptibility

The property has a relatively high wildfire ignition risk due to its proximity to residential areas, a public road, and a public trail network. Some areas of the property are overstocked plantations which contain abundant small woody debris. However, there are also some older mixed forests on the property that have lower fuel levels and are less prone to burning. Fire response access is generally good due to a road along the southern boundary and an extensive trail network.

Carbon Storage

The property contains a mix of forest types and ages, resulting in variable carbon storage potential. Areas that were previously high-graded now have low-stocked, hardwood-dominated forests with limited carbon storage. Replanting with conifers in these areas would enhance carbon sequestration. Douglas-fir plantations on the property have high long-term carbon potential but they are currently overstocked, slowing growth and carbon sequestration. Thinning these stands would improve overall carbon storage. Mature mixed conifer forests are also present on the property, which provide high carbon storage capacity.

Cultural Resources

The Lake Whatcom watershed is a landscape rich with cultural significance for Indigenous peoples—particularly the Lummi Nation and the Nooksack and Swinomish Tribes—who have maintained deep spiritual, cultural, and subsistence connections to the landscape. Although a review of the Washington State Department of Archaeology and Historic Preservation Wisaard online database did not identify any known historical sites on this property and none were encountered while developing this plan, this property has a long history of human use and artifacts may be present. Please see the previous discussion about cultural use practices in the Lake Whatcom Watershed for a more detailed assessment of best management practices moving forward.

Recreation

The preserve has a large trail network, but use is likely limited due to the lack of trailheads. There are a couple access points from North Shore Road, but there are no designated parking areas. There is also an access point through a neighborhood from Eagleridge Drive.

Recommendations

Roads and Access

There are no existing road maintenance concerns at this time but it is currently unclear if all abandoned roads have been formally decommissioned. Given the flat topography of this property, abandoned forest roads pose a minimal risk, but additional assessment may be useful to confirm all roads meet regulatory standards. Given management recommendations, at least one of the abandoned roadways leading in from the North Shore Road should be restored to facilitate commercial thinning interventions in the overstocked Douglas-fir plantation. To avoid creating a new stream crossing it may be prudent to instead restore a shorter section of both entry roads. Otherwise, no new road construction is recommended.

When roads are active, implement a maintenance plan for ditches, culverts, and road grades to ensure all active roads maintain a high standard of function. See the best management practices identified in Section 2. After management objectives have been met, any active roads should be formally decommissioned. At a minimum, culverts should be removed and permanent water bars installed to control drainage, and full restoration would include road grade restoration and reforestation.

Health and Resiliency

Recommendations for addressing observed overstocking and invasive species are given at the management unit level below.

Wildfire Susceptibility

Shaded fuel breaks are recommended within 100 feet of public roads and existing structures which are designed to keep fires on the ground and slow their spread until firefighting resources can arrive. For

additional details on implementation, see the description of a shaded fuel break given in the discussion of Wildfire Susceptibility in Section 2 of this document.

Forest Types

All recommendations for this property follow the previous discussion of forest-types in section 3 and are discussed by management unit below.

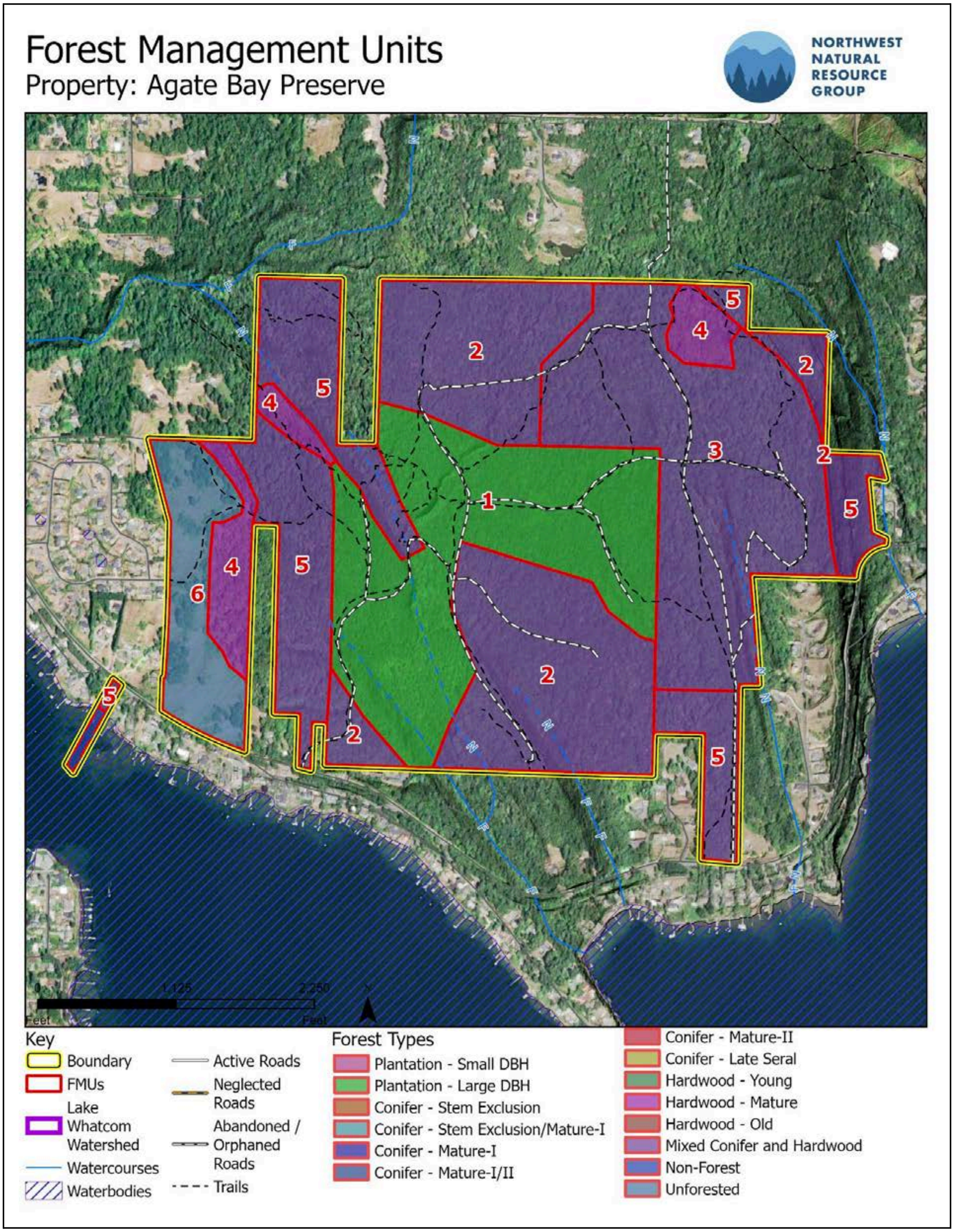
Management Units

Forest cover was delineated into the forest management units (FMUs) using both remotely sensed data, historic inventory units, and field inventory data. The forestland within these management units share similar forest characteristics and management recommendations. For each FMU, this plan describes the geophysical attributes and forest conditions and assesses the unit against the plans management objectives using the previously described framework by forest type. Recommendations are then given by FMU, typically referencing general recommendations by forest type, but more information is given as needed. Finally, a schedule of management activities by year and FMU is given at the end of this section.

Summary of Forest Management Units

FMU	Acres	Forest Type	Management
1	95	Conifer Plantation - Large DBH	Thinning
2	108	Mixed Conifer and Hardwood	None
3	97	Mixed Conifer and Hardwood	Invasive Species Management & Planting
4	21	Mixed Hardwood - Mature	Invasive Species Management & Planting
5	73	Mixed Conifer and Hardwood	None
6	26	Unforested	Future Thinning
Total	**421**		

Map of Forest Management Units



FMU 1 - Conifer Plantation - Large DBH

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	DF	227	182	272	53	6	11	16	83
	Minor	RA	15	20	7		4	6	8	88
	All	All	252	214	283		4	11	16	84
Midstory	Major	BM	15	3	3	1	2	4	6	20
		RA	15	3	3		2	4	6	20
	All	All	30	6	7		2	4	6	20
Total	All	All	282	220	290	55	2	10	16	77

Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.

This FMU is located near the center of the preserve on mostly mild south-facing slopes with occasional steep bands. The soil productivity rating is site class II on the east side and site class III on the west side. It is estimated that this unit was clearcut harvested around 1990 and replanted with Douglas-fir, but red alder has also regenerated and makes up a minor component of the overstory. Total stocking is approximately 282 TPA, and the overstory contains approximately 252 TPA. Overstory Douglas-fir average 11 inches DBH and 83 ft tall. The midstory contains approximately 30 TPA and is primarily composed of bigleaf maple and red alder that both average 4 inches DBH and 20 ft tall. The unit is currently overstocked with low species and structural diversity common to plantations. Per the earlier discussion of overstocked, large-diameter plantations, a two-part sequence of variable density thinning is recommended, and potential underplanting once density has been sufficiently reduced. This unit can be accessed with commercial harvesting equipment by temporarily restoring 0.2 and 0.7 miles of abandoned roadbed.

FMU 2 - Mixed Conifer and Hardwood

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	BM	81	113	228	66	4	19	32	100
		DF	47	41	100		16	16	20	100
	Minor	RA	17	20	11		4	7	12	100
		RC	15	16	50		4	21	32	100
	All	All	169	200	403		4	17	32	100
Midstory	Major	BM	23	8	7	5	4	5	10	26

		DF	14	4	10		4	8	8	
		RC	14	4	10		4	8	8	
	All	All	64	20	33		4	6	10	27
Total	All	All	233	220	435	71	4	14	32	80
Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.										

This unit consists of four separate areas across the property, generally near the boundary edge. The unit has mostly mild slopes with occasional steep bands and a soil productivity rating that ranges from site class II to III. This unit appears to be a naturally regenerated second growth forest following a clearcut in the mid-1900s which was later high-graded in the 1980s or 1990s. Total stocking is approximately 233 TPA. The overstory contains approximately 169 TPA and is primarily composed of bigleaf maple and Douglas-fir, with small components of red alder and western redcedar. Overstory Douglas-fir average 16 inches DBH and 100 ft tall. Overstory bigleaf maple average 19 inches DBH and 100 ft tall. The midstory contains approximately 64 TPA and is primarily composed of bigleaf maple, western redcedar and Douglas-fir. Midstory Douglas-fir and redcedar average 8 inches DBH. Midstory bigleaf maple average 5 inches DBH and 26 ft tall. This is a mixed conifer and hardwood forest with no health concerns. Per the earlier discussion of this forest type, no management activities are recommended.

FMU 3 - Mixed Conifer and Hardwood

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	BM	43	32	155	47	4	20	36	98
		RA	95	16	22		0	4	8	31
	Minor	DF	31	34	53		0	13	20	82
		RC	20	13	45		4	15	32	78
	All	All	192	96	280		0	10	36	59
Midstory	Major	BM	27	11	6	6	0	4	4	
		GF	12	6	16		8	12	16	
		RC	15	7	17		4	10	16	
	All	All	54	24	39		0	8	16	
Total	All	All	246	120	319	53	0	10	36	59
Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.										

This unit is on the east side of the preserve on mild south-facing slopes. The soil productivity rating is site class II. It is estimated that this unit was high-grade harvested around 2005 with most of the high-value conifer species removed. Total stocking is approximately 246 TPA. The overstory contains approximately 192 TPA and is primarily composed of bigleaf maple and red alder, with small components of Douglas-fir and western redcedar. Overstory bigleaf maple average 20 inches DBH and 98 ft tall, and red alder average 4 inches DBH and 31 ft tall. The midstory contains approximately 54 TPA and is primarily composed of bigleaf maple, western redcedar and grand fir. Midstory grand fir average 12 inches DBH, redcedar average 10 inches DBH, and maple average 4 inches DBH. Some of the gaps left from the high-grade harvest filled in with a mix of species, but many have been colonized by invasive Himalayan blackberry which is preventing regeneration. Invasive species management is recommended across this unit to remove the blackberry followed by planting of a mix of conifer species. This unit can be accessed by foot along hiking trails or by restoring 0.25 miles of abandoned road bed.

FMU 4 - Mixed Hardwood - Mature

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	RA	46	40	60	16	4	12	16	61
	All	All	64	76	93		4	12	28	65
Midstory	Major	BM	56	20	24	4	0	6	12	
Total	All	All	120	96	117	20	0	9	28	65
Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.										

This FMU is split between two separate areas on the northeast and west sides of the preserve. The unit has mild southwest-facing slopes and a soil productivity rating of site class II in the northeast area and site class III in the west area. This unit has a complex disturbance history, but was likely cleared in the late 1960s or early 1970s. Portions of the stand were then planted as a residential orchard and others were left to regenerate naturally with red alder and other hardwoods. Total stocking is approximately 120 TPA. The overstory contains approximately 64 TPA and is primarily composed of red alder that average 12 inches DBH and 61 ft tall. The midstory contains approximately 56 TPA and is primarily composed of bigleaf maple that average 6 inches DBH. This stand has low stocking and declining alder which has allowed invasive Himalayan blackberry to colonize. Invasive species management is recommended across this unit to remove the blackberry followed by planting of a mix of conifer species. There is no current road access to this unit.

FMU 5 - Mixed Conifer and Hardwood

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	BM	36	63	92	63	8	18	32	119
		DF	45	114	175		12	23	36	135
	Minor	GF	12	22	43		12	22	32	120
		RC	20	17	30		4	13	32	83
	All	All	121	228	359		4	19	36	118
Midstory	Major	RC	35	36	41	11	0	11	20	

	Minor	BM	13	14	9		8	8	12	
		DF	12	6	8		4	8	12	
	All	All	75	68	71		0	10	20	
Total	All	All	196	296	431	72	0	16	36	118
Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.										

This unit consists of five separate areas spread out around the edges of the preserve. The terrain is mostly mild southwest-facing slopes, but some steep bands are present, particularly on the east side. The soil productivity rating ranges from site class II to III. This unit appears to be a naturally regenerated second growth forest following a clearcut in the early 1900s. Unlike other units at this property, no harvests have occurred in the intervening years. Total stocking is approximately 196 TPA. The overstory contains approximately 121 TPA and is primarily composed of bigleaf maple and Douglas-fir, with small components of grand fir and western redcedar. Overstory Douglas-fir average 23 inches DBH and 135 ft tall, and maple average 18 inches DBH and 119 ft tall. The midstory contains approximately 75 TPA and is primarily composed of western redcedar, with small components of bigleaf maple and Douglas-fir. Midstory western redcedar average 11 inches DBH. This is a mixed conifer and hardwood forest with no health concerns. Per the earlier discussion of this forest type, no management activities are recommended. The southern edge of this unit borders North Shore Road, but most of the unit does not have current road access.

FMU 6 - Unforested

This unit is located on the west side of the preserve on gentle southwest-facing slopes. The soil productivity rating is site class II. This unit is a field that has been planted at a density of around 320 TPA with Douglas-fir, shore pine, and western white pine. Planting has occurred in several waves starting in 2013 and as a result there are several aged cohorts. The oldest trees are around 10 ft tall while the youngest trees are only two to three feet tall, recently planted. Some areas of the unit still remain unforested and the dominant ground cover is thick grass. It is recommended to evaluate the site for a pre-commercial thinning in 15 years to reduce density and modify species composition depending on mortality. This unit is currently accessible by foot from Eagleridge Drive.

Management Activity Schedule

Timeline	Activity	Priority	FMU	Prescription
2025 to 2030	Invasive Species	1	3, 4	Remove invasive species.
	Thinning (CT / NCT)	1	1	Thin to an initial target density of 140 to 170 TPA.
	Planting	1	3, 4	Plant with 150-250 TPA of a mix of species suitable to the site conditions.

Timeline	Activity	Priority	FMU	Prescription
2035 to 2040	Thinning (CT / NCT)	2	1	Thin to a final target density of 80 to 110 TPA within 10-15 years after the last thinning entry.
	Planting	3	1	Underplant after thinning with 150 TPA shade-tolerant conifers suitable to site conditions or wait 5-10 years and assess natural regeneration, planting if necessary.
2040 to 2045	Thinning (PCT)	2	6	Evaluate for pre-commercially thinning and, if necessary, thin to a target density of 250 to 300 TPA.
2050 to 2055	Thinning (CT / NCT)	3	6	Evaluate for thinning 10-15 years after the last thinning entry and, if necessary, thin to a target density of 140 to 170 TPA.
Notes: PCT - Pre-commercial Thinning, CT - Commercial Thinning, NCT - Non-commercial Thinning. Priority Levels: 1 - High, 2 - Moderately High, 3 - Moderate, 4 - Low. Additional thinning and planting considerations are identified in Section 1 of this document as well as in the FMU-specific section above.				

Parcel Table

Owner	Parcel ID	Year Acquired	Previous Owner
City	3803232350970000	2016	Private
City	3803232360320000	2016	Private
City	3803233150660000	2002	Trillium
City	3803233660660000	2002	Trillium
City	3803234330970000	2006	Private
City	3803234630310000	2006	Private
City	3803234630310001	2016	Private
City	3803235130320000	2006	Private
City	3803240320160000	2006	Private
City	3803240340490000	2006	Private
City	3803240940730000	2006	Private
City	3803250443760000	2006	Private
City	3803250444210000	2006	Private

Owner	Parcel ID	Year Acquired	Previous Owner
City	3803250533110000	2008	Private
City	3803250625160000	2006	Private
City	3803251405360000	2006	Private
City	3803251424800000	2006	Private
City	3803260813530000	2020	Private
City	3803260893630000	2020	Private
City	3803261405330000	2012	Private
City	3803261653480000	2012	Private
City	3803261663910000	2012	Private
City	3803261664360000	2012	Private
City	3803261664750000	2012	Private
City	3803261955190000	2012	Private
City	3803262304050000	2016	Private
City	3803262375320000	2012	Private
City	3803262524060000	2002	Trillium
City	3803262983400000	2002	Trillium
City	3803263603400000	2002	Trillium
City	3803263634700000	2002	Trillium
City	3803264303400000	2002	Trillium
City	3803264304700000	2002	Trillium
City	3803264944700000	2002	Trillium

Agate Creek Preserve

Overview

Site Description

Agate Creek Preserve is a 151-acre property owned by the City of Bellingham on the north side of Lake Whatcom, near Agate Bay. The forest is partially surrounded by private residences, and can be accessed from Agate Bay Lane.

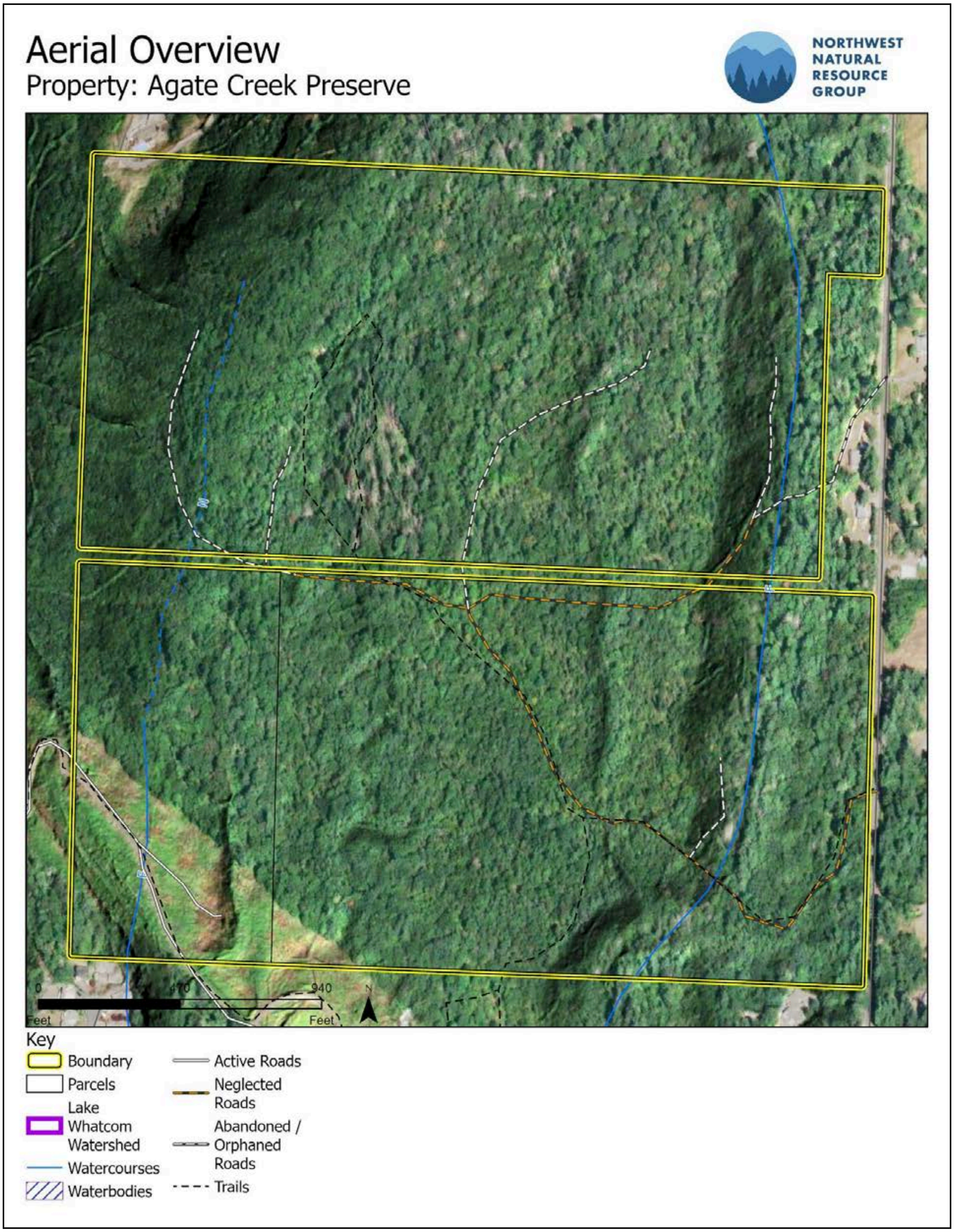
Property Information

This forest is located in Section 24, Township 38N, Range 03E of the US Public Land Survey System and includes three parcels that are listed in the table at the end of this section.

Management History

Agate Creek Preserve consists of three parcels that were acquired by the City of Bellingham. Two parcels were transferred ownership in 2014 from private landowners, and the third parcel was acquired by the city in 2016. The preserve was previously managed as timberland. It is estimated that most of the preserve was clearcut during various harvests between 1940 and 1980.

Property Overview Map



Assessment

Topoclimate

The Agate Creek Preserve features variable topography, with much of the site situated on a broad plateau between Agate Creek on the east and a series of hills to the west. The eastern edge slopes down toward Agate Creek, where soils are wetter and follow the creek's north–south alignment. Small pockets of wetter soils also occur along an unnamed stream on the western side of the property.

Vegetation Zone

According to vegetation zone maps for North America, the following Ecological Systems were likely present prior to Euro-American settlement. More information on these maps and full descriptions of each system can be found in the discussion of Vegetation Zones in Section 2 of this document.

- North Pacific Maritime Mesic-Wet Douglas-fir-Western Hemlock Forest
- North Pacific Seasonal Sitka Spruce Forest
- North Pacific Lowland Riparian Forest and Shrubland

Soils

Data from the USDA Natural Resource Conservation Service (NRCS) Soil Surveys were used to identify the major soil types that underlay this forest, which are described in more detail in the discussion of Soil Productivity in Section 2. Information about specific soil units likely present at this property, including depth, drainage, productivity, and relevant management concerns are listed in the table below. The location of these soil units can be found in the accompanied map packet for this property.

Forest Soil Units Summary Table

Soil Unit	Productivity		Management Concerns					Acres (Pct)
	Site Class	Max Growth	Drought Stress Hazard	Wind Throw Hazard	Mass Wasting Hazard	Logging Rutting Hazard	Logging Compact Hazard	
Everett Series Very Gravelly Ashy Sandy Loam on 2-8% Slopes Shallow (18in) Somewhat Excessively Drained	DF-3	143 ft3/ac/yr	High	Low	Mod.	Low	Mod.	100 (66%)
Everett Series Very Gravelly Ashy Sandy Loam on 15-35% Slopes Shallow (18in) Somewhat Excessively Drained	DF-3	143 ft3/ac/yr	High	Low	High	Low	Mod.	22 (14%)
Squalicum Series Gravelly Ashy Loam on 15-30% Slopes Deep (44in) Moderately Well Drained	DF-2	186 ft3/ac/yr	Mod.	Low	High	Mod.	High	17 (11%)
Squalicum Series Gravelly Ashy Loam on 5-15% Slopes Deep (44in) Moderately Well Drained	DF-2	186 ft3/ac/yr	Mod.	Low	Mod.	Mod.	High	8 (6%)
Everett Series Very Gravelly Ashy Sandy Loam on 8-15% Slopes Shallow (18in) Somewhat Excessively Drained	DF-3	143 ft3/ac/yr	High	Low	Mod.	Low	Mod.	5 (3%)

Slope Stability

As previously described in Section 2, this plan utilizes remotely mapped topographic data as well as hazard zones and historic landslides identified by the State of Washington Department of Natural Resources (DNR) to gauge the likelihood that unstable slopes will be found within a proposed management area. The presence of a mapped hazard zone or historic landslide does not preclude management, but indicates that further investigation is required.

The northwest corner of the site contains the steepest terrain, with slope ranging from 40% to over 70%. The area where the plateau meets the Agate Creek is also somewhat steep, ranging from 40%-65%. The central region of the site is a plateau and has no slopes above 40%. No known landslides have occurred and there are no identified hazard zones.

Hydrology

Agate Creek flows along the east side of the preserve, draining directly into Lake Whatcom and supporting fish-bearing habitat. An additional unnamed stream flows through the west side of the preserve and is identified as fish-bearing by the DNR’s hydrography database for approximately 800 feet within the property. Water runoff from the abandoned road that now serves as the main footpath has begun to channelize and deposit sediment into Agate Creek, increasing turbidity and reducing water quality, which may negatively affect fish habitat.

Roads and Access

The main access point for this site is directly off Agate Bay Lane in the southeast corner of the preserve. A city gate can be found on the Agate Bay Lane between Burnhaven Lane and Mayflower Lane and an unnamed old road bed begins here which has been converted to a hiking trail that traverses from the preserve's southeast corner to the central-west side of the preserve. The old road bed crosses Agate Creek and while the previous road crossing has been pulled, the steep stream banks and current trail crossing are causing some minor erosion into the creek. West of the creek, the old road has not been properly decommissioned and several culverts were found still in place. Since this road is extremely flat, these culverts pose little risk at the moment, but indicate that a formal road abandonment procedure has not been undertaken. In some locations the old road bed is impacting the local hydrology, causing ponding and wetlands to form on the uphill side of the road. More importantly, channelization was seen in the old road bed leading down to Agate Creek and this likely causes sediment to be deposited into the creek during strong rain events. In addition, a powerline easement and minor access roads runs though the southwest portion of the site. Several other trails were found on the site connecting with the powerline easement in the southwest corner and exiting to residential neighborhoods on the preserve's western edge.

Health and Resiliency

The Agate Creek Preserve forest is dominated by hardwoods from the last disturbance roughly 20-40 years ago. In some areas across the site, it appears that there were failed conifer plantings, likely with the aim of converting the forest to a conifer-dominated site. Grand fir that were replanted are declining due to beetle infestations. The overstocked plantation has allowed the beetles to spread rapidly throughout the stand, and almost all of the grand fir are infested. Himalayan blackberry is also present throughout the preserve, which is impacting forest development in some areas.

Wildlife Habitat

A review of the Washington State Department of Fish and Wildlife Priority Species Database identified little brown bat, big brown bat, and Yuma myotis bat as having been documented somewhere within the 23,000-acre township containing Agate Creek Preserve. A biodiversity area and corridor runs through the west side of the preserve that is a priority area for terrestrial habitat. Additionally, the two streams on the property are habitat for Cutthroat trout, and the riparian area of Agate Creek is a priority area for aquatic habitat.

This site provides habitat for birds, especially woodpeckers, due to the abundance of hardwood trees. The marshy areas of the site provide habitat for small amphibians, such as along the creeks that flow through the preserve. The understory is dense and multi-layered, which is beneficial for a variety of animal species. Large downed wood and snags are generally limited throughout the property.

Wildfire Susceptibility

The Agate Creek Preserve has a relatively low wildfire risk due to the dampness of the soil and the abundance of hardwood species. However, there is still a risk of wildfire ignition on or near the site due to the close proximity to residential properties and roadways. The easy access from Agate Bay Lane provides a quick response to fire.

Carbon Storage

This site has low carbon storage potential because the forest is hardwood dominant. Hardwood trees typically grow faster than conifer trees, but they ultimately store less carbon due to their shorter lifespans.

Cultural Resources

The Lake Whatcom watershed is a landscape rich with cultural significance for Indigenous peoples—particularly the Lummi Nation and the Nooksack and Swinomish Tribes—who have maintained deep spiritual, cultural, and subsistence connections to the landscape. Although a review of the Washington State Department of Archaeology and Historic Preservation Wisaard online database did not identify any known historical sites on this property and none were encountered while developing this plan, this property has a long history of human use and artifacts may be present. Please see the previous discussion about cultural use practices in the Lake Whatcom Watershed for a more detailed assessment of best management practices moving forward.

Recreation

The Agate Creek Preserve offers limited recreational opportunities due to its small size and minimal trail network. A main trail runs from the southeast corner to the central-west portion of the site and several other small trails were found on the site connecting with the powerline easement in the southwest corner and exiting to residential neighborhoods on the preserve's western edge. However, the absence of parking and signage limits trail usage.

Recommendations

Roads and Access

The old road bed that runs through the central portion of this property is not needed for management activities and should be formally decommissioned. At a minimum, culverts should be removed, permanent water bars installed to control drainage, and water crossings restored to their normal function.

Health and Resiliency

Recommendations for addressing observed beetle infestations and invasive species are given at the management unit level below.

Wildfire Susceptibility

Shaded fuel breaks are recommended within 100 feet of public roads and existing structures which are designed to keep fires on the ground and slow their spread until firefighting resources can arrive. For additional details on implementation, see the description of a shaded fuel break given in the discussion of Wildfire Susceptibility in Section 2 of this document.

Forest Types

All recommendations for this property follow the previous discussion of forest-types in section 3 and are discussed by management unit below.

Management Units

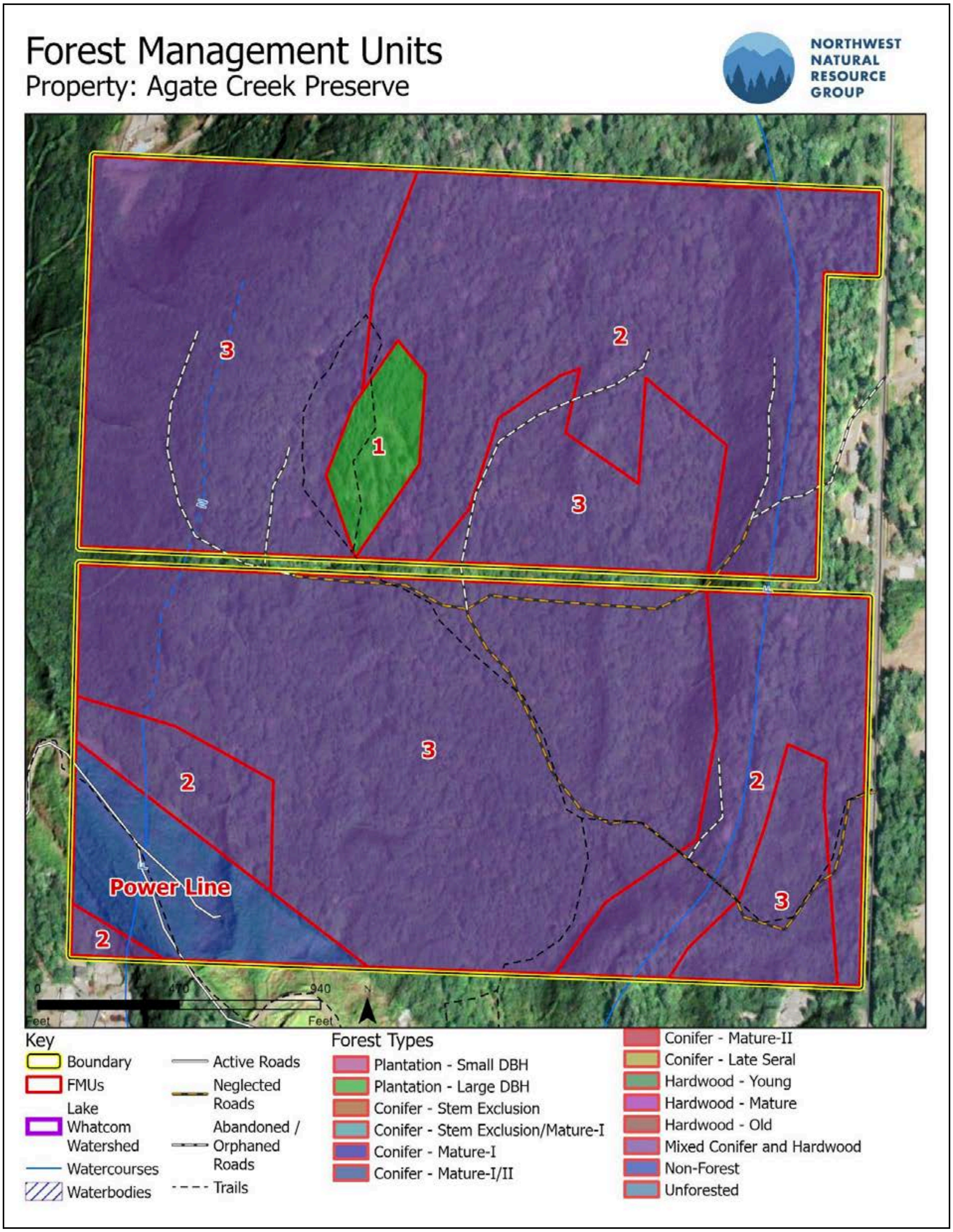
Forest cover was delineated into the forest management units (FMUs) using both remotely sensed data, historic inventory units, and field inventory data. The forestland within these management units share similar forest characteristics and management recommendations. For each FMU, this plan describes the geophysical attributes and forest conditions and assesses the unit against the plans management objectives using the previously described framework by forest type. Recommendations are then given by FMU, typically referencing general recommendations by forest type, but more information is given as needed. Finally, a schedule of management activities by year and FMU is given at the end of this section.

Summary of Forest Management Units

FMU	Acres	Forest Type	Management
1	3	Conifer Plantation - Large DBH	Invasive Species Management & Planting
2	52	Mixed Conifer and Hardwood	None

FMU	Acres	Forest Type	Management
3	89	Mixed Conifer and Hardwood	None
Power Line	8	Unforested	Not Applicable
Total	**151**		

Map of Forest Management Units



FMU 1 - Conifer Plantation - Large DBH

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	GF	260	340	446	80	10	14	18	140
Total	All	All	260	340	446	80	10	14	18	140

Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.

FMU 1 is a flat, dry section located near the center of the Agate Creek Preserve. The soil productivity rating is site class III. The unit was likely clearcut before the 1950s, possibly for a homesite, and replanted with grand fir in the early 1980s. Since then, management has been minimal, resulting in a density of about 260 TPA, with self-thinning occurring due to competition. Overstory grand fir average 14 inches DBH and 140 feet tall. There is currently no midstory. A large amount of mortality is currently occurring in this unit. While no mortality agent was definitively identified, insect frass suggests a bark beetle infestation which appears specific to grand fir as no dead or dying Douglas-fir were observed. Since this unit contains most of the grand fir at this property, this infestation is likely to taper off naturally in the coming years, but will likely kill more grand fir before it finishes. In some areas, grand fir is regenerating in the understory, but a thick brush layer, including invasive Himalayan blackberry, precludes establishment across much of the unit. To ensure the future forest cover of this unit, it is recommended to remove the invasive species and underplant with additional conifers to increase species diversity of the site. There is currently no road access to this stand.

FMU 2 - Mixed Conifer and Hardwood

Stand Composition Summary

<table>
<tr><th>Canopy Position</th><th>Cohort Type</th><th>Species</th><th>TPA</th><th>BAA</th><th>SDI</th><th>RD</th><th>Min DBH</th><th>Avg DBH</th><th>Max DBH</th><th>Avg HT</th></tr>
<tr><td rowspan="5">Overstory</td><td rowspan="2">Major</td><td>BM</td><td>36</td><td>53</td><td>81</td><td rowspan="5">40</td><td>8</td><td>17</td><td>24</td><td>119</td></tr>
<tr><td>RC</td><td>37</td><td>55</td><td>89</td><td>8</td><td>17</td><td>32</td><td>120</td></tr>
<tr><td rowspan="2">Minor</td><td>CW</td><td>17</td><td>21</td><td>18</td><td>8</td><td>10</td><td>18</td><td>104</td></tr>
<tr><td>DF</td><td>12</td><td>16</td><td>29</td><td>10</td><td>18</td><td>32</td><td>124</td></tr>
<tr><td>All</td><td>All</td><td>123</td><td>176</td><td>250</td><td>6</td><td>15</td><td>32</td><td>117</td></tr>
<tr><td rowspan="3">Midstory</td><td rowspan="2">Major</td><td>BM</td><td>14</td><td>5</td><td>6</td><td rowspan="3">3</td><td>2</td><td>6</td><td>10</td><td>37</td></tr>
<tr><td>RC</td><td>31</td><td>9</td><td>14</td><td>2</td><td>6</td><td>10</td><td>39</td></tr>
<tr><td>All</td><td>All</td><td>49</td><td>16</td><td>22</td><td>2</td><td>6</td><td>10</td><td>37</td></tr>
<tr><td>Total</td><td>All</td><td>All</td><td>172</td><td>192</td><td>271</td><td>43</td><td>2</td><td>13</td><td>32</td><td>94</td></tr>
<tr><td colspan="11">Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.</td></tr>
</table>

FMU 2 consists of a moderately flat plateau and the adjacent riparian area around Agate Creek which slopes downward off the plateau. The soil productivity rating is site class III. It is estimated that the unit naturally regenerated following a harvest around 1940–1950s. Total stocking is approximately 172 TPA. The overstory contains approximately 123 TPA and is primarily composed of bigleaf maple and western redcedar, with small components of black cottonwood and Douglas-fir. Overstory western redcedar average 17 inches DBH and 120 ft tall, and maple average 17 inches DBH and 119 ft tall. The midstory contains approximately 49 TPA and is primarily composed of bigleaf maple and western redcedar. Midstory redcedar average 6 inches DBH and 39 ft tall, and maple average 6 inches DBH and 37 ft tall. This is a mixed stand with a diverse structure. Per the earlier recommendations of mixed conifer and hardwood stands with no health concerns, no management activities are recommended. The east side of the stand is accessible from Agate Bay Lane.

FMU 3 - Mixed Conifer and Hardwood

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	BM	54	35	48	24	6	9	18	65
		RA	41	27	30		4	8	18	49
	Minor	CW	22	16	26		6	11	18	101
		DF	15	12	14		6	10	14	74
		RC	12	9	14		8	11	16	85
	All	All	151	105	139		4	9	18	69
Midstory	Major	BM	39	11	12	5	2	5	8	33
	Minor	CW	13	5	6		4	6	8	45
		RA	16	6	4		2	5	8	28
		RC	14	3	3		2	4	6	27
	All	All	92	28	28		2	5	8	33
Total	All	All	243	133	167	29	2	8	18	55

Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.

FMU 3 is mostly flat with some small drainage pockets, except for the northwest corner which is moderately sloped. The soil productivity rating ranges from site class II to III. It is estimated that this unit was clearcut and replanted as Douglas-fir plantation in the late 1980s to early 1990s. However, high mortality of planted conifer species led FMU 3 to becoming a hardwood dominant forest, though remnants of the conifer plantation remains. Total stocking is approximately 243 TPA. The overstory contains approximately 151 TPA and is primarily composed of bigleaf maple and red alder, with small components of black cottonwood, Douglas-fir and western redcedar. Overstory maple average 9 inches DBH and 65 ft tall, and alder averages 8 inches DBH and is 49 ft tall. The midstory contains approximately 92 TPA and is primarily composed of bigleaf maple, with small components of black cottonwood, red alder and western redcedar. Midstory bigleaf maple average 5 inches DBH and 33 ft tall. While this mixed stand is currently more dominant to hardwoods than conifers, shade-tolerant conifers are regenerating in the understory, and their presence will likely increase as the forest develops. Per the earlier recommendations of mixed conifer and hardwood stands with no health concerns, no management activities are recommended.

Management Activity Schedule

Timeline	Activity	Priority	FMU	Prescription
2025 to 2030	Invasive Species	1	1	Remove invasive species.
	Planting	1	1	Plant with 150-250 TPA of a mix of species suitable to the site conditions.
Notes: Priority Levels: 1 - High, 2 - Moderately High, 3 - Moderate, 4 - Low. Additional thinning and planting considerations are identified in Section 1 of this document as well as in the FMU-specific section above.				

Parcel Table

Owner	Parcel ID	Year Acquired	Previous Owner
City	3803243021910000	2014	Private
City	3803243923300000	2014	Private
City	3803244301950000	2016	Private

Agate Pond Preserve

Overview

Site Description

Agate Pond Preserve is a 155-acre property owned by the City of Bellingham on the north side of Lake Whatcom. It is located off Squalicum Lake Road, north of the city owned Soto Rynder and Agate Creek Preserves.

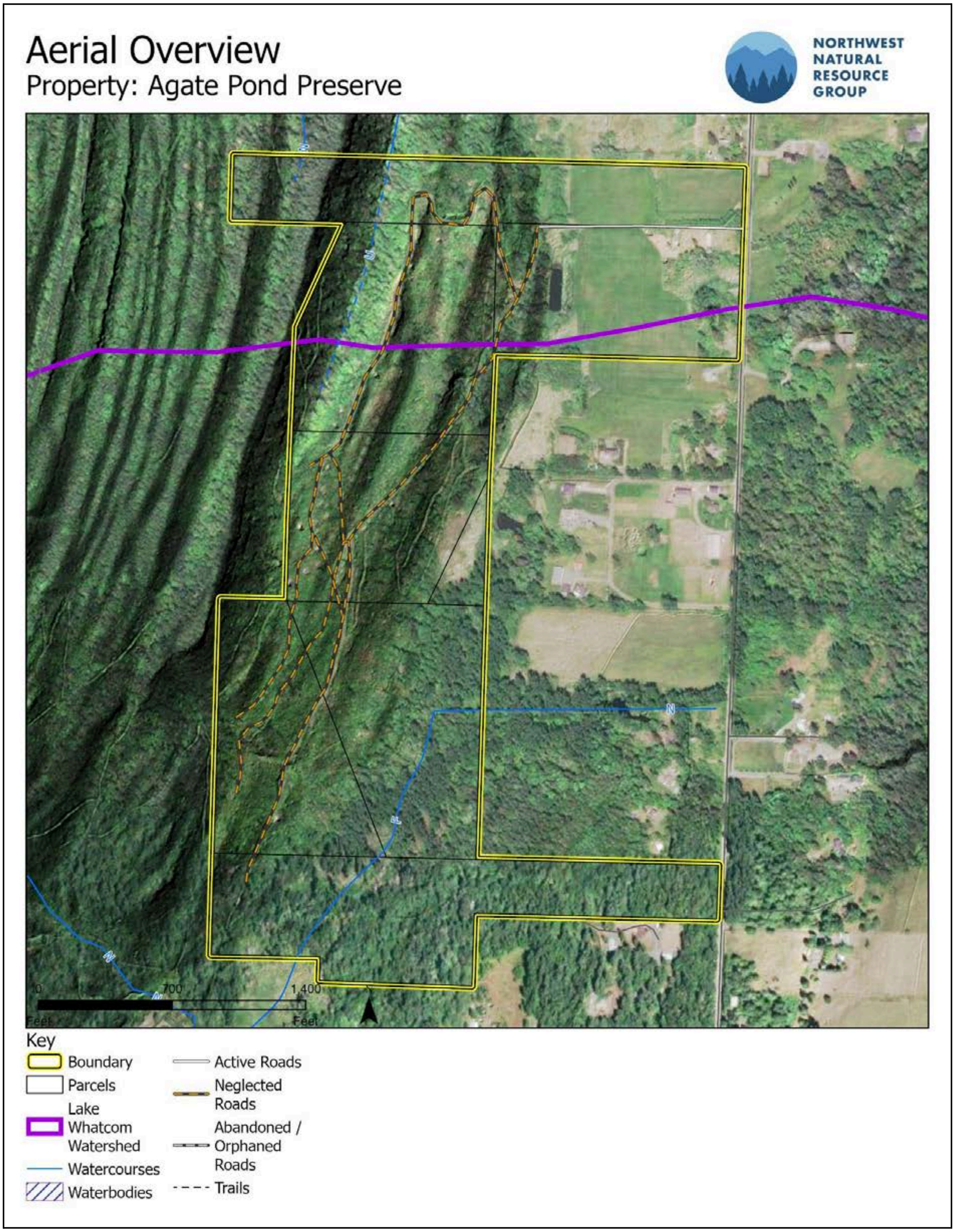
Property Information

This forest is located in Section 18, Township 38N, Range 04E of the US Public Land Survey System and includes eight parcels that are listed in the table at the end of this section.

Management History

The preserve was acquired by the city in 2019 and 2020 from private ownership. The entire forest at the Agate Pond Preserve was likely clearcut sometime in the last 80 to 120 years and left to regenerate naturally. Subsequent harvest activity in 2015 and 2016 clearcut most of the western side of the property. Both sites were replanted with Douglas-fir following the harvest, but high mortality of the planted trees has occurred, particularly at the location of the 2015 harvest. Recent restoration activities by the City have focused on removing old structures and reforesting a large field near the preserve entrance.

Property Overview Map



Assessment

Topoclimate

The Agate Pond Preserve is located on the east side of Squalicum Mountain. The western half of the property has moderate east-facing slopes that form into small benches. Slight drainages are present along the hill and provide cooler microclimates. Areas in the east and south sides of the property are almost entirely flat.

Vegetation Zone

According to vegetation zone maps for North America, the following Ecological Systems were likely present prior to Euro-American settlement. More information on these maps and full descriptions of each system can be found in the discussion of Vegetation Zones in Section 2 of this document.

- North Pacific Lowland Riparian Forest and Shrubland
- North Pacific Maritime Mesic-Wet Douglas-fir-Western Hemlock Forest
- North Pacific Seasonal Sitka Spruce Forest

Soils

Data from the USDA Natural Resource Conservation Service (NRCS) Soil Surveys were used to identify the major soil types that underlay this forest, which are described in more detail in the discussion of Soil Productivity in Section 2. Information about specific soil units likely present at this property, including depth, drainage, productivity, and relevant management concerns are listed in the table below. The location of these soil units can be found in the accompanied map packet for this property.

Forest Soil Units Summary Table

Soil Unit	Productivity		Management Concerns					Acres (Pct)
	Site Class	Max Growth	Drought Stress Hazard	Wind Throw Hazard	Mass Wasting Hazard	Logging Rutting Hazard	Logging Compact Hazard	
Squalicum Series Gravelly Ashy Loam on 15-30% Slopes Deep (44in) Moderately Well Drained	DF-2	186 ft3/ac/yr	Mod.	Low	High	Mod.	High	51 (33%)
Labounty Series Ashy Silt Loam on 0-2% Slopes Poorly Drained	RA-4	100 ft3/ac/yr	Mod.	Medium	Low	High	High	46 (30%)

Soil Unit	Productivity		Management Concerns					Acres (Pct)
	Site Class	Max Growth	Drought Stress Hazard	Wind Throw Hazard	Mass Wasting Hazard	Logging Rutting Hazard	Logging Compact Hazard	
Nati Series Ashy Loam on 30-60% Slopes Mod. Deep (38in) Well Drained	DF-3	129 ft3/ac/yr	Mod. High	High	High	High	High	27 (18%)
Squalicum Series Gravelly Ashy Loam on 5-15% Slopes Deep (44in) Moderately Well Drained	DF-2	186 ft3/ac/yr	Mod.	Low	Mod.	Mod.	High	21 (14%)
Everett Series Very Gravelly Ashy Sandy Loam on 15-35% Slopes Shallow (18in) Somewhat Excessively Drained	DF-3	143 ft3/ac/yr	High	Low	High	Low	Mod.	8 (5%)

Slope Stability

As previously described in Section 2, this plan utilizes remotely mapped topographic data as well as hazard zones and historic landslides identified by the State of Washington Department of Natural Resources (DNR) to gauge the likelihood that unstable slopes will be found within a proposed management area. The presence of a mapped hazard zone or historic landslide does not preclude management, but indicates that further investigation is required.

The site is generally flat and mostly contains slopes under 40%, though there are some short steep bands with slopes over 70% in the northwest corner of the preserve. No known landslides have occurred, and there are no identified hazard zones. There is the potential for small areas of rule-identified landforms to exist on the site, particularly inner gorges in steam channels, but these can be easily avoided during future operations.

Hydrology

This property is situated primarily in the Lake Whatcom watershed and serves as the headwaters of Agate Creek, which drains to the south and is identified as fish-bearing in the DNR's hydrography database. Forested wetlands can be found in the center of the property and in the northeast corner. In the northwest corner, there is a small seasonal stream that flows north into the Squalicum Creek watershed.

Roads and Access

The property is accessed off Squalicum Lake Road where a gated road provides access to the preserve's northern boundary. This road is rocked and in good condition until the base of the western slopes where it becomes overgrown with brush. Unnamed forest roads run southwest along the eastern-facing slopes of the preserve but are currently overgrown with brush, though the road grades are in good condition. These neglected roads were used during recent harvest activities in 2015 and 2016 have not been formally decommissioned with drainage culverts still in place.

Health and Resiliency

Himalayan blackberry is a health concern at this site and is precluding the natural establishment of forest cover, primarily in areas harvested in 2015 and 2016. Specific areas of impact are noted in the Management Units section below. Aside from this invasive species concern, no other significant forest health issues were observed.

Wildlife Habitat

According to the Washington State Department of Fish and Wildlife's Priority Habitat database, Agate Pond Preserve potentially falls within bald eagle nesting territory, and a gray wolf has been observed within the 23,000-acre township that contains the site. The Preserve also has cliff nesting habitat in the northwest corner and habitat for wetland species throughout the site.

The abundance of hardwood trees provides habitat for many bird species. The understory is dense and multi-layered in many areas, which is beneficial for a variety of animal species. The conifer-dominant areas generally provide more snags and downed logs. While they are currently still limited in number and size, their presence will likely increase as the forest continues to grow and develop. The reforestation site currently provides limited habitat features, but converting the field to a forest will provide more habitat for wildlife with time.

Wildfire Susceptibility

Close proximity to residential areas increase ignition probability of wildfire at the preserve, and the presence of dense, brushy vegetation creates potential ladder fuels when it is dry. The forest is variable in composition, with a strong hardwood component that is more resistant to fire. There is one road that provides easy access for containment of wildfire.

Carbon Storage

Currently, the site is storing relatively little carbon due to its hardwood dominance and young forest conditions. The northwest corner, which contains large conifers, holds the greatest carbon storage at present. Over time, the site has strong potential to increase carbon storage if young stands are thinned as they become overstocked to promote growth and if forest composition shifts toward greater conifer dominance.

Cultural Resources

The Lake Whatcom watershed is a landscape rich with cultural significance for Indigenous peoples—particularly the Lummi Nation and the Nooksack and Swinomish Tribes—who have maintained deep spiritual, cultural, and subsistence connections to the landscape. Though a review of the Washington State Department of Archaeology and Historic Preservation Wisaard online database did not identify any known historical sites on this property and none were encountered while developing this plan, this property has a long history of human use and artifacts may be present. Please see the previous discussion about cultural use practices in the Lake Whatcom Watershed for a more detailed assessment of best management practices moving forward.

Recreation

Recreational access is limited at the site. While there is a central trail at the preserve, it is overgrown with Himalayan blackberry which limits recreational opportunities. A local access trail was identified entering the property from the south but no other recreation was identified during this assessment.

Recommendations

Roads and Access

Access should be restored along the neglected roads at this property to facilitate immediate management activities and to ensure that drainage control structures, such as culverts and ditches, are functioning properly. Implement a maintenance plan for ditches, culverts, and road grades to ensure all active roads maintain a high standard of function. See the best management practices identified in Section 2.

Minor spurs on the upper slopes can be decommissioned at this time, but the larger roads should be maintained to facilitate heavy equipment for future thinning operations in the old plantation stands. After management interventions are complete at the old plantation stands, the entire road system can be formally decommissioned. At a minimum, culverts should be removed and permanent water bars installed to control drainage, and full restoration would include road grade restoration and reforestation. This may be an opportunity to manage the unsanctioned recreational trial usage in this vicinity.

Health and Resiliency

Recommendations for addressing observed invasive species are given at the management unit level below.

Wildfire Susceptibility

Shaded fuel breaks are recommended within 100 feet of public roads and existing structures which are designed to keep fires on the ground and slow their spread until firefighting resources can arrive. For

additional details on implementation, see the description of a shaded fuel break given in the discussion of Wildfire Susceptibility in Section 2 of this document.

Forest Types

All recommendations for this property follow the previous discussion of forest-types in section 3 and are discussed by management unit below.

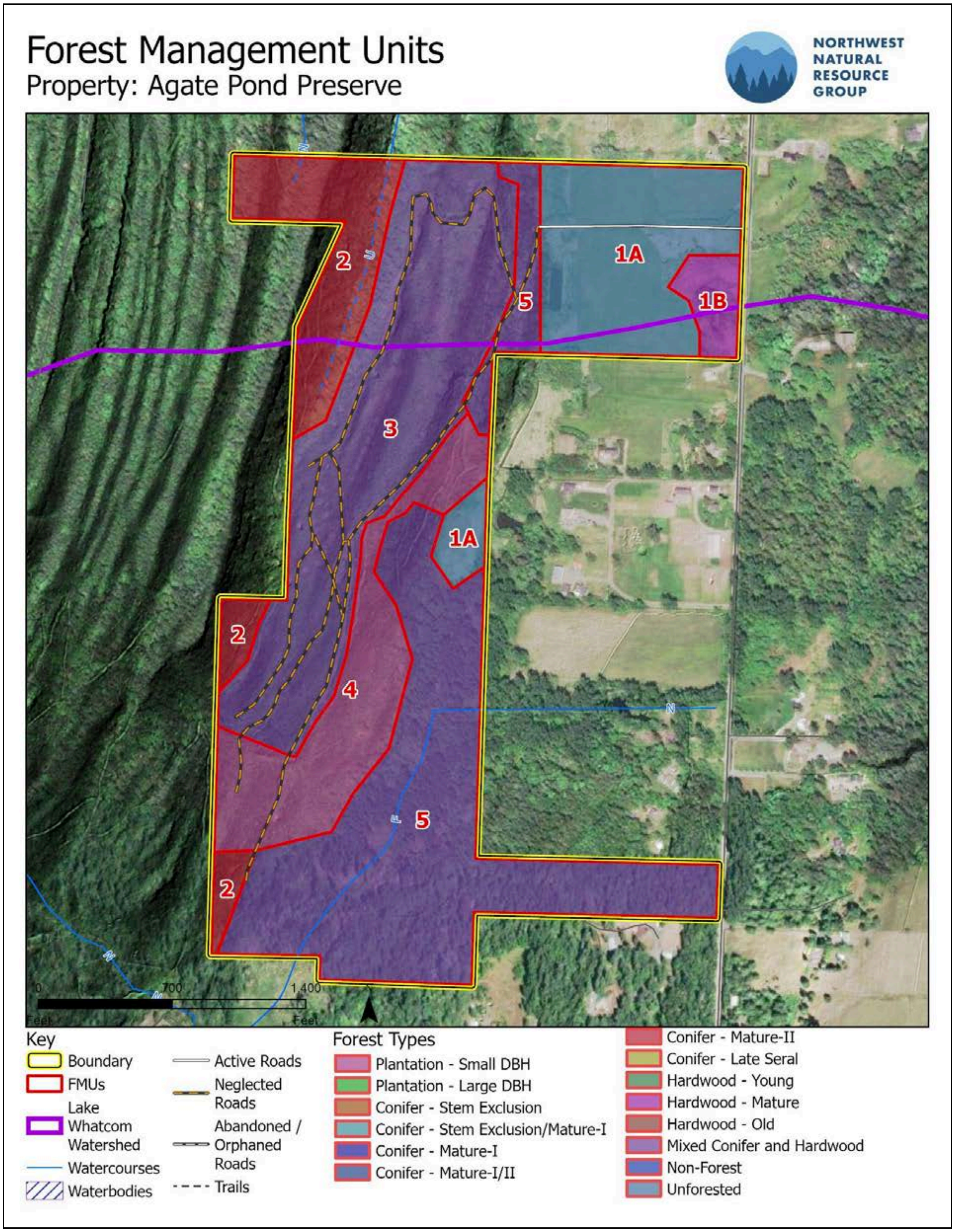
Management Units

Forest cover was delineated into the forest management units (FMUs) using both remotely sensed data, historic inventory units, and field inventory data. The forestland within these management units share similar forest characteristics and management recommendations. For each FMU, this plan describes the geophysical attributes and forest conditions and assesses the unit against the plans management objectives using the previously described framework by forest type. Recommendations are then given by FMU, typically referencing general recommendations by forest type, but more information is given as needed. Finally, a schedule of management activities by year and FMU is given at the end of this section.

Summary of Forest Management Units

FMU	Acres	Forest Type	Management
1A	23	Unforested	Future Thinning
1B	3	Mixed Hardwood - Mature	None
2	17	Mixed Conifer - Mature-II	None
3	42	Mixed Conifer and Hardwood	Monitor Invasive Species
4	19	Conifer Plantation - Small DBH	Future Thinning
5	51	Mixed Conifer and Hardwood	None
Total	155		

Map of Forest Management Units



FMU 1A - Unforested

This FMU is primarily a flat field, likely used for pastoral purposes before city ownership, with active reforestation currently in progress. This unit also includes a smaller grass field to the south which appears to have hosted a previous fruit orchard. The unit has a soil productivity rating of site class RA. No restoration or replanting has occurred in this smaller field. In the larger field, Grand fir, Sitka spruce, black cottonwood, Douglas-fir, and western redcedar seedlings were planted in 2024. The seedlings were planted at a high density in grid spacing ranging from 10-foot by 10-foot to 6-foot by 12-foot, and average around 550 TPA. Seedlings are generally doing well, ranging from 2ft to 6ft tall depending on species and exact age, but some post-planting mortality was observed and more is expected as the trees mature. It is recommended to evaluate the site for a pre-commercial thinning in 15 years to reduce density and modify species composition depending on mortality. This unit is accessible from Squalicum Lake Road.

FMU 1B - Mixed Hardwood - Mature

Stand Composition Summary

<table>
<tr><th>Canopy Position</th><th>Cohort Type</th><th>Species</th><th>TPA</th><th>BAA</th><th>SDI</th><th>RD</th><th>Min DBH</th><th>Avg DBH</th><th>Max DBH</th><th>Avg HT</th></tr>
<tr><td>Overstory</td><td>Major</td><td>CW</td><td>100</td><td>160</td><td>134</td><td>26</td><td>8</td><td>12</td><td>20</td><td>100</td></tr>
<tr><td rowspan="5">Midstory</td><td rowspan="4">Major</td><td>BM</td><td>25</td><td>5</td><td>6</td><td rowspan="5">4</td><td>2</td><td>4</td><td>6</td><td>20</td></tr>
<tr><td>CW</td><td>25</td><td>5</td><td>6</td><td>2</td><td>4</td><td>6</td><td>20</td></tr>
<tr><td>RA</td><td>25</td><td>5</td><td>6</td><td>2</td><td>4</td><td>6</td><td>20</td></tr>
<tr><td>WO</td><td>25</td><td>5</td><td>6</td><td>2</td><td>4</td><td>6</td><td>20</td></tr>
<tr><td>All</td><td>All</td><td>100</td><td>20</td><td>23</td><td>2</td><td>4</td><td>6</td><td>20</td></tr>
<tr><td>Total</td><td>All</td><td>All</td><td>200</td><td>180</td><td>157</td><td>30</td><td>2</td><td>8</td><td>20</td><td>60</td></tr>
<tr><td colspan="11">Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.</td></tr>
</table>

FMU 1B is a small area of mature hardwoods between FMU 1A and Squalicum Lake Road. It was likely clearcut at the same time as FMU 1a, but left to grow for 80 years or more and today has features of a forested wetland. The stand has a cottonwood overstory at about 100 TPA, a mixed hardwood midstory, and a lush understory. The overstory black cottonwood average 12 inches DBH and 100 ft tall. The midstory contains approximately 100 TPA and is primarily composed of bigleaf maple, Oregon white oak, red alder, and black cottonwood, each with an average DBH of 4 inches and height of 20 ft tall. Total stocking across the overstory and midstory is approximately 200 TPA. This stand is primarily a wetland area with a multi-storied canopy system and no forest health concerns. No management is recommended. This unit is accessible from Squalicum Lake Road.

FMU 2 - Mixed Conifer - Mature-II

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	DF	40	96	163	48	12	24	32	140
		RC	30	72	64		8	16	24	140
	Minor	BM	15	36	32		8	16	24	140
		RA	15	36	32		8	16	24	140
	All	All	100	240	291		8	19	32	140
Midstory	Major	BM	30	10	13	4	2	6	12	60
		RC	30	10	13		2	6	12	60
	All	All	60	20	26		2	6	12	60
Total	All	All	160	260	317	52	2	14	32	110

Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.

FMU 2 appears to be a naturally regenerated second growth forest after an initial clearcut event from over 100 years ago. It is a steep stand, with one dip at over 70% slope and has a soil productivity rating of site class III. This FMU was likely ignored during more recent harvest events, such as with FMU 3 and 4, due to slope restrictions and logistical feasibility. The stand is a diverse conifer mix with natural gaps and a multi-layered canopy. Total stocking is approximately 160 TPA. The overstory contains approximately 100 TPA and is primarily composed of western redcedar and Douglas-fir, with small components of bigleaf maple and red alder. The overstory Douglas-fir average 24 inches DBH and 140 ft tall, while the western redcedar average 16 inches DBH and 140 ft tall. The midstory contains approximately 60 TPA and is primarily composed of bigleaf maple and western redcedar. The midstory western redcedar and the bigleaf maple both average 6 inches DBH and 60 ft tall. This forest is in the Mature-II stage of development with no health concerns. Per the earlier discussion of mixed conifer forests in this stage, no management activities are recommended. There is no current road access to this stand.

FMU 3 - Mixed Conifer and Hardwood

Stand Composition Summary *(Forested Areas Only)*

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	BM	72	2	17	8	2	4	6	15
		RA	68	2	16		2	4	8	15
	Minor	DF	32	4	7		1	3	5	20
		RC	34	1	8		2	4	6	20
	All	All	210	10	48		2	4	8	17
Total	All	All	210	15	48	8	2	4	8	17

Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.

This FMU has variable topography and is located in the middle of the preserve. It has a soil productivity rating of site class of II. This unit was harvested and replanted with Douglas-fir in 2015, though high mortality of the planted trees has occurred. Much of the unit is now dominated by invasive Himalayan blackberry and other shrubs, precluding the establishment of forest cover.

Areas that are forested are dominated by naturally regenerated hardwood species, such as red alder and cottonwood. Total stocking in the forested areas is approximately 210 TPA. The overstory contains approximately 150 TPA and is primarily composed of bigleaf maple and Douglas-fir, with small components of red alder and western redcedar. The overstory Douglas-fir and bigleaf maple both average 4 inches DBH and 20 ft tall. The midstory contains approximately 60 TPA and is primarily composed of bigleaf maple, which average 4 inches DBH and 10 ft tall.

In the forested areas of this unit, the blackberry will likely be suppressed as the canopy closes and reduces light availability to the understory. However, much of the unit is unforested with large patches of blackberry outcompeting all native species and preventing regeneration. It is recommended to remove the blackberry and plant across this unit in the unforested areas. Ongoing maintenance will be necessary to ensure forest cover can be restored on this unit. This unit is accessible by unnamed, neglected forest roads used to harvest this unit in 2015.

FMU 4 - Conifer Plantation - Small DBH

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	DF	315	26	72	22	2	4	6	20
	Minor	BM	58	4	13		1	3	5	10
		CH	58	4	13		1	3	5	15
		CW	22	2	5		2	4	6	15
		RA	58	4	13		1	3	6	15
	All	All	510	40	117		1	4	6	15
Total	All	All	510	40	117	22	1	4	6	15

Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.

This FMU was clearcut and replanted with conifers in 2016. Survival of the planted trees has been higher than in FMU 3. The area is mostly flat, though some areas reach 40% slope. The FMU has a soil productivity rating of site class II. The total stocking is approximately 510 TPA. The overstory is primarily composed of Douglas-fir, with a small component of bigleaf maple that have naturally regenerated. The overstory Douglas-fir average 4 inches DBH and 20 ft tall. No midstory is currently present in this stand. This forest is the Canopy Closure stage of development. Per the earlier discussion of Douglas-fir plantations, this unit should be pre-commercially thinned in 5-10 years followed by a series of commercial thinnings. There is currently Himalayan blackberry widespread across the unit. Invasive species should be monitored as the canopy closes and managed if their presence persists. This unit is accessible by unnamed neglected forest roads used to log this unit in 2016.

FMU 5 - Mixed Conifer and Hardwood

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	CW	50	82	106	45	6	16	28	127
	Minor	BM	18	34	35		6	15	24	120
		DF	21	34	55		8	18	28	120
		GF	17	28	39		8	17	28	120
	All	All	121	206	259		6	16	28	122
Midstory	Major	BM	17	5	5	4	2	5	8	37
		RC	61	21	20		2	5	14	27
	All	All	85	28	28		2	5	14	30
Total	All	All	206	234	287	49	2	11	28	84

Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.

FMU 5 contains a mix of hardwoods and conifers in the upland areas, with black cottonwood dominating the lower reaches and wetland zones. The stand likely has not been disturbed since before the 1950s because of the wetland within it. The FMU is very flat and gently slopes upwards on the west side. It has soil productivity ratings of site class RA and II. Total stocking is approximately 206 TPA. The overstory contains approximately 121 TPA and is primarily composed of black cottonwood, with a small component of bigleaf maple. The overstory black cottonwood averages 16 inches DBH and is 127 ft tall. The midstory contains approximately 85 TPA and is primarily composed of bigleaf maple and western redcedar, which both average 5 inches DBH. The redcedar average 27 ft tall in the midstory, and the bigleaf maple average 37 ft tall. This is a mixed conifer and hardwood forest with no health concerns, and the species that inhabit the site are very suitable for the wet soil conditions. Per the earlier discussion of this type of forest, no management activities are recommended. The east side of this unit is accessible from Squalicum Lake Road and the central and south west corner of the unit can be accessed from neglected forest roads used to harvest adjacent stands in 2016.

Management Activity Schedule

Timeline	Activity	Priority	FMU	Prescription
2025 to 2030	Invasive Species	1	3	Remove invasive species.
	Planting	1	3	Plant with 150-250 TPA of a mix of species suitable to the site conditions.
2030 to 2035	Monitor	3	4	Monitor the stand for invasive species after it reaches canopy closure and manage if necessary.
	Thinning (PCT)	1	4	Pre-commercially thin to a target density of 250 to 300 TPA.
2040 to 2045	Thinning (PCT)	2	1a	Evaluate for pre-commercially thinning and, if necessary, thin to a target density of 250 to 300 TPA.
	Thinning (CT / NCT)	1	4	Thin to an initial target density of 140 to 170 TPA within 10-15 years after the last thinning entry.
2050 to 2055	Thinning (CT / NCT)	2	4	Thin to a final target density of 80 to 110 TPA within 10-15 years after the last thinning entry.
2055 to 2060	Thinning (CT / NCT)	2	1a	Evaluate for thinning and, if necessary, thin to a target density of 140 to 170 TPA within 15-20 years after the last thinning entry.
Notes: PCT - Pre-commercial Thinning, CT - Commercial Thinning, NCT - Non-commercial Thinning. Priority Levels: 1 - High, 2 - Moderately High, 3 - Moderate, 4 - Low. Additional thinning and planting considerations are identified in Section 1 of this document as well as in the FMU-specific section above.				

Parcel Table

Owner	Parcel ID	Year Acquired	Previous Owner
City	3804180342000000	2020	Private
City	3804180633020000	2020	Private
City	3804180924120000	2020	The Oeser Company
City	3804181052000000	2020	The Oeser Company
City	3804181342920000	2020	Private
City	3804181351190000	2019	Private
City	3804181544870000	2020	The Oeser Company
City	3804182104410000	2020	The Oeser Company

Blue Canyon Preserve

Overview

Site Description

Blue Canyon Preserve is an 823-acre property owned by the City of Bellingham on the southeast side of Lake Whatcom. The property extends from the eastern shore of Lake Whatcom up south and western-facing slopes to the upper ridgelines of Stuart Mountain. To the south and east it borders forestland primarily owned by the Washington Department of Natural Resources (DNR). To the north it borders forestland in Lake Whatcom Park owned by Whatcom County. The community of Blue Canyon sits at the bottom of the property along the shores of Lake Whatcom.

Property Information

This forest is located in Sections 14, 15, 22, and 23 of Township 37N, Range 04E of the US Public Land Survey System and includes 11 parcels that are listed in the table at the end of this section.

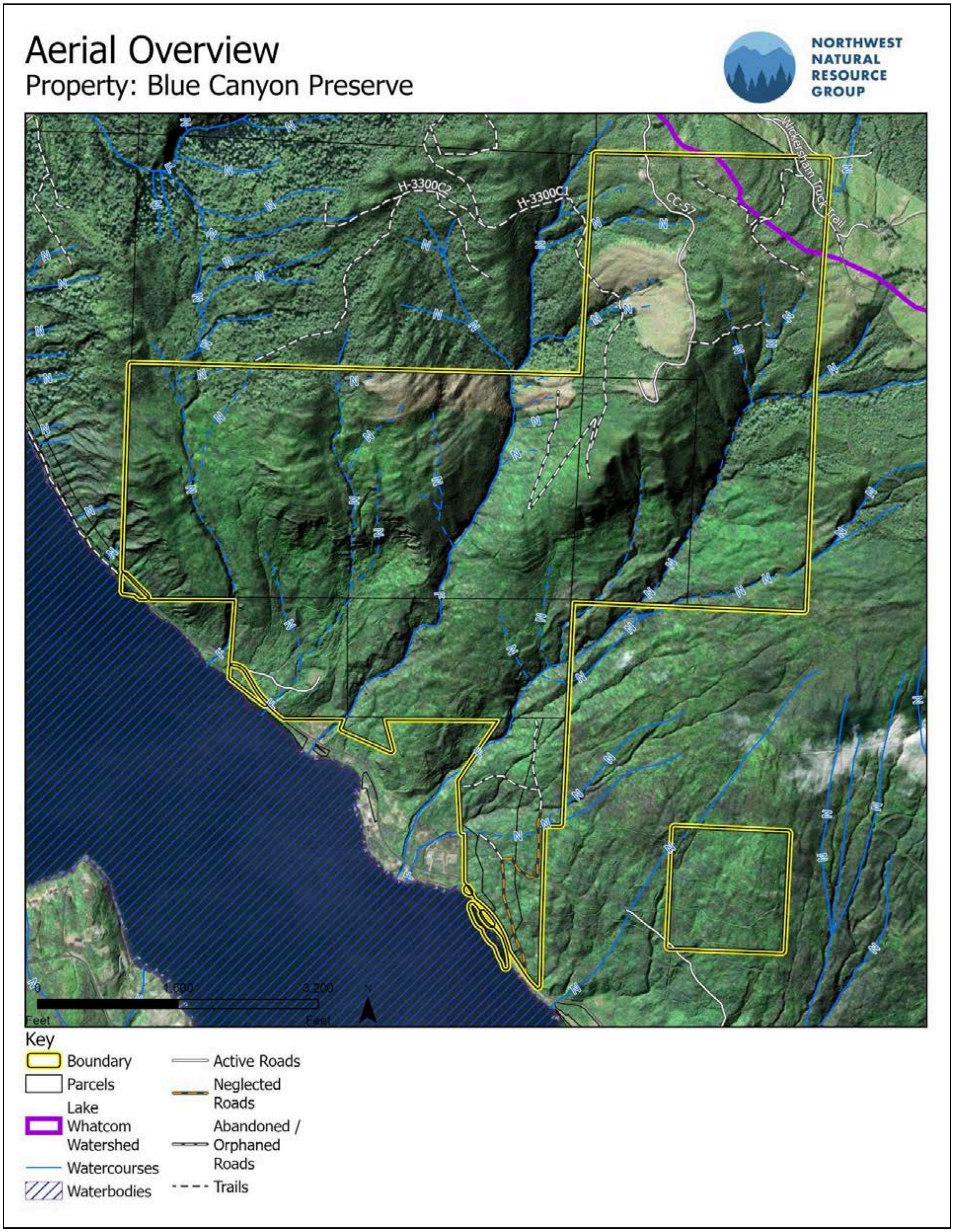
Management History

Most of the forestland at Blue Canyon Preserve was originally logged by early settlers during the late 19th and early 20th century. The Blue Canyon Coal Mine operated on the lower slopes of the property near the lakeshore from 1891 through 1919. A railroad operated by the Bellingham Bay and Eastern Railway (later part of the Northern Pacific Railroad) once transported coal and logs along the east shore of Lake Whatcom in the late 1800s and early 1900s.

Logging started lower on the mountain and in easy-to-access locations, before progressing upslope onto steeper and less accessible terrain. Much of the area was logged out by the 1940s. For a time, post-logging broadcast burning was commonly employed to reduce logging slash, and many older hand-cut stumps bear the mark of these fires. At higher elevations, the stands are younger, frequently cut with power saws, and fire marks are infrequent. The parcels that make up this property came to be owned by private timber companies, including the Nielsen Brothers Inc which purchased the majority of the property in 1990. Subsequent logging operations in the 1990s used helicopter yarding to remove high value timber from the steep inaccessible slopes leading down to Lake Whatcom. This unique style of logging maintained forest cover across much of the property and avoided the creation of an extensive road system on the lower mountain. On the upper ridgeline, accessible stands have been clearcut harvested at periodic intervals since 1990s, leading to the formation of Douglas-fir plantations.

The majority of this property was purchased by the City of Bellingham from Nielsen Brothers Inc. in 2023 and 2025, but a few small parcels on the south side were purchased from other private landowners in 2021 and 2023.

Property Overview Map



Assessment

Topoclimate

The preserve is situated on mostly southwest-facing slopes at elevations ranging from 200 to 2,800 feet. The property is characterized by steep terrain that descends toward the shores of Lake Whatcom, with three main drainages that flow into Lake Whatcom. As part of the last foothills before the larger Cascade Mountains, the area receives higher rainfall than locations west of the lake due to orographic lift. When moist air from the lowlands is forced upward by the rising terrain, it cools and condenses, producing increased precipitation. Upper slopes are cooler and can receive snowfall in winter, while lower elevations near the lake experience milder temperatures year-round. The predominantly southwest-facing slopes create slightly warmer microclimates. During the winter, storm fronts moving inland from the Pacific collide with the upper ridgelines of the preserve, leading to intense winter storms that can deliver large volumes of precipitation in short time spans.

Vegetation Zone

According to vegetation zone maps for North America, the following Ecological Systems were likely present prior to Euro-American settlement. More information on these maps and full descriptions of each system can be found in the discussion of Vegetation Zones in Section 2 of this document.

- North Pacific Hypermaritime Western Red-cedar-Western Hemlock Forest
- North Pacific Maritime Mesic-Wet Douglas-fir-Western Hemlock Forest
- North Pacific Mesic Western Hemlock-Silver Fir Forest

Soils

Data from the USDA Natural Resource Conservation Service (NRCS) Soil Surveys were used to identify the major soil types that underlay this forest, which are described in more detail in the discussion of Soil Productivity in Section 2. Information about specific soil units likely present at this property, including depth, drainage, productivity, and relevant management concerns are listed in the table below. The location of these soil units can be found in the accompanied map packet for this property.

Forest Soil Units Summary Table

Soil Unit	Productivity		Management Concerns					Acres (Pct)
	Site Class	Max Growth	Drought Stress Hazard	Wind Throw Hazard	Mass Wasting Hazard	Logging Rutting Hazard	Logging Compact Hazard	
Andic Xerochrepts-Rock outcrop Complex Ashy Loam on 60-90% Slopes Mod. Deep (24in)	DF-3	143 ft3/ac/yr	High	High	High	High	High	256 (31%)

Soil Unit	Productivity		Management Concerns					Acres (Pct)
	Site Class	Max Growth	Drought Stress Hazard	Wind Throw Hazard	Mass Wasting Hazard	Logging Rutting Hazard	Logging Compact Hazard	
Well Drained								
Squires Series Very Channery Medial Loam on 30-60% Slopes Mod. Deep (30in) Well Drained	DF-2	186 ft3/ac/yr	Mod. High	Medium	High	Low	High	177 (21%)
Revel Series Loam on 30-60% Slopes Mod. Deep (35in) Well Drained	DF-4	114 ft3/ac/yr	Mod. High	High	High	High	High	173 (21%)
Getchell Series Slightly Decomposed Plant Material on 15-30% Slopes Mod. Deep (39in) Moderately Well Drained	WH-4	200 ft3/ac/yr	Low.	High	High	High	Mod.	75 (9%)
Chuckanut Series Gravelly Medial Loam on 15-30% Slopes Deep (56in) Well Drained	DF-2	186 ft3/ac/yr	Mod. High	Low	High	High	Mod.	56 (7%)
Chuckanut Series Gravelly Medial Loam on 30-65% Slopes Deep (56in) Well Drained	DF-2	186 ft3/ac/yr	Mod. High	Low	High	High	Mod.	49 (6%)
Montborne-Rinker Complex Very Channery Medial Silt Loam on 30-60% Slopes Mod. Deep (29in) Moderately Well Drained	DF-3	157 ft3/ac/yr	Low.	Medium	High	Mod.	High	18 (2%)

Slope Stability

As previously described in Section 2, this plan utilizes remotely mapped topographic data as well as hazard zones and historic landslides identified by the State of Washington Department of Natural Resources (DNR) to gauge the likelihood that unstable slopes will be found within a proposed management area. The presence of a mapped hazard zone or historic landslide does not preclude management, but indicates that further investigation is required.

The preserve is characterized by steep terrain, with most slopes exceeding 40% and some reaching over 70%. The steepest terrain is generally near and above stream channels. Several potential hazard zones are present, including rule-identified inner gorges along stream channels and a convergent headwall at the headwaters of the southernmost stream. Additional hazard zones occur on very steep terrain on the west side of the property, including the slopes directly above the shore of Lake Whatcom. Numerous historic landslides and debris flows have been documented across the preserve, including a very large historic deep-seated landslide on the entire southern part of the property that extends farther south beyond the property boundary. The Forest Practices Act identifies the ground-water recharge zone and toes of deep-seated landslides as potentially unstable terrain that must be avoided during forest operations. Additional assessment will need to be conducted before any forest operations are conducted in or near this large historic landslide or any other unstable landforms at this property.

Hydrology

There are three main stream systems within Blue Canyon Preserve, each consisting of a primary channel and associated tributaries. The southernmost system is the largest of the three, and all streams flow south or southwest into Lake Whatcom. According to the DNR's hydrography database, the northernmost stream is non-fish-bearing within the property, the central stream is fish-bearing for nearly its entire length, and the southernmost stream is fish-bearing for approximately 0.3 miles within the preserve. All tributaries to these main streams are non-fish-bearing.

Roads and Access

The preserve can be accessed from the Blue Canyon road along the lakeshore as well as from the top of the ridgeline via the Wickersham Truck Trail. The Wickersham Truck Trail runs from the Chanterelle Trailhead at Lake Whatcom Park down to the town of Acme. From the Wickersham Truck Trail, the active CC-57 road provides access along the upper ridgeline to most of the plantations in this area. The City is maintaining this road and it is drivable for 0.5 miles. Towards the end of the road an abandoned spur runs east providing access into the top of the watershed. In addition, an abandoned spur off the Truck Trail provides additional access to the very northeast corner of the property. The orphaned H-3300C road briefly enters the property's western side but is only accessible from within the nearby Lake Whatcom Park.

There are two access points to preserve property from the Blue Canyon road. At the end of the Blue Canyon Road, a gated forest road leads uphill for one quarter mile to a large clearing that was likely used for helicopter yarding in the past. This road is currently active and in good condition. Closer to the community of Blue Canyon an overgrown road leads uphill into the preserve's southeast corner. This road has not been formally abandoned and drainage culverts are still in place but stream crossings have been removed. Finally, the non-contiguous parcel included in the preserve's south east corner can be accessed from a gated forest road off the Park Road. This road touches the preserve boundary but no roads currently enter this parcel, though lidar imagery suggests there was once an extensive array of yarding roads on this parcel.

Forest roads were assessed to determine their status and suitability for management activities as well as to identify any potential maintenance or design issues. Notable findings of this assessment are summarized below.

Neglected and/or Improperly Abandoned Roads. One road was identified that, having not been officially abandoned, is theoretically "active" but maintenance has been neglected for many years. This road is the unnamed forest road off Blue Canyon Road which accesses the southeast corner of the preserve. This road is currently overgrown. Culverts are still in place along the road bed including some undersized culverts, though stream crossings have been removed. On the abandoned spur in the property's northeast corner, though legally abandoned, water is starting to form minor channels on the roadway which can be easily mitigated.

Existing Orphan Roads. This assessment did not identify any major concern with existing orphan roads that warrant a management recommendation. The only known orphaned road is the H-3300C system which originates in Lake Whatcom Park and was reviewed during the DNR's RMAP process prior to reconveyance.

Drainage Control Issues on Active Roads. Active roads were generally in good shape with a few small issues identified with drainage control structures. These issues include:

- On the active access road off Blue Canyon Road previously used for helicopter yarding, a non-fish-bearing water crossing at the bottom of the road has a partially clogged inlet which could pose a problem in the future.
- On the active CC-57 road along the upper ridgeline, some minor ditch infilling was observed, but otherwise all drainage control structures are in good condition.

Health and Resiliency

Overstocking is the main forest health concern at Blue Canyon Preserve. The upper slopes of the preserve are mostly young Douglas-fir plantations, one of which is currently overstocked. The others are growing at unsustainable densities and overstocking is expected to occur in the near future as the trees get larger. There is also a naturally regenerated stand growing at a very high density of over 600 trees per acre. Much of the property is at a higher risk of drought stress due to the south and southwest facing slopes and overstocking compounds this risk.

Wildlife Habitat

A review of the Washington State Department of Fish and Wildlife Priority Species Database identified Townsend's big-eared bat and myotis bat as having been documented somewhere within the 23,000-acre township containing Agate Bay Preserve. The fish-bearing streams are habitat for cutthroat trout and an area of cliffs and bluffs in the central part of the property is identified as a priority habitat feature.

The preserve supports a mosaic of habitat types that provide diverse wildlife values. Mixed conifer and hardwood stands dominate much of the property, offering structural and species diversity that supports a variety of birds, small mammals, and amphibians. Mature mixed conifer areas and older riparian forests provide larger-diameter trees and downed woody debris that serves as habitat features. Riparian corridors that flow into Lake Whatcom provide cool, shaded microclimates that can be used by amphibians and aquatic species. Younger Douglas-fir plantations offer limited structural diversity and fewer habitat features but have potential to develop greater complexity over time with management.

Wildfire Susceptibility

Fire ignition probability is generally low in the preserve due to a lack of recreational access and limited nearby residential areas. The adjacent properties are primarily forestland, but there are some private residences near the south side. Mixed conifer and hardwood forests are the most abundant forest type at the preserve. These forests are less susceptible to fire because hardwood species have large water-laden leaves and lower content of resin and pitch that makes them less likely to burn in a fire, and their low-density crowns can reduce the chance of a crown fire spreading. Young Douglas-fir plantations on the upper ridgeline present higher susceptibility due to dense stocking and the accumulation of fine fuels that can ignite more readily. Older mixed conifer forests in the Mature-II stage of development have a minor presence at the preserve, and these forests have lower densities, taller crowns, and reduced fuel loads which reduce their susceptibility to high-severity fire. There is road access along the upper ridgeline, but the steep terrain and lack of internal roads or trails across most of the preserve would pose challenges to suppression efforts if a fire were to occur.

Carbon Storage

The property contains a mix of forest types and ages, resulting in variable carbon storage potential. Much of the Douglas-fir was removed from the property when it was helicopter-logged in the 1990s, reducing the carbon storage of these stands. However, these stands generally still have a healthy conifer component which allows them to maintain good carbon storage long term. The hardwood-dominant stands, particularly those composed of red alder, have lower long-term carbon potential because of the species' shorter lifespan. Young Douglas-fir plantations on the property are not currently storing high amounts of carbon, but they have good long-term carbon storage potential. They currently are growing at optimal rates but the densities are not sustainable long term. Thinning these stands as they reach the Stem Exclusion phase will ensure optimal growth rates and carbon sequestration.

Cultural Resources

The Lake Whatcom watershed is a landscape rich with cultural significance for Indigenous peoples—particularly the Lummi Nation and the Nooksack and Swinomish Tribes—who have maintained deep spiritual, cultural, and subsistence connections to the landscape. Although a review of the Washington State Department of Archaeology and Historic Preservation Wisaard online database did not identify any known historical sites on this property and none were encountered while developing this plan, this property has a long history of human use and artifacts may be present. Please see the previous discussion about cultural use practices in the Lake Whatcom Watershed for a more detailed assessment of best management practices moving forward.

Recreation

There is no developed recreation access at the Blue Canyon Preserve and no recreational activities were observed during this assessment.

Recommendations

Roads and Access

This plan recommends the following actions be taken to improve the maintenance and function of the existing road system at Blue Canyon Preserve:

- **Neglected and/or Improperly Abandoned Roads.** The neglected road off Blue Canyon Road should be abandoned after management activities are concluded. At a minimum, culverts should be removed and permanent water bars installed to control drainage, and full restoration would include road grade restoration and reforestation. The abandoned road spur in the property's northeast corner is necessary for future management and while currently in good condition, water bars should be added to the road grade to better remove water from the abandoned roadway.
- **Drainage Control Issues on Active Roads.** Clear out the plugged inlet on the lower access road previously identified. Implement a maintenance plan for ditches, culverts, and road grades to ensure all active roads maintain a high standard of function. See the best management practices identified in Section 2.

Health and Resiliency

Recommendations for addressing observed overstocking are given at the management unit level below.

Wildfire Susceptibility

It is recommended to create shaded fuel breaks within 100 feet of public roads and existing structures which are designed to keep fires on the ground and slow their spread until firefighting resources can arrive. For additional details on implementation, see the description of a shaded fuel break given in the discussion of Wildfire Susceptibility in Section 2 of this document.

Forest Types

Summarized below are the general forest types present at Blue Canyon Preserve and their management recommendations.

Forest Types Summary Table

Forest Type	Acres	Proportion
Conifer Plantation - Small DBH	47	6%
Conifer Plantation - Large DBH	124	15%
Mixed Conifer - Stem Exclusion	76	9%
Mixed Conifer - Stem Exclusion/Mature-I	0	0%
Mixed Conifer - Mature-I	0	0%
Mixed Conifer - Mature-I/II	0	0%
Mixed Conifer - Mature-II	131	16%
Mixed Conifer - Late Seral	0	0%
Mixed Hardwood - Young	21	3%
Mixed Hardwood - Mature	0	0%
Mixed Hardwood - Old	0	0%
Mixed Conifer and Hardwood	422	51%
Unforested	2	0%
Non-Forest	0	0%
Total	**823**	**100%**

Mixed Conifer Stands

Mixed conifer stands are common at Blue Canyon Preserve, representing about 25% of the property. These stands regenerated naturally following clearcut harvests in the last 80 to 120 years. After clearcutting, the forest was left to regenerate naturally, and unlike other stands, no intervening management has occurred. Today, these stands are primarily dominated by a mixture of conifers, primarily Douglas-fir and western hemlock, though western redcedar and western white pine are also present. At one point this forest type was likely the most common forest type at this property before high-grading harvests in the 1990s opened up canopy gaps that became filled with hardwoods and clearcut harvests on the upper ridgelines were replaced with Douglas-fir plantations. These harvests excluded riparian buffer zones around local streams and provide evidence of the pre-logging forest composition.

As previously described in Section 3, the management of mixed conifer stands is best delineated by stand development stage, and recommendations follow the general discussion earlier in this document. For stands in Stem Exclusion, this plan recommends variable density commercial thinning, with priority varying from moderate (level 3) to high (level 1) depending on stocking. Given their generally high priority, when commercial access is not possible, non-commercial thinning should be utilized in the most overstocked stands. This plan recommends variable density thinning in Mature-I stands, but assigns these stands priority varying from low (level 4) to moderate (level 3) depending on stocking. Finally, this plan generally does not recommend management in Mature-II or older stands.

Mixed Conifer and Hardwoods

Mixed conifer and hardwood stands are very common at Blue Canyon Preserve, representing about 51% of the property. These stands primarily formed after high-grading harvests in the 1990s removed high-value Douglas-fir from naturally regenerated second growth mixed conifer forests. This left other conifers, such as cedar and hemlock, and opened up canopy gaps that became dominated by red alder and bigleaf maple.

As previously described in Section 3, the management of these stands can follow either more mixed-conifer recommendations or mixed-hardwood recommendations depending on the proportion of species present, but in well-mixed stands typically focuses on forest health issues. At Blue Canyon Preserve, since these stands are generally in good health, exhibiting high diversity, and growing at sustainable densities, large-scale management is not recommended in most cases.

Plantations

Around 21% of Blue Canyon Preserve forestland are Douglas-fir plantations. These stands are typically third generation forests, having been established after clearcut harvests of the naturally regenerated second growth forests over the last 15 to 40 years. These plantations were established at high densities of primarily Douglas-fir. Unlike other plantations in this management plan, these plantations have been actively managed to produce valuable timber. Pre-commercial thinning operations have maintained Douglas-fir dominance and optimal growing conditions to produce the maximum timber value. As a result, while none of the conifer plantations are currently overstocked, they are growing at unsustainable long-term densities.

A more complete description and assessment of plantation silviculture and recommendations for these stands is provided in Section 3 of this document. Broadly, all plantations at Blue Canyon Preserve require future management interventions to accelerate the transition of these stands towards forests with more complex stand structures, thereby improving resiliency, reducing fire risk, increasing hydrological maturity, and providing additional wildlife habitat. As previously described in Section 3, pre-commercial thinning is recommended in overstocked, small diameter stands and variable density commercial thinning in overstocked, large-diameter stands. Given high-levels of homogeneity and the likelihood that multiple entries are needed to restore forest function, thinning plantations is one of the highest priority management recommendations made in this plan. Broadly, access to these stands is good and thinning can be primarily commercial. Additional details are provided in each management unit below.

Management Units

Forest cover was delineated into the forest management units (FMUs) using both remotely sensed data, historic inventory units, and field inventory data. The forestland within these management units share similar forest characteristics and management recommendations. The forestland at Blue Canyon

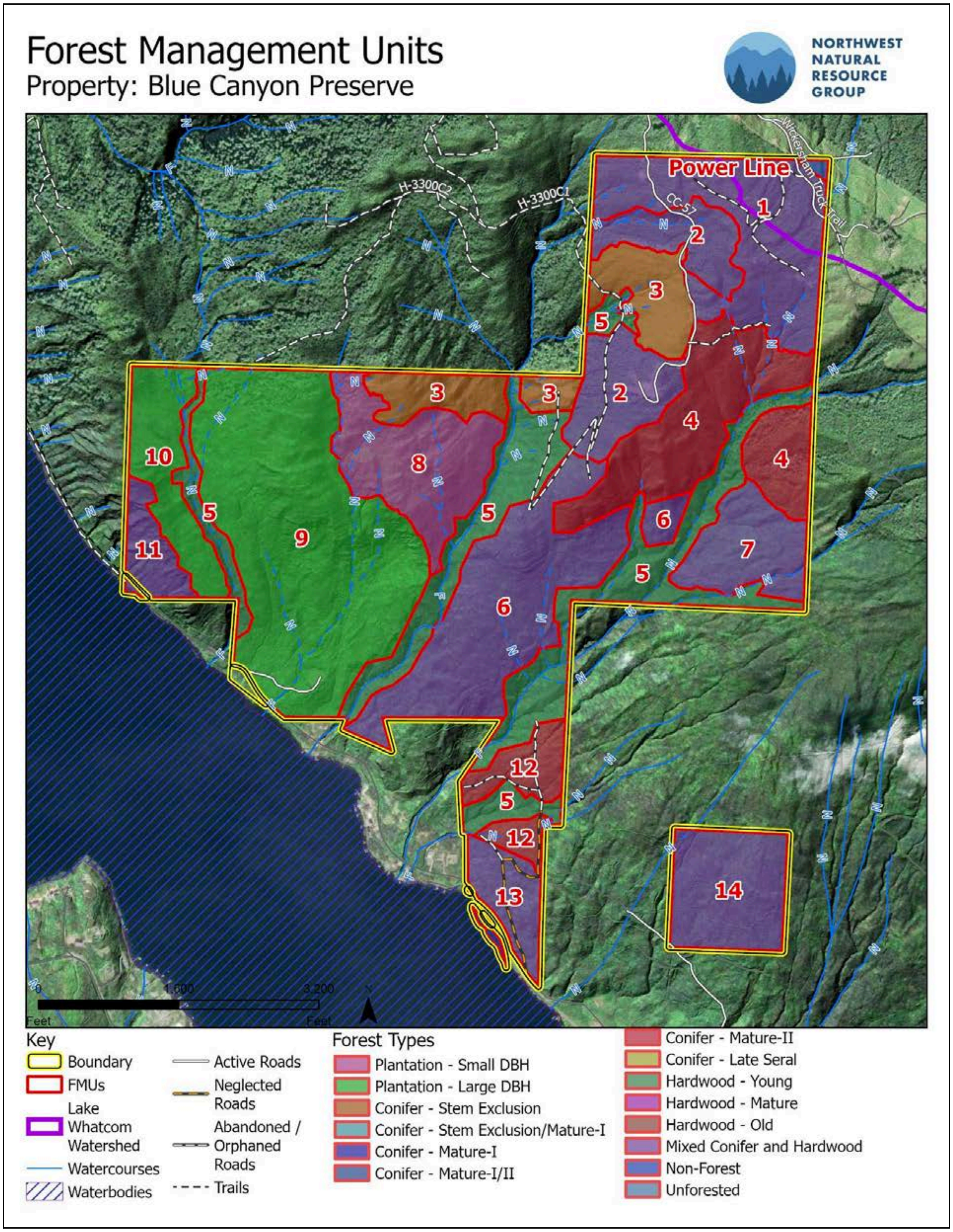
Preserve was inventoried in 2023 as part of an appraisal of forestland owned by Nielsen Brothers Inc during sales negotiations with the City of Bellingham. This dataset and management unit boundaries were used to augment contemporary data collection, especially in units with difficult access. The dataset differs slightly from the current assessment model, as it does not include minimum or maximum DBH, tree height, or midstory tree data. However, the data was sufficient to inform management recommendations. Additional data was collected in accessible units and those requiring additional investigation.

For each FMU, this plan describes the geophysical attributes and forest conditions and assesses the unit against the plans management objectives using the previously described framework by forest type. Recommendations are then given by FMU, typically referencing general recommendations by forest type, but more information is given as needed. Finally, a schedule of management activities by year and FMU is given at the end of this section.

Summary of Forest Management Units

FMU	Acres	Forest Type	Management
1	72	Conifer Plantation - Large DBH	Future Thinning
2	52	Conifer Plantation - Large DBH	Future Thinning
3	47	Conifer Plantation - Small DBH	Future Thinning
4	76	Mixed Conifer - Stem Exclusion	Thinning
5	117	Mixed Conifer - Mature-II	None
6	92	Mixed Conifer and Hardwood	None
7	31	Mixed Conifer and Hardwood	Monitoring
8	52	Mixed Conifer and Hardwood	None
9	157	Mixed Conifer and Hardwood	None
10	32	Mixed Conifer and Hardwood	None
11	14	Mixed Conifer - Mature-II	None
12	21	Mixed Hardwood - Young	Thinning and Underplanting
13	18	Mixed Conifer and Hardwood	None
14	40	Mixed Conifer and Hardwood	None
Power Line	1	Unforested	Not Applicable
Total	**823**		

Map of Forest Management Units



FMU 1 - Conifer Plantation - Large DBH

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	DF	238	111	220	45	6	10	14	40
		WH	70	31	49		4	8	12	40
	All	All	308	142	269		4	9	14	40
Total	All	All	308	142	269	45	4	9	14	40

Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.

This FMU is located at the upper elevations of the property in the northeast corner. It has mild to moderate south- and west-facing slopes and a soil productivity rating of site class IV. The stand was clearcut around 2006 and replanted with Douglas-fir, but some western hemlock has also naturally regenerated. Total stocking is approximately 308 TPA. The overstory is primarily composed of western hemlock and Douglas-fir. Overstory Douglas-fir average 10 inches DBH and 40 ft tall, and hemlock average 8 inches DBH and 40 ft tall. No midstory is currently present in this stand. This stand was pre-commercially thinned in the last few years, which opened up the canopy. The current stocking levels will not be sustainable long term, however, and per the earlier discussion of Douglas-fir plantations, a two-part sequence of variable density thinning is recommended starting in 10-15 years, and potential underplanting once density has been sufficiently reduced. This unit is accessible off the Wickersham Truck Trail via an unnamed abandoned road. The road is in good condition, and while needing some minor modifications to prevent surface erosion, can be easily restored to working condition for future operations.

FMU 2 - Conifer Plantation - Large DBH

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	DF	330	210	374	72	6	11	18	70
Total	All	All	330	210	374	72	6	11	18	70

Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.

This FMU consists of two areas on the north side of the property along the upper ridgeline. Both areas have moderate to steep west-facing slopes and a soil productivity rating of site class IV. The southern area was clearcut around 1997 and the northern area was clearcut around 1999. Both areas were replanted with Douglas-fir. Total stocking is approximately 380 TPA. The overstory is primarily composed of Douglas-fir that average 11 inches DBH and 70 ft tall. No midstory is currently present in this stand. This plantation is overstocked and currently in the Stem Exclusion phase of development. Per the earlier discussion of overstocked plantations, a two-part sequence of variable density thinning is recommended starting in 5-10 years, and potential underplanting once density has been sufficiently reduced. The stand is currently accessible from the Wickersham Truck Trial via the CC-57 road. Most of the slopes are moderate enough to enable ground-based commercial thinning activities.

FMU 3 - Conifer Plantation - Small DBH

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Avg HT
Overstory	Major	DF	380	33	87	17	5
Total	All	All	380	33	87	17	5

Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.

This FMU consists of three separate areas on the north side of the stand that were recently clearcut harvested. The westmost two areas were clearcut in 2020 and lie on either side of a stream that was buffered during the harvest. The terrain is moderate to steep east- and west-facing slopes and the soil productivity rating ranges from site class II to III. The eastmost area was clearcut in 2018 and contains moderate to steep west-facing slopes. It has a soil productivity rating of site class IV. Total stocking is approximately 380 TPA. The overstory is primarily composed of Douglas-fir that average 1-2 inches DBH and 5 ft tall. This young Douglas-fir plantation is in the early seral phase of development, so no immediate management is recommended but the current stocking levels will not be sustainable long term. Per the earlier recommendation of small-diameter Douglas-fir plantations, an initial pre-commercial thinning is recommended in 10-15 years, followed by a two-part sequence of variable density thinnings in the future, and potential underplanting once density has been sufficiently reduced. The eastmost area is currently accessible from the Wickersham Truck Trial via the CC-57 road and the westmost areas have no current road access.

FMU 4 - Mixed Conifer - Stem Exclusion

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	DF	163	74	219	99	8	12	18	74
		RC	138	55	113		4	9	24	76
		WH	289	170	315		4	10	16	68
	Minor	WP	38	12	80		12	16	24	80
	All	All	628	312	726		4	11	24	72
Midstory	Major	RC	42	6	10	2	2	4	6	20
		WH	42	6	10		2	4	6	20

	All	All	84	12	19		2	4	6	20
Total	All	All	712	324	746	101	2	10	24	66

Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.

This FMU consists of two areas on either side of a stream on the east side of the property. It has mostly steep southeast- and west-facing terrain and a soil productivity rating of site class IV. The exact history of this FMU is unknown, but historical aerial imagery suggests it was clearcut around the 1970s. It was likely replanted with Douglas-fir, but several other species filled in naturally. Total stocking is approximately 712 TPA. The overstory contains approximately 628 TPA and is primarily composed of western hemlock, Douglas-fir and western redcedar, with a small component of western white pine. Overstory Douglas-fir average 12 inches DBH and 74 ft tall, redcedar average 9 inches DBH and 76 ft tall, and hemlock average 10 inches DBH and 68 ft tall. The midstory contains approximately 84 TPA and is primarily composed of western hemlock and western redcedar that both average 4 inches DBH and 20 ft tall. This mixed conifer stand is severely overstocked in the Stem Exclusion phase. Per the earlier discussion of this forest type, a sequence of variable density thinnings is recommended. The stand is currently accessible from the Wickersham Truck Trial via the CC-57 road and an unnamed abandoned road spur leading east. The steep terrain will likely require cable-yarding for commercial operations. The presence of a large, historical deep-seated landslide downslope of this unit will require further assessment and possibly much of this unit will be considered unsuitable for forest operations.

FMU 5 - Mixed Conifer - Mature-II

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	DF	96	208	340	74	12	22	36	5
	All	All	120	260	391		12	21	36	5
Midstory	Major	RC	40	30	40	10	6	10	16	60
		WH	40	30	40		6	10	16	60
	All	All	80	60	80		6	10	16	60
Total	All	All	200	320	471	82	6	16	36	27

Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.

This FMU represents various riparian areas across the property that were buffered during the various harvest activities that occurred throughout the property in the last 50 years. The slopes of these areas are generally steep and southwest-facing, and the soil productivity rating ranges from site class II to IV. In general, they consist of second-growth forests likely following an original clearcut harvest in the early 1900s. Total stocking is approximately 200 TPA. The overstory contains approximately 120 TPA and is primarily composed of Douglas-fir that average 22 inches DBH and 5 ft tall. The midstory contains approximately 80 TPA and is primarily composed of western hemlock and western redcedar that both average 10 inches DBH and 60 ft tall. Red alder likely used to be more dominant in the riparian areas, but has experienced age-related decline. The mixed conifer forests in these riparian areas are in the Mature-II phase of development, with well-established midstory and understory cohorts. Per the earlier recommendations of forests in the stage and the unit's locations in riparian zones, no management activities are recommended.

FMU 6 - Mixed Conifer and Hardwood

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Avg DBH
Overstory	Major	WH	49	33	58	37	11
	Minor	RA	27	19	34		12
		RC	27	71	95		22
		BM	16	27	40		18
		DF	13	15	24		14
	Total	All	138	169	257		15
Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.							

This FMU is located in the central area of the property on mostly moderate southwest-facing slopes. The soil productivity rating ranges from site class II to III. The stand was helicopter-logged in the 1990s, removing most of the high value Douglas-fir. Assessment of this stand is based on 2023 inventory data, as the stand was not revisited due to limited accessibility. Total overstory stocking is approximately 138 TPA. The overstory is primarily composed of western hemlock, with small components of red alder, western redcedar, bigleaf maple, and Douglas-fir. Hemlock average 11 inches DBH. This stand is mixed in composition and growing at healthy stocking levels. This unit is also on slopes that include hazard zones and historic landslide activity. For these reasons, no management is recommended in this unit. There is no current road access to this stand.

FMU 7 - Mixed Conifer and Hardwood

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Avg DBH
Overstory	Major	RA	108	65	117	38	11
	Minor	RC	19	46	63		21
		BM	13	9	16		12
	Total	All	151	148	232		15
Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.							

This FMU is located in the southeast corner of the property. It has mostly moderate west-facing slopes and a soil productivity rating that ranges from site class II to III. The stand was helicopter-logged in the 1990s, removing most of the high value Douglas-fir. Assessment of this stand is based on 2023 inventory data, as the stand was not revisited due to limited accessibility. Total overstory stocking is approximately 151 TPA. The overstory is primarily composed of red alder that average 11 inches DBH, with a small component of western redcedar and bigleaf maple. While this unit contains a mix of conifer and hardwood species, red alder is the dominant species. The alder is expected to live for at least another 25-30 years so there is no concern about forest cover in the near future, and regeneration is expected to occur given the conifer seed sources in the stand. Monitoring is still recommended in 25-30 years to ensure that there is regeneration as the red alder begins to decline, allowing for a successful transition from the short-lived hardwoods to long-lived conifers. There is no current road access to this stand.

FMU 8 - Mixed Conifer and Hardwood

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Avg DBH
Overstory	Major	WH	44	49	77	38	14
		RC	24	52	73		20
	Minor	RA	18	26	39		16
		BM	11	26	35		21
	Total	All	105	180	260		17
Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.							

This FMU is located in the central part of the property on moderate to steep southwest- and southeast-facing slopes. The soil productivity rating ranges from site class II to III. The stand was helicopter-logged in the 1990s, removing most of the high value Douglas-fir. Assessment of this stand is based on 2023 inventory data, as the stand was not revisited due to limited accessibility. Total overstory stocking is approximately 87 TPA. The overstory is primarily composed of red alder and bigleaf maple, with small components of Douglas-fir and western hemlock. Alder average 10 inches DBH and bigleaf maple average 12 inches DBH. While this stand is missing the presence of Douglas-fir due to the logging, its resilience is improved by the presence of several other species. As a mixed conifer and hardwood forest with healthy stocking, no management activities are recommended. There is no current road access to this stand.

FMU 9 - Mixed Conifer and Hardwood

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Avg DBH
Overstory	Major	RC	32	44	68	44	16

		RA	32	31	51		13
		WH	30	29	48		13
	Minor	DF	27	43	64		17
		BM	24	33	51		16
	Total	All	147	183	283		15
Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.							

This FMU is located on the west side of the property near the shoreline of Lake Whatcom. It has moderate to steep southwest facing slopes and a soil productivity rating that ranges from site class II to III. The stand was helicopter-logged in the 1990s, removing most of the high value Douglas-fir. Assessment of this stand is based on 2023 inventory data, as the stand was not revisited due to limited accessibility. Total overstory stocking is approximately 147 TPA. The overstory is primarily composed of western redcedar, red alder, and western hemlock, with small components of Douglas-fir and bigleaf maple Redcedar average 16 inches DBH, alder average 13 inches DBH, and hemlock average 13 inches DBH. This stand is mixed in composition and growing at healthy stocking levels. This unit is also on slopes that include hazard zones and historic landslide activity. For these reasons, no management is recommended in this unit. The bottom of this unit can be accessed via the active forest road at the end of Blue Canyon Road but much of the unit is not accessible by road.

FMU 10 - Mixed Conifer and Hardwood

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Avg DBH
Overstory	Major	RA	34	20	36	19	10
		BM	25	20	34		12
	Minor	DF	12	8	14		11
		WH	11	12	19		14
	Total	All	87	72	120		13
Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.							

This FMU is located on the west side of the property near the shoreline of Lake Whatcom. It has mostly moderate southeast facing slopes and a soil productivity rating that ranges from site class II to III. The stand was helicopter-logged in the 1990s, removing most of the high value Douglas-fir. Assessment of this stand is based on 2023 inventory data, as the stand was not revisited due to limited accessibility. Total overstory stocking is approximately 87 TPA. The overstory is primarily composed of red alder and bigleaf maple, with small components of Douglas-fir and western hemlock. Alder average 10 inches DBH and bigleaf maple average 12 inches DBH. This stand is mixed in composition and growing at healthy stocking levels. No management activities are recommended. There is no current road access to this stand.

FMU 11 - Mixed Conifer - Mature-II

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	DF	32	96	130	56	12	24	32	160
	Minor	BM	16	48	41		10	18	24	160
		RC	16	48	41		10	18	24	160
	All	All	80	240	326		10	23	> 48	160
Midstory	Major	DF	30	10	21	7	4	8	12	60
		RC	30	10	21		4	8	12	60
	All	All	60	20	42		4	8	12	60
Total	All	All	140	260	367	62	4	17	> 48	117

Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.

This FMU is located on the west side of the property near the shore of Lake Whatcom. It has very steep southwest-facing slopes and a soil productivity rating of site class IV. The exact history of the site is unknown, but no evidence of logging activity was observed, indicating that the stand likely originated following a wildfire over 200 years ago based on the presence of scattered old growth trees. It was likely not logged due to the very steep terrain. The 2023 Blue Canyon Fire burned through parts of this stand at varying intensities. While the fire primarily operated as a surface-fire, prevalent ladder fuels did enable the fire to occasionally enter the canopy, scorching and killing some trees. Given the lower densities of this stand these crown fire events were not sustained and fire severity was low to moderate across much of the fire. While many smaller diameter trees died in this blaze, most of the medium to large-sized trees are still alive two years later and ground-cover has re-established in many areas.

Assessment data was collected in unburned areas of the stand. Here total stocking is approximately 140 TPA. The overstory contains approximately 80 TPA and is primarily composed of Douglas-fir, with small components of bigleaf maple and western redcedar. Overstory Douglas-fir average 24 inches DBH and 160 ft tall. The midstory contains approximately 60 TPA and is primarily composed of Douglas-fir and western redcedar that both average 8 inches DBH and 60 ft tall. This is a mixed conifer forest in the Mature-II phase of development with a well-established midstory cohort. The recent wildfire did not cause a significant disturbance to this stand, as much of the overstory survived. Regeneration is expected to occur with time in patches of high mortality due to the presence of seed sources throughout the stand, so there is no concern about future forest cover and no management activities are recommended. There is no current road access to this stand.

FMU 12 - Mixed Hardwood - Young

Stand Composition Summary

Canopy	Cohort	Species	TPA	BAA	SDI	RD	Min	Avg	Max	Avg

Position	Type						DBH	DBH	DBH	HT
Overstory	Major	RA	204	60	90	34	4	6	10	60
	Minor	BM	68	20	48		4	8	14	60
		CW	68	20	48		4	8	14	60
	All	All	340	100	185		4	7	14	60
Total	All	All	340	100	185	34	4	7	14	60

Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.

This FMU is located on the southern tip of the property near the shore of Lake Whatcom. It has mostly moderate southwest-facing slopes and a soil productivity rating that ranges from site class II to III. This unit originated after a clearcut harvest in 1990. A Douglas-fir plantation was likely started here following the clearcut but has failed across much of the site and the site is dominated by naturally regenerated hardwoods. Total stocking is approximately 340 TPA. The overstory is primarily composed of red alder, with small components of bigleaf maple and black cottonwood. Overstory red alder average 6 inches DBH and 60 ft tall. No midstory is currently present in this stand, and very little regeneration is occurring.

Per the earlier discussion of young hardwood dominated stands, the primary concern is ensuring conifer establishment and long-term forest cover. Given the current small diameter of the hardwoods, this plan recommends pre-commercial thinning followed by underplanting of shade-tolerant conifers to ensure long-term forest cover. The southern portion of this unit can be accessed via the neglected road leading off Blue Canyon Road, but since water crossings have been pulled, access to the northern portion of the unit is limited, though field crews should be able to cross the gully with some effort.

FMU 13 - Mixed Conifer and Hardwood

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	BM - Cohort 1	45	60	116	62	12	18	30	120
		CW	45	60	116		12	18	30	120
	Minor	BM - Cohort 2	12	16	8		4	8	12	60
		PB	12	16	8		4	8	12	60
		RA	12	16	8		4	8	12	60
		RC	27	36	69		12	18	30	120
		WH	27	36	69		12	18	30	120
	All	All	180	240	395		4	16	30	120
Total	All	All	180	240	395	62	4	16	30	120

Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.

This FMU is located on the southern tip of the property near the shore of Lake Whatcom. It has mostly moderate southwest-facing slopes and a soil productivity rating that ranges from site class II to III. It is estimated that the site was high-grade harvested in the 1990s, which removed the high-value conifers. Hardwood species were left as well as some western redcedar and western hemlock. Where trees were removed, several hardwood species regenerated which now make up a younger cohort of the overstory. Total stocking is approximately 180 TPA. The overstory is primarily composed of black cottonwood and bigleaf maple, with small components of paper birch, red alder, western redcedar and western hemlock. Overstory maple average 18 inches DBH and 120 ft tall, and cottonwood average 18 inches DBH and 120 ft tall. No midstory is currently present in this stand. This stand is mixed in composition and growing at healthy stocking levels. While the high-grading removed many of the conifers, the presence of retained redcedar and hemlock ensures that there is a nearby seed source. Some redcedar is already regenerating on the site and more regeneration is expected with time. No management activities are recommended. This unit can be accessed via the neglected road leading off Blue Canyon Road that winds through this unit.

FMU 14 - Mixed Conifer and Hardwood

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Avg DBH
Overstory	Major	RA	57	32	50	34	9
	Minor	DF	21	41	58		19
		BM	18	36	51		19
		RC	16	24	36		17
	Total	All	117	142	209		16

Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.

This FMU represents the square parcel on the south side that is separate from the rest of the property. It has mostly moderate southwest-facing slopes and a soil productivity rating of site class III. The exact history of this FMU is unknown, but historical aerial imagery suggests it was clearcut around the 1970s. It was likely replanted with Douglas-fir, but survival was low and several other species naturally regenerated. Assessment of this stand is based on 2023 inventory data, as the stand was not revisited due to limited accessibility. Total overstory stocking is approximately 117 TPA. The overstory is primarily composed of red alder, with small components of Douglas-fir, western redcedar, and bigleaf maple. Alder average 9 inches DBH. This stand is mixed in composition and growing at healthy stocking levels. While the composition is more dominant to red alder, the species is expected to live for at least another 30 years so there is no concern about forest cover in the near future. For these reasons, no management is recommended. An unnamed gated forest road off Park Road provides access to the corner of this stand and was recently used to harvest an adjacent property.

Management Activity Schedule

Timeline	Activity	Priority	FMU	Prescription
2025 to 2030	Thinning (CT / NCT)	1	4	Thin to an interim target density of 250 to 300 TPA.
	Thinning (PCT)	2	12	Pre-commercially thin to a target density of 150 to 200 TPA.
	Planting	2	12	Underplant with 150-250 TPA of shade-tolerant conifers suitable to site conditions.
2030 to 2035	Thinning (CT / NCT)	1	2	Thin to an initial target density of 140 to 170 TPA.
2035 to 2040	Thinning (PCT)	1	3	Pre-commercially thin to a target density of 250 to 300 TPA.
	Thinning (CT / NCT)	1	1	Thin to an initial target density of 140 to 170 TPA.
		2	4	Thin to an initial target density of 140 to 170 TPA within 10-15 years after the last thinning entry.
2045 to 2050	Thinning (CT / NCT)	1	3	Thin to an initial target density of 140 to 170 TPA within 10-15 years after the last thinning entry.
		2	2	Thin to a final target density of 80 to 110 TPA within 15-20 years after the last thinning entry.
	Planting	3	2	Underplant after thinning with 150 TPA shade-tolerant conifers suitable to site conditions or wait 5-10 years and assess natural regeneration, planting if necessary.
2050 to 2055	Thinning (CT / NCT)	2	1	Thin to a final target density of 80 to 110 TPA within 15-20 years after the last thinning entry.
		3	4	Evaluate the stand for a second thinning and, if necessary, thin to a final target density 80 to 110 TPA within 15-20 years after the last thinning entry.
	Planting	3	1	Underplant after thinning with 150 TPA shade-tolerant conifers suitable to site conditions or wait 5-10 years and assess natural regeneration, planting if necessary.
		4	7	Monitor the stand for natural regeneration and, if necessary, underplant with 150-250 TPA of shade-tolerant conifers suitable to site conditions.
2055 to 2060	Thinning (CT / NCT)	2	3	Thin to a final target density of 80 to 110 TPA within 10-15 years after the last thinning entry.

Timeline	Activity	Priority	FMU	Prescription
	Planting	3	3	Underplant after thinning with 150 TPA shade-tolerant conifers suitable to site conditions or wait 5-10 years and assess natural regeneration, planting if necessary.
Notes: PCT - Pre-commercial Thinning, CT - Commercial Thinning, NCT - Non-commercial Thinning. Priority Levels: 1 - High, 2 - Moderately High, 3 - Moderate, 4 - Low. Additional thinning and planting considerations are identified in Section 1 of this document as well as in the FMU-specific section above.				

Parcel Table

Owner	Parcel ID	Year Acquired	Previous Owner
City	3704140640640000	2025	Nielsen Brothers Inc
City	3704141980700000	2025	Nielsen Brothers Inc
City	3704154530480000	2025	Nielsen Brothers Inc
City	3704222055110000	2025	Nielsen Brothers Inc
City	3704223334160000	2023	Timberline Logging Inc
City	3704224265080000	2025	Nielsen Brothers Inc
City	3704224582300000	2021	Private
City	3704224742850000	2021	Private
City	3704225182500000	2021	Private
City	3704231951970000	2023	Nielsen Brothers Inc

Brannian Creek Preserve

Overview

Site Description

Brannian Creek Preserve is a 64-acre property owned by the City of Bellingham on the south side of Lake Whatcom. It is located along Camp 2 Road on the western fork of Brannian Creek.

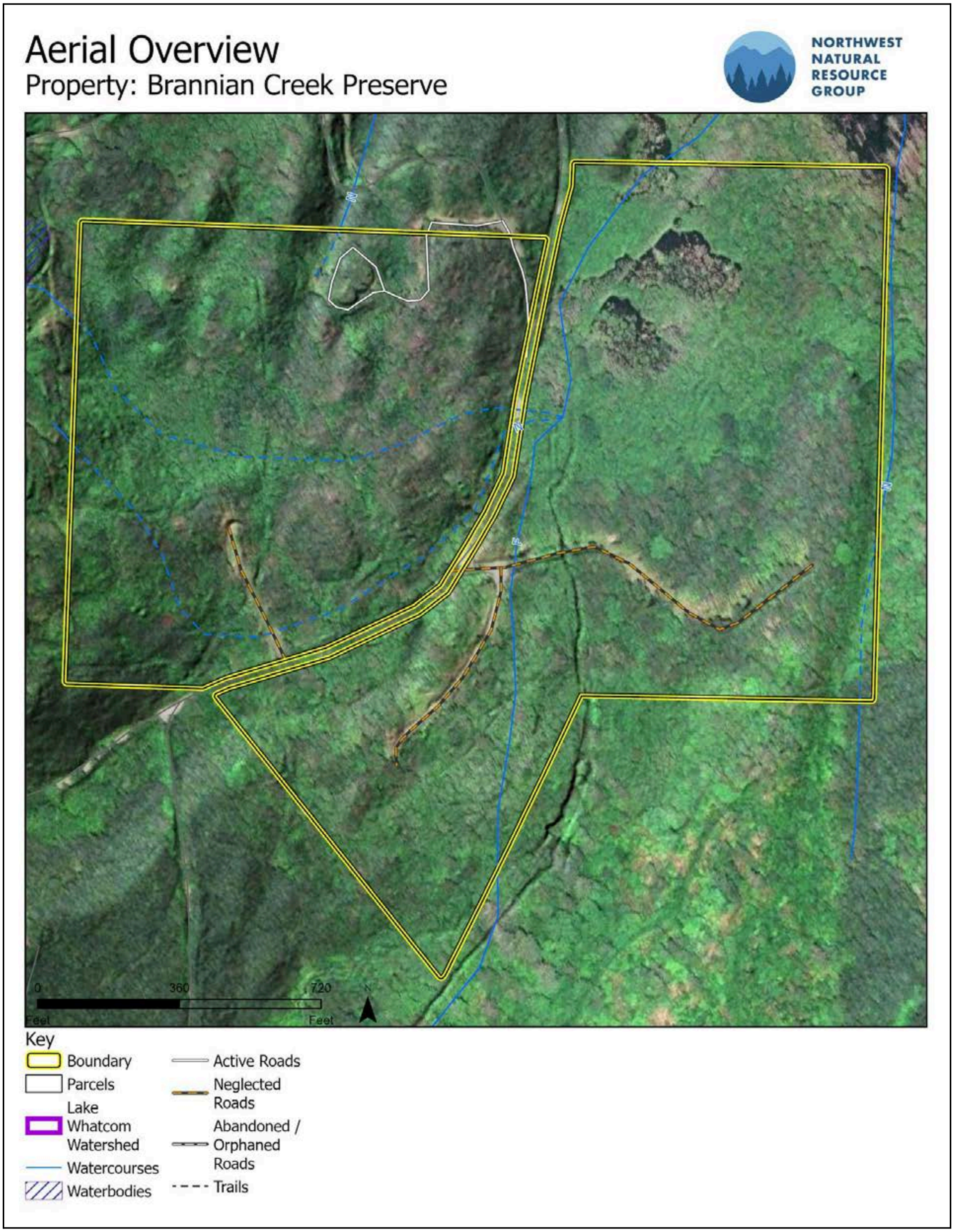
Property Information

This forest is located in Section 33, Township 37N, Range 04E of the US Public Land Survey System and includes one parcel that is listed in the table at the end of this section.

Management History

The original forestland at the preserve was likely clearcut harvested sometime in the late 19th or early 20th century. The exact land use history in the intervening years is unclear, but the City of Bellingham purchased the property in 2023 from Nielsen Brothers inc. It was previously managed as commercial timberland and most of the property was last harvested around 1980.

Property Overview Map



Assessment

Topoclimate

The preserve's mostly flat terrain contributes to relatively uniform temperature and moisture conditions across much of the site, with limited variation in solar exposure. There are some moderate east-facing slopes on the west side of the preserve that receive less afternoon sun, resulting in slightly cooler and moister microclimates. The presence of several streams and a pond also create slightly cooler microclimatic conditions in adjacent areas, particularly in the warmer summer months.

Vegetation Zone

According to vegetation zone maps for North America, the following Ecological Systems were likely present prior to Euro-American settlement. More information on these maps and full descriptions of each system can be found in the discussion of Vegetation Zones in Section 2 of this document.

- North Pacific Seasonal Sitka Spruce Forest
- North Pacific Lowland Riparian Forest and Shrubland

Soils

Data from the USDA Natural Resource Conservation Service (NRCS) Soil Surveys were used to identify the major soil types that underlay this forest, which are described in more detail in the discussion of Soil Productivity in Section 2. Information about specific soil units likely present at this property, including depth, drainage, productivity, and relevant management concerns are listed in the table below. The location of these soil units can be found in the accompanied map packet for this property.

Forest Soil Units Summary Table

Soil Unit	Productivity		Management Concerns					Acres (Pct)
	Site Class	Max Growth	Drought Stress Hazard	Wind Throw Hazard	Mass Wasting Hazard	Logging Rutting Hazard	Logging Compact Hazard	
Sehome Series Medial Loam on 8-15% Slopes Mod. Deep (26in) Moderately Well Drained	DF-2	186 ft3/ac/yr	Mod. High	Medium	High	High	Mod.	31 (48%)
Barneston Series Very Gravelly Ashy Loam on 0-8% Slopes Somewhat Excessively Drained	DF-3	157 ft3/ac/yr	High	Low	Low	Low	Mod.	20 (31%)

Soil Unit	Productivity		Management Concerns					Acres (Pct)
	Site Class	Max Growth	Drought Stress Hazard	Wind Throw Hazard	Mass Wasting Hazard	Logging Rutting Hazard	Logging Compact Hazard	
Shalcar-Fishtrap Undifferentiated group Muck on 0-2% Slopes Very Poorly Drained	RA-4	86 ft3/ac/yr	Low.	High	Low	High	High	6 (9%)
Sehome Series Medial Loam on 30-60% Slopes Mod. Deep (26in) Moderately Well Drained	DF-2	186 ft3/ac/yr	Mod. High	Medium	High	High	Mod.	4 (6%)
Wickersham Series Channery Ashy Silt Loam on 0-8% Slopes Mod. Deep (21in) Well Drained	DF-2	186 ft3/ac/yr	Low.	Low	Low	High	Mod.	2 (3%)
Squires Series Very Channery Medial Loam on 30-60% Slopes Mod. Deep (30in) Well Drained	DF-2	186 ft3/ac/yr	Mod. High	Medium	High	Low	High	2 (2%)

Slope Stability

As previously described in Section 2, this plan utilizes remotely mapped topographic data as well as hazard zones and historic landslides identified by the State of Washington Department of Natural Resources (DNR) to gauge the likelihood that unstable slopes will be found within a proposed management area. The presence of a mapped hazard zone or historic landslide does not preclude management, but indicates that further investigation is required.

The preserve is mostly flat with moderate slopes on the west side that are mostly less than 40%. A historic landslide has been documented on the northwest side of the property that extended to the upper slopes outside of the property. There are no hazard zones within the preserve.

Hydrology

The preserve contains the western fork of Brannian Creek that flows through the center of the preserve and through a wetland on the north side. This stream is identified as fish-bearing by the DNR's hydrography database. It flows north and eventually merges with the main fork of Brannian Creek before flowing into Lake Whatcom. Two additional non-fish-bearing streams flow down the slopes on the west side of the preserve and into the western fork.

Roads and Access

The publicly accessible Camp 2 Road runs through the center of the preserve. Prior to purchase by the City, the previous owner constructed three short road segments to facilitate future harvest activities. Two of these provide access to the west of the Camp 2 road and one to the east. One of the western spurs is now neglected, mostly overgrowth with red alder and Himalayan blackberry, while the other spur on the property's northern boundary is still drivable. In the center of the property, a spur road provides access into the eastern portion of this property and includes a bridge to cross Brannian Creek. No concerns were noted on the neglected roads during this assessment.

Health and Resiliency

Forest health concerns on the property include bark beetle infestation and overstocking. A major bark beetle infestation has caused significant mortality of the young Douglas-fir plantation at this site. This infestation was not noted during the 2023 appraisal of this property and appears to have occurred within the last two years. Mortality is at least 50% in many locations but probably averages closer to 35-40% across the entire plantation. Because the affected trees are below 10 inches in diameter, this infestation may be the Douglas-fir Pole or Engraver beetles, which prefer smaller diameter trees, but could also be the more common Douglas-fir beetle. Both species have been identified in the nearby vicinity by DNR aerial forest health surveys. In either case, the infestation has likely already peaked and while mortality will continue to occur, the infestation is expected to taper over the next two to three years.

The Douglas-fir stands were overstocked before the outbreak, so the beetles have naturally reduced density of these areas, and there is currently still sufficient forest cover. The mature hardwood stands on the property are overstocked and have a persistent shrub layer which is preventing the successful establishment of conifer species. As the short-lived hardwood species begin to decline over time, the lack of conifer regeneration could pose a concern for maintaining long-term forest cover in this area.

Wildlife Habitat

A review of the Washington State Department of Fish and Wildlife Priority Species Database identified Townsend's big-eared bat and myotis bat as having been documented somewhere within the 23,000-acre township containing Brannian Creek Preserve. The wetland is identified as a priority area for aquatic habitat.

The bark beetle outbreak has created numerous snags that contribute to wildlife habitat, though most are relatively small, and large downed wood is limited across the property. The more open canopy resulting from ongoing tree mortality will allow for increased shrub growth in the understory, providing important forage for wildlife. The hardwood stands also support a diverse shrub layer. Additionally, the wetland and stream systems on the property offer valuable habitat for aquatic and riparian species.

Wildfire Susceptibility

Overall ignition probability at the preserve is low due to being primarily surrounded by forestland and the limited public access. The numerous dead trees left behind by bark beetle outbreak have increased fuel loads in the short-term. The areas in the preserve dominated by hardwoods, however, are less susceptible to fire due to the higher moisture content and lower resin levels in hardwoods. Access for firefighting is good, with Camp 2 Road and existing forest roads providing potential entry routes if needed.

Carbon Storage

The Douglas-fir snags that are abundant on the property are no longer sequestering carbon, but they will continue to store it for many years. The stands were overstocked prior to the beetle outbreak, so the surviving trees now have more resources available, which can increase their growth rates and carbon sequestration potential. Douglas-fir that survive the outbreak also have high carbon storage potential due to their long lifespan. Hardwood-dominated areas currently store less carbon, but establishing conifers in the understory to replace these short-lived hardwoods over time would increase the carbon storage potential of these areas.

Cultural Resources

The Lake Whatcom watershed is a landscape rich with cultural significance for Indigenous peoples—particularly the Lummi Nation and the Nooksack and Swinomish Tribes—who have maintained deep spiritual, cultural, and subsistence connections to the landscape. Although a review of the Washington State Department of Archaeology and Historic Preservation Wisaard online database did not identify any known historical sites on this property and none were encountered while developing this plan, this property has a long history of human use and artifacts may be present. Please see the previous discussion about cultural use practices in the Lake Whatcom Watershed for a more detailed assessment of best management practices moving forward.

Recreation

There is no developed recreational access at the Brannian Creek Preserve.

Recommendations

Roads and Access

The two neglected and one active road segments at this property will be useful for future management activities. Given the flat topography they present little maintenance challenge but should be monitored periodically. Implement a maintenance plan for ditches, culverts, and road grades to ensure all active roads maintain a high standard of function. See the best management practices identified in Section 2.

After management activities have concluded all road segments can be abandoned. At a minimum, culverts and bridges should be removed and permanent water bars installed to control drainage, and full restoration would include road grade restoration and reforestation.

Health and Resiliency

Recommendations for addressing the observed bark beetle infestation and overstocking are given at the management unit level below.

Wildfire Susceptibility

Shaded fuel breaks are recommended within 100 feet of public roads and existing structures which are designed to keep fires on the ground and slow their spread until firefighting resources can arrive. For additional details on implementation, see the description of a shaded fuel break given in the discussion of Wildfire Susceptibility in Section 2 of this document.

Forest Types

All recommendations for this property follow the previous discussion of forest-types and are discussed by management unit below.

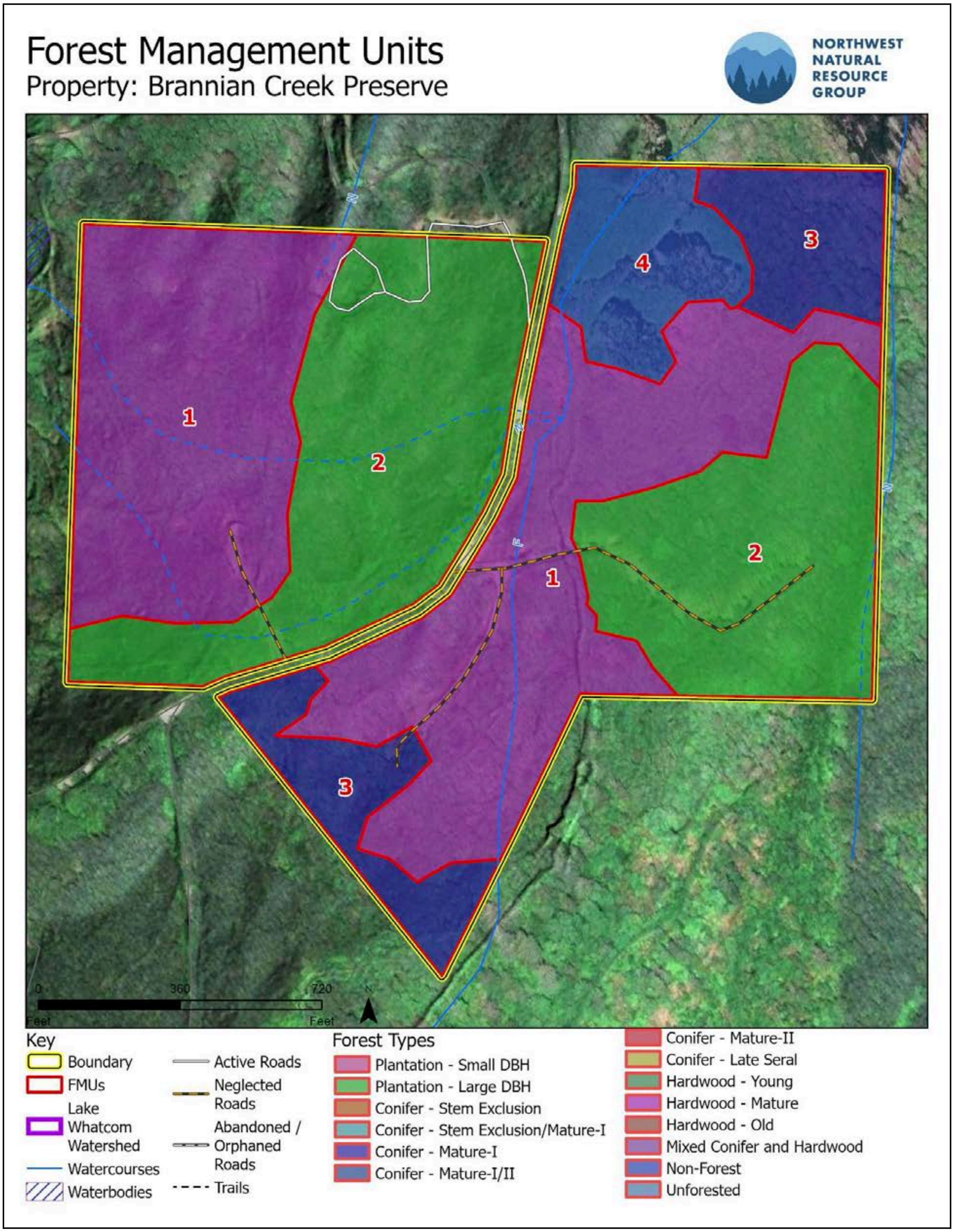
Management Units

Forest cover was delineated into the forest management units (FMUs) using both remotely sensed data, historic inventory units, and field inventory data. The forestland within these management units share similar forest characteristics and management recommendations. For each FMU, this plan describes the geophysical attributes and forest conditions and assesses the unit against the plans management objectives using the previously described framework by forest type. Recommendations are then given by FMU, typically referencing general recommendations by forest type, but more information is given as needed. Finally, a schedule of management activities by year and FMU is given at the end of this section.

Summary of Forest Management Units

FMU	Acres	Forest Type	Management
1	29	Mixed Hardwood - Mature	Thinning
2	24	Conifer Plantation - Large DBH	Monitoring
3	7	Mixed Conifer - Mature-I	None
4	4	Wetland	None
Total	**64**		

Map of Forest Management Units



FMU 1 - Mixed Hardwood - Mature

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	RA	224	84	157	47	4	8	12	100
	Minor	BM	32	12	32		4	10	16	100
		CH	32	12	32		4	10	16	100
		CW	32	12	32		4	10	16	100
	All	All	320	120	253		4	9	16	100
Midstory	Major	RC	10	1	2	1	2	4	6	10
		WH	10	1	2		2	4	6	10
	All	All	20	2	5		2	4	6	10
Total	All	All	340	122	257	48	2	8	16	95

Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.

This FMU consists of two areas on either side of Camp 2 Road. The terrain on the west side contains mild east-facing slopes while the terrain on the east side of the road is mostly flat. The soil productivity rating is site class II on the west side of the road and mostly site class III on the east side of the road. This unit was clearcut around 1980, along with the majority of the property. It was likely replanted with Douglas-fir, but survival was low, and hardwoods naturally regenerated. Total stocking is approximately 340 TPA. The overstory contains approximately 320 TPA and is primarily composed of red alder, with small components of bigleaf maple, bitter cherry and black cottonwood. Overstory red alder average 8 inches DBH and 100 ft tall. The midstory contains approximately 20 TPA and is primarily composed of western hemlock and western redcedar that both average 4 inches DBH and 10 ft tall. This mature hardwood stand is overstocked and has a persistent shrub layer which is preventing the successful establishment of conifer species. Per the earlier discussion of mature hardwood stands, a commercial thinning is recommended followed by underplanting of shade-tolerant conifers. This unit is accessible from the Camp 2 Road as well as the three unnamed road spurs previously discussed.

FMU 2 - Conifer Plantation - Large DBH

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	DF	218	137	292	59	6	12	18	100
	Minor	RA	38	25	17		4	6	10	100
	All	All	256	162	309		4	11	18	100
Midstory	Major	RC	6	1	1	0	2	4	6	20
		WH	6	1	1		2	4	6	20

	All	All	13	1	3		2	4	6	20
Total	All	All	269	163	312	60	2	11	18	96
Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.										

This FMU is the largest on the property and consists of two areas on either side of Camp 2 Road. The terrain on the west side of the road is rolling while the terrain on the east side of the road is mostly flat. The soil productivity rating is mostly site class II, with a small area of site class III soil. This unit was clearcut around 1980, along with the majority of the property. It was likely replanted with Douglas-fir, and survival was higher compared to FMU 1. Total stocking is approximately 269 TPA. The overstory contains approximately 256 TPA and is primarily composed of Douglas-fir, with a small component of red alder. Overstory Douglas-fir average 12 inches DBH and 100 ft tall. The midstory contains approximately 13 TPA and is primarily composed of western redcedar and western hemlock that both average 4 inches DBH and 20 ft tall.

The density of this stand has significantly been reduced in recent years due to a bark beetle infestation. Mortality of the Douglas-fir is over 50% in some areas. The beetle outbreak has naturally reduced density in what used to be a very overstocked stand, and mortality will likely continue to occur over the next five years as the infestation abates. No immediate action is necessary since there is still sufficient forest cover, but it is recommended to monitor the beetle outbreak over the next 5-10 years. If additional significant mortality occurs without natural regeneration, planting may be necessary to ensure future forest cover. This unit is accessible from the Camp 2 Road as well as unnamed road spurs previously discussed.

FMU 3 - Mixed Conifer - Mature-I

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	RC	56	77	119	43	8	16	24	100
		WH	56	77	119		8	16	24	100
	Minor	CW	16	22	21		6	12	16	100
		PB	16	22	21		6	12	16	100
		RA	16	22	21		6	12	16	100
	All	All	160	220	302		6	15	24	100
Midstory	Major	RC	50	30	35	9	2	8	12	40
		WH	50	30	35		2	8	12	40
	All	All	100	60	70		2	8	12	40
Total	All	All	260	280	372	51	2	12	24	77
Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.										

This FMU consists of two small areas on the east side of Camp 2 Road that were not harvested when the rest of the property was clearcut around 1980. The forest in this unit likely originated naturally following a clearcut harvest in the early 1900s. The topography of the unit is mostly flat, and the soil productivity rating is site class III. Total stocking is approximately 260 TPA. The overstory contains approximately 160 TPA and is primarily composed of western redcedar and western hemlock, with small components of black cottonwood, paper birch and red alder. Overstory redcedar and hemlock both average 16 inches DBH and 100 ft tall. The midstory contains approximately 100 TPA and is primarily composed of western redcedar and western hemlock that both average 8 inches DBH and 40 ft tall. This stand is in the Mature-I stage of development with a cohort of trees developing in the understory and midstory. The stand has healthy stocking densities, with the overstory density already being below the initial target density for this forest type. Given these factors, no management is recommended. Part of the unit is accessible from Camp 2 Road and at the end of the unnamed road spur in the southeastern portion of the property.

FMU 4 - Wetland

This FMU represents a large wetland complex in the northeast corner of the property. It contains a type A wetland and associated riparian area that is dominated by red alder and cottonwood. No resource concerns were observed at the wetland, so no management activities are recommended. The unit is accessible from Camp 2 Road.

Management Activity Schedule

Timeline	Activity	Priority	FMU	Prescription
2025 to 2030	Thinning (CT / NCT)	3	1	Thin to a target density of 150 to 200 TPA.
	Planting	3	1	Underplant with 150-250 TPA of shade-tolerant conifers suitable to site conditions.
2030 to 2035	Planting	3	2	Monitor the mortality of the Douglas-fir and regeneration and, if necessary, plant with 150-250 TPA of a mix of species suitable to site conditions.
Notes: CT - Commercial Thinning, NCT - Non-commercial Thinning. Priority Levels: 1 - High, 2 - Moderately High, 3 - Moderate, 4 - Low. Additional thinning and planting considerations are identified in Section 1 of this document as well as in the FMU-specific section above.				

Parcel Table

Owner	Parcel ID	Year Acquired	Previous Owner
City	3704335083160000	2023	Nielsen Brothers Inc

Dutch Harbor Preserve

Overview

Site Description

Dutch Harbor Preserve is a 67-acre property owned by the City of Bellingham on the northwest side of Lake Whatcom. It is located near Sudden Valley along Lake Whatcom Boulevard.

Property Information

This forest is located in Section 36 of Township 38N, Range 03E and Section 31 of Township 38 North, Range 04E of the US Public Land Survey System and includes 12 parcels that are listed in the table at the end of this section.

Management History

The various parcels of the Dutch Harbor Preserve were acquired by the city between 2009-2023 from various private parties. The specific land use history of the site is unknown, but the original old growth forest was likely removed sometime in the last 100 to 150 years and replaced by naturally regenerated conifers and hardwoods. A small area on the property’s western edge was logged again in the early 2000s.

Property Overview Map

Assessment

Topoclimate

Dutch Harbor Preserve includes a plateau formation and a steep slope facing north towards Lake Whatcom. The north facing slopes provide cooler conditions for this area. The rest of the preserve is mostly flat, though small drainage pockets can be found on the largest parcel of the preserve.

Vegetation Zone

According to vegetation zone maps for North America, the following Ecological Systems were likely present prior to Euro-American settlement. More information on these maps and full descriptions of each system can be found in the discussion of Vegetation Zones in Section 2 of this document.

- North Pacific Maritime Mesic-Wet Douglas-fir-Western Hemlock Forest
- North Pacific Seasonal Sitka Spruce Forest
- North Pacific Hypermaritime Western Red-cedar-Western Hemlock Forest

Soils

Data from the USDA Natural Resource Conservation Service (NRCS) Soil Surveys were used to identify the major soil types that underlay this forest, which are described in more detail in the discussion of Soil Productivity in Section 2. Information about specific soil units likely present at this property, including depth, drainage, productivity, and relevant management concerns are listed in the table below. The location of these soil units can be found in the accompanied map packet for this property.

Forest Soil Units Summary Table

Soil Unit	Productivity		Management Concerns					Acres (Pct)
	Site Class	Max Growth	Drought Stress Hazard	Wind Throw Hazard	Mass Wasting Hazard	Logging Rutting Hazard	Logging Compact Hazard	
Nati Series Ashy Loam on 30-60% Slopes Mod. Deep (38in) Well Drained	DF-3	129 ft3/ac/yr	Mod. High	High	High	High	High	31 (46%)
Sehome Series Medial Loam on 2-8% Slopes Mod. Deep (26in) Moderately Well Drained	DF-2	186 ft3/ac/yr	Mod. High	Medium	Mod.	High	Mod.	19 (29%)
Nati Series Ashy Loam on 5-15% Slopes Mod. Deep (37in)	DF-2 / DF-3	172 ft3/ac/yr	Mod. High	Medium	High	High	High	16 (24%)

Soil Unit	Productivity		Management Concerns					Acres (Pct)
	Site Class	Max Growth	Drought Stress Hazard	Wind Throw Hazard	Mass Wasting Hazard	Logging Rutting Hazard	Logging Compact Hazard	
Well Drained								

Slope Stability

As previously described in Section 2, this plan utilizes remotely mapped topographic data as well as hazard zones and historic landslides identified by the State of Washington Department of Natural Resources (DNR) to gauge the likelihood that unstable slopes will be found within a proposed management area. The presence of a mapped hazard zone or historic landslide does not preclude management, but indicates that further investigation is required.

The site contains a mix of plateaus and slopes, with some steep slopes over 70% located near the shores of Lake Whatcom on the southeast side of the preserve. There are no known landslides or identified hazard zones. Heavy equipment will need to be excluded from the steeper slopes to avoid the risk of soil depositing into the lake in the event of a landslide.

Hydrology

There are multiple stream systems within the Dutch Harbor Preserve. There is a cluster of three streams near the access point on the northwest side, with one identified as fish-bearing by the DNR's hydrography database. These streams merge and flow northwest into Lake Whatcom. There is a second fish-bearing stream that is isolated from the other network on the southeast side of the preserve. This stream also flows northwest and into Lake Whatcom.

Roads and Access

The preserve is primarily accessed directly off Lake Whatcom Boulevard. The western portion of the preserve can be accessed by a gated road off Lake Whatcom Boulevard, known locally as waterline road. This road is used and maintained by the local water district and provides access across much of the unit. A landing or some form of truck turnaround was found around 600ft down the waterline road on city property, likely the remnants of past logging activities. In addition, an older road once led due south from Lake Whatcom Boulevard nearby to the current gate and provided access during more recent logging activities, but has since been abandoned. No issues were observed with the road system during this assessment.

Health and Resiliency

Some overstocking was observed in Forest Management Unit 3, which is described in the Recommendations section below. Otherwise, no forest health or resiliency issues were identified.

Wildlife Habitat

A review of the Washington State Department of Fish and Wildlife Priority Species Database identified little brown bat, big brown bat, and Yuma myotis bat as having been documented somewhere within the 23,000-acre township containing Dutch Harbor Preserve. The streams within this site host kokanee salmon and cutthroat trout. The abundance of large trees, snags, and understory vegetation also provides habitat for many different wildlife species.

Wildfire Susceptibility

Wildfire risk at the property is relatively low overall. The site is mostly surrounded by the Stimpson Reserve, but there are some nearby neighborhoods and a recreational trail that slightly increases ignition potential. Young alder stands are dense and could carry surface fire, but the predominance of hardwoods throughout the forest provides some resistance to high-severity wildfire. Access for firefighting is available from Lake Whatcom Boulevard, though steep slopes descending toward the Dutch Harbor Preserve may limit easy access in some areas.

Carbon Storage

Most of the property has high carbon storage potential due to the presence of long-lived conifers with healthy stocking and good growth rates. Areas dominated by red alder have lower carbon storage because of the species' short lifespan. Establishing conifers in these areas would improve long-term carbon storage capacity.

Cultural Resources

The Lake Whatcom watershed is a landscape rich with cultural significance for Indigenous peoples—particularly the Lummi Nation and the Nooksack and Swinomish Tribes—who have maintained deep spiritual, cultural, and subsistence connections to the landscape. Although a review of the Washington State Department of Archaeology and Historic Preservation Wisaard online database did not identify any known historical sites on this property and none were encountered while developing this plan, this property has a long history of human use and artifacts may be present. Please see the previous discussion about cultural use practices in the Lake Whatcom Watershed for a more detailed assessment of best management practices moving forward.

Recreation

Dutch Harbor Preserve has some limited recreation use. The waterline road is used for both mountain biking and hiking and some unofficial trails appear to provide access to nearby residential developments and the Stimson Family Nature Preserve to the south.

Recommendations

Roads and Access

Given current management recommendations, no new road construction is necessary. The waterline road should be maintained in coordination with the local water district or other responsible parties. Implement a maintenance plan for ditches, culverts, and road grades to ensure all active roads maintain a high standard of function. See the best management practices identified in Section 2 for additional details.

Health and Resiliency

Recommendations for addressing observed overstocking are given at the management unit level below.

Wildfire Susceptibility

Shaded fuel breaks are recommended within 100 feet of public roads and existing structures which are designed to keep fires on the ground and slow their spread until firefighting resources can arrive. For additional details on implementation, see the description of a shaded fuel break given in the discussion of Wildfire Susceptibility in Section 2 of this document.

Forest Types

All recommendations for this property follow the previous discussion of forest-types in section 3 and are discussed by management unit below.

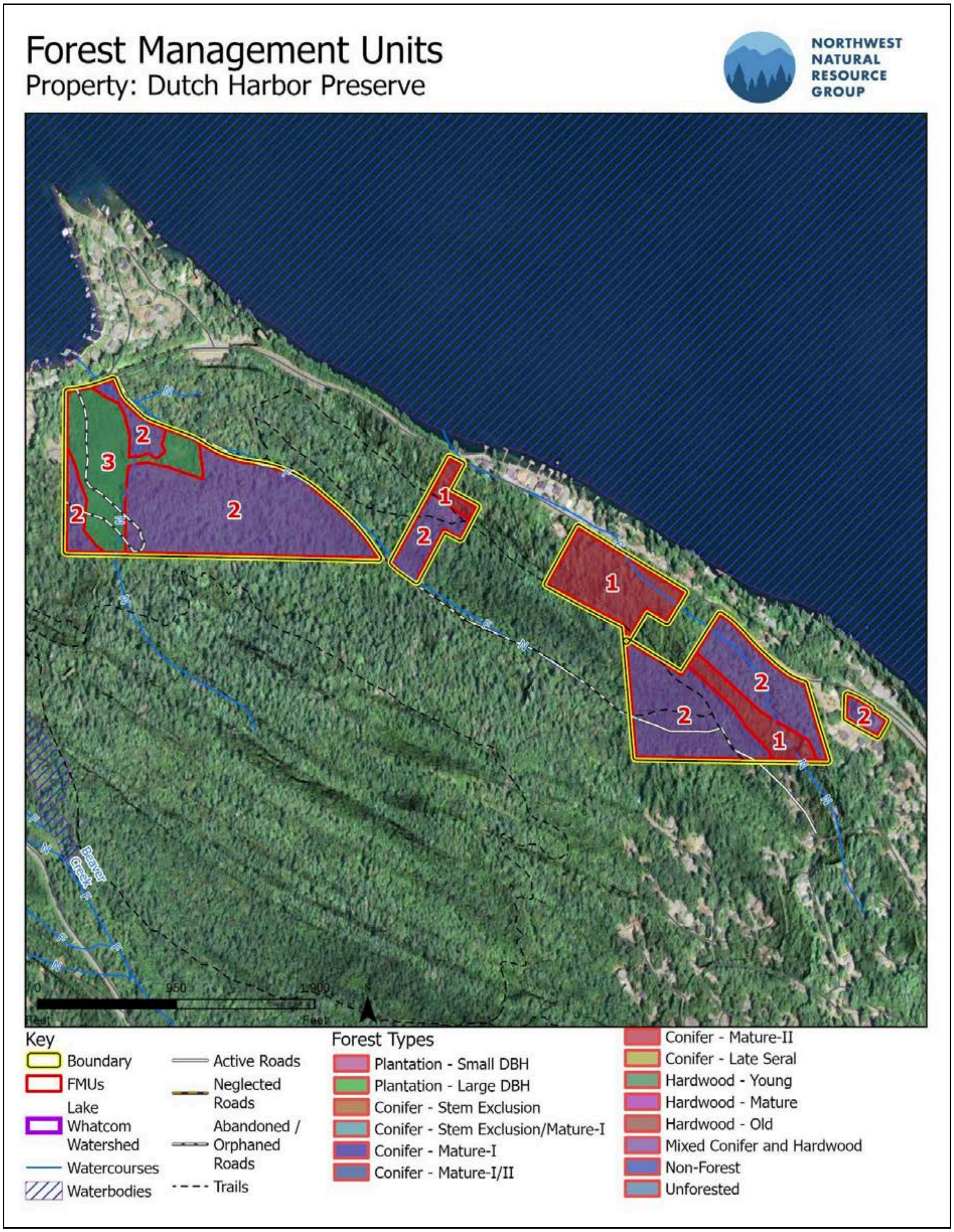
Management Units

Forest cover was delineated into the forest management units (FMUs) using both remotely sensed data, historic inventory units, and field inventory data. The forestland within these management units share similar forest characteristics and management recommendations. For each FMU, this plan describes the geophysical attributes and forest conditions and assesses the unit against the plans management objectives using the previously described framework by forest type. Recommendations are then given by FMU, typically referencing general recommendations by forest type, but more information is given as needed. Finally, a schedule of management activities by year and FMU is given at the end of this section.

Summary of Forest Management Units

FMU	Acres	Forest Type	Management
1	12	Mixed Conifer - Mature-II	None
2	45	Mixed Conifer and Hardwood	None
3	10	Mixed Hardwood - Young	Thinning & Planting
Total	**67**		

Map of Forest Management Units



FMU 1 - Mixed Conifer - Mature-II

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	DF	40	80	69	13	12	14	18	160
Midstory	Major	DF	30	12	40	14	10	12	14	100
		RC	40	16	28		6	8	10	100
		WH	30	12	30		8	10	12	100
	All	All	100	40	98		6	10	14	100
Total	All	All	140	120	167	29	6	11	18	117

Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.

FMU 1 regenerated naturally following clearcutting of the original forest. The exact origination date is unknown, but likely occurred over 100 years ago. The very steep northeast-facing FMU averages over 70% slope, and the soil productivity rating is site class III. Total stocking is approximately 140 TPA. The overstory contains approximately 40 TPA and is primarily composed of Douglas-fir. Overstory Douglas-fir average 14 inches DBH and 160 ft tall. The midstory contains approximately 100 TPA and is primarily composed of western hemlock, western redcedar and Douglas-fir. Midstory Douglas-fir average 12 inches DBH and 100 ft tall, redcedar average 8 inches DBH and 100 ft tall, and hemlock average 10 inches DBH and 100 ft tall. Because of the developed midstory, this stand has developed to the Mature II stage of development. Per the previous discussion about mixed conifer stands in this stage of development, no management is recommended. This unit is partially accessible from Lake Whatcom Boulevard.

FMU 2 - Mixed Conifer and Hardwood

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	BM	31	22	54	36	12	14	16	100
		DF	40	48	85		14	16	18	120
		RC	51	43	76		10	13	16	104
	All	All	132	120	227		8	14	18	108
Midstory	Major	BM	12	4	3	4	2	4	6	40
		RA	10	5	10		8	10	12	80
		WH	10	5	10		8	10	12	80
	All	All	38	17	29		2	8	12	61
Total	All	All	170	137	256	40	2	13	18	97

Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.

FMU 2 regenerated naturally following clearcutting of the original forest. The exact origination date is unknown, but likely occurred sometime before 1950, potentially over 100 years ago. The unit has moderate slopes that do not exceed 65% and a soil productivity rating that ranges from site class II to III. Total stocking is approximately 170 TPA. The overstory contains approximately 132 TPA and is primarily composed of bigleaf maple, western redcedar and Douglas-fir. Overstory Douglas-fir average 16 inches DBH and 120 ft tall, redcedar average 13 inches DBH and 104 ft tall, and maple average 14 inches DBH and 100 ft tall. The midstory contains approximately 38 TPA and is primarily composed of western hemlock, bigleaf maple and red alder. Midstory hemlock and alder average 10 inches DBH and 80 ft tall, and maple average 4 inches DBH and 40 ft tall. This is a mixed conifer and hardwood forest with no health concerns and that is diverse in composition and structure. Per the earlier discussion of this forest type, no management activities are recommended. Portions of this unit are accessible from Lake Whatcom Boulevard and along the waterline road.

FMU 3 - Mixed Hardwood - Young

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	RA	488	62	215	46	2	6	10	60
	Minor	BM	30	5	13		4	6	12	60
		DF	30	5	13		4	6	12	60
	All	All	548	72	241		2	6	12	60
Midstory	Major	RC	8	1	2	0	2	4	6	20
		WH	8	1	2		2	4	6	20
	All	All	16	1	4		2	4	6	20
Total	All	All	564	73	245	46	2	6	12	59

Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.

The east side of this FMU was cut in 1998 and left unplanted until the west side was also cleared sometime in the early 2000s. Both were likely planted as a conifer mix, though unsuccessfully, as red alder dominates the stand in the current day. The City underplanted conifers in this stand within the last 10 years, but survival has been low other than near the road, potentially due to a dense red alder overstory. The FMU is fairly flat, though a small section in the south has moderate slopes. The soil productivity rating ranges from site class II to III. Total stocking is approximately 564 TPA. The overstory contains approximately 548 TPA and is primarily composed of red alder, with small components of bigleaf maple and Douglas-fir. Overstory red alder average 6 inches DBH and 60 ft tall. The midstory contains approximately 16 TPA and is primarily composed of western hemlock and western redcedar that both average 4 inches DBH and is 20 ft tall. This young hardwood stand is stocked at high densities that are unsustainable. Per the earlier discussion of young hardwood stands, a pre-commercial thinning is recommended followed by underplanting. This unit can be accessed via the waterline road as well as an old road grade used to previously log the stand.

Management Activity Schedule

Timeline	Activity	Priority	FMU	Prescription
2025 to 2030	Thinning (PCT)	2	3	Pre-commercially thin to a target density of 150 to 200 TPA.
	Planting	2	3	Plant with 150-250 TPA of a mix of species suitable to the site conditions.
Notes: PCT - Pre-commercial Thinning. Priority Levels: 1 - High, 2 - Moderately High, 3 - Moderate, 4 - Low. Additional thinning and planting considerations are identified in Section 1 of this document as well as in the FMU-specific section above.				

Parcel Table

Owner	Parcel ID	Year Acquired	Previous Owner
City	3803361491890000	2010	Private
City	3803361901670000	2009	Private
City	3803362261670000	2009	Private
City	3803362621670000	2009	Private
City	3803363101600000	2009	Private
City	3803363791730000	2009	Private
City	3803364021650000	2009	Private
City	3803364821300000	2010	Private
City	3803365041210000	2010	Private
City	3804310301100000	2017	Private
City	3804310740450000	2010	Private
City	3804311620340000	2023	Private

Lake Geneva Preserve

Overview

Site Description

Lake Geneva Preserve is a 125-acre property owned by the City of Bellingham on the east side of Lake Whatcom. It is located between Lake Louise Road and Lake Whatcom Boulevard.

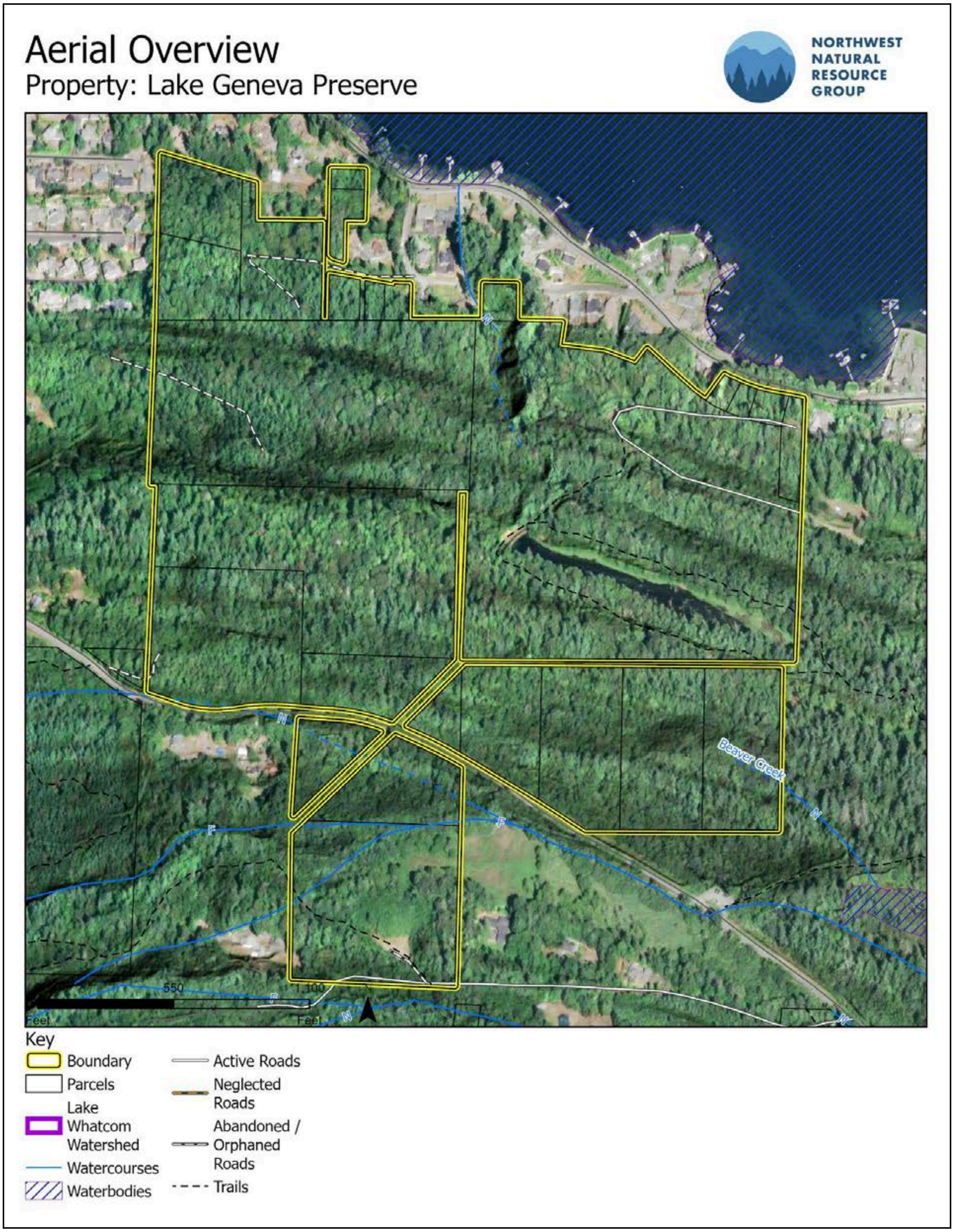
Property Information

This forest is located in Section 35, Township 38N, Range 03E of the US Public Land Survey System and includes 24 parcels that are listed in the table at the end of this section.

Management History

The parcels that make up the preserve were gradually acquired by the City between 2001 and 2022 from private landowners. Most of the preserve is second-growth forest that likely naturally regenerated following clearcut harvests in the early- to mid-1900s. In the properties northwest corner, a harvest sometime between 1950 and 1970 removed these older trees and the forest has regenerated in hardwoods.

Property Overview Map



Assessment

Topoclimate

The topography of the preserve is characterized by the distinctive folds of the Chuckanut Formation with a series of elongated ridges and depressions. These folded landforms create variable microclimates, with cooler and wetter conditions occurring within the lower troughs. The folds often contain short steep slopes up to 70 percent in some areas. The terrain generally becomes steeper toward the north as the terrain descends toward Lake Whatcom. Proximity to the lake moderates temperatures throughout the year, resulting in a generally mild local climate.

Vegetation Zone

According to vegetation zone maps for North America, the following Ecological Systems were likely present prior to Euro-American settlement. More information on these maps and full descriptions of each system can be found in the discussion of Vegetation Zones in Section 2 of this document.

- North Pacific Maritime Mesic-Wet Douglas-fir-Western Hemlock Forest
- North Pacific Hypermaritime Western Red-cedar-Western Hemlock Forest
- North Pacific Seasonal Sitka Spruce Forest

Soils

Data from the USDA Natural Resource Conservation Service (NRCS) Soil Surveys were used to identify the major soil types that underlay this forest, which are described in more detail in the discussion of Soil Productivity in Section 2. Information about specific soil units likely present at this property, including depth, drainage, productivity, and relevant management concerns are listed in the table below. The location of these soil units can be found in the accompanied map packet for this property.

Forest Soil Units Summary Table

Soil Unit	Productivity		Management Concerns					Acres (Pct)
	Site Class	Max Growth	Drought Stress Hazard	Wind Throw Hazard	Mass Wasting Hazard	Logging Rutting Hazard	Logging Compact Hazard	
Chuckanut Series Gravelly Medial Loam on 15-30% Slopes Deep (56in) Well Drained	DF-2	186 ft3/ac/yr	Mod. High	Low	High	High	Mod.	57 (45%)
Nati Series Ashy Loam on 30-60% Slopes Mod. Deep (38in)	DF-3	129 ft3/ac/yr	Mod. High	High	High	High	High	37 (30%)

Soil Unit	Productivity		Management Concerns					Acres (Pct)
	Site Class	Max Growth	Drought Stress Hazard	Wind Throw Hazard	Mass Wasting Hazard	Logging Rutting Hazard	Logging Compact Hazard	
Well Drained								
Squalicum Series Gravelly Ashy Loam on 5-15% Slopes Deep (44in) Moderately Well Drained	DF-2	186 ft3/ac/yr	Mod.	Low	Mod.	Mod.	High	15 (12%)
Nati Series Ashy Loam on 15-30% Slopes Mod. Deep (31in) Well Drained	DF-2 / DF-3	172 ft3/ac/yr	Mod. High	Medium	High	High	High	7 (6%)
Chuckanut Series Gravelly Medial Loam on 5-15% Slopes Deep (56in) Well Drained	DF-2	186 ft3/ac/yr	Mod. High	Low	Mod.	High	Mod.	5 (4%)
Labounty Series Ashy Silt Loam on 0-2% Slopes Poorly Drained	RA-4	100 ft3/ac/yr	Mod.	High	Low	High	High	2 (2%)

Slope Stability

As previously described in Section 2, this plan utilizes remotely mapped topographic data as well as hazard zones and historic landslides identified by the State of Washington Department of Natural Resources (DNR) to gauge the likelihood that unstable slopes will be found within a proposed management area. The presence of a mapped hazard zone or historic landslide does not preclude management, but indicates that further investigation is required.

Most of the preserve contains slopes less than 40% but there are some steep short bands that have slopes greater than 70%. No known landslides have occurred, and there are no hazard zones. There is the potential for small areas of rule-identified inner gorges in stream channels to exist on the site, but these can be easily avoided during operations.

Hydrology

There are three streams on the south side of the preserve that converge and flow east into Beaver Creek. According to the DNR’s hydrography database, the northernmost stream is non-fish-bearing, while the other two are identified as fish-bearing. Beaver Creek continues eastward and ultimately flows into Lake

Whatcom. In the northeast portion of the property lies Geneva Pond, which outlets to the north through a non-fish-bearing stream that also flows into Lake Whatcom. There is also a wetland just south of the pond.

Roads and Access

Most of the preserve lies between Lake Louise Road to the south and Lake Whatcom Boulevard to the north, with a smaller portion extending south of Lake Louise Road. Access to the southern portion of the preserve is via Valleybrook Lane. In the north access is through a gate at the end of Strawberry Shore Drive off Lake Whatcom Boulevard. Strawberry Shore Drive continues into the property and provides access to an adjacent residential property. The City is responsible for road maintenance on the portion of the road within their property boundary and an access easement is held by the neighboring landowner. In addition, the adjacent Stimpson Family Nature Preserve to the southeast has a parking area, and a trail system originating from this parking area eventually enters the Lake Geneva Preserve near Geneva Pond. An unused road entrance was found on the southwest corner of the northern portion of this property leading off Lake Louise Road but appears to end after less than 50 feet. Historic road access was also identified in the property’s northwest corner. No issues were identified with active or abandoned roads during this assessment.

Health and Resiliency

The only forest health concern observed at the Lake Geneva Preserve is overstocking of a couple small areas of young hardwoods. This forest type only represents about four acres of the preserve though, and most of the preserve is older mixed forest with no health concerns.

Wildlife Habitat

A review of the Washington State Department of Fish and Wildlife Priority Species Database identified little brown bat, big brown bat, and Yuma myotis bat as having been documented somewhere within the 23,000-acre township containing Lake Geneva Preserve. The fish-bearing stream system that connects with Beaver Creek is habitat for Cutthroat Trout.

Most of the preserve contains older mixed stands that contain larger downed wood and snags that offer habitat, as well as a healthy understory shrub layer with plants that provide food for wildlife. Geneva Pond and the adjacent wetland provide valuable habitat for many aquatic species.

Wildfire Susceptibility

Wildfire susceptibility within the preserve is generally low. The forest is primarily composed of older stands with limited ladder fuels, and the presence of hardwood species further reduces fire risk. Hardwoods are less susceptible to fire because they have large water-laden leaves and lower content of resin and pitch that makes them less likely to burn in a fire. Ignition probability is slightly elevated by the proximity to recreational use in the neighboring Stimpson Family Nature Reserve and nearby residential areas to the north, but there is good road access around the perimeter, including Lake Louise Road and adjacent neighborhood roads, which would support firefighting efforts. Internal access within the preserve is limited.

Carbon Storage

Carbon storage potential across the preserve is moderate, reflecting its mixed composition of conifers and hardwoods. Conifers contribute higher carbon storage, while hardwood-dominated areas generally store less. Most of the forest is at healthy stocking levels, supporting robust growth and ongoing carbon sequestration. Small areas of young hardwoods have lower carbon storage potential, but this can be improved over time with the establishment of conifers.

Cultural Resources

The Lake Whatcom watershed is a landscape rich with cultural significance for Indigenous peoples—particularly the Lummi Nation and the Nooksack and Swinomish Tribes—who have maintained deep spiritual, cultural, and subsistence connections to the landscape. Although a review of the Washington State Department of Archaeology and Historic Preservation Wisaard online database did not identify any known historical sites on this property and none were encountered while developing this plan, this property has a long history of human use and artifacts may be present. Please see the previous discussion about cultural use practices in the Lake Whatcom Watershed for a more detailed assessment of best management practices moving forward.

Recreation

Lake Geneva Preserve is bordered to the east by Stimpson Family Nature Preserve, which receives high recreational use on its trail systems. One trail extends from this preserve into the northeast part of Lake Geneva Preserve and loops around Geneva Pond. There is also an access trail off of Valleybrook Lane on the south side of the preserve that eventually connects with the trail system in nearby North Beaver Creek Preserve.

Recommendations

Roads and Access

There are no existing road maintenance concerns at this time and no new road construction is recommended. Implement a maintenance plan for ditches, culverts, and road grades to ensure the short segment of active road maintains a high standard of function. See the best management practices identified in Section 2.

Health and Resiliency

Recommendations for addressing observed overstocking are given at the management unit level below.

Wildfire Susceptibility

Shaded fuel breaks are recommended within 100 feet of public roads and existing structures which are designed to keep fires on the ground and slow their spread until firefighting resources can arrive. For additional details on implementation, see the description of a shaded fuel break given in the discussion of Wildfire Susceptibility in Section 1 of this document.

Forest Types

All recommendations for this property follow the previous discussion of forest-types in section 3 and are discussed by management unit below.

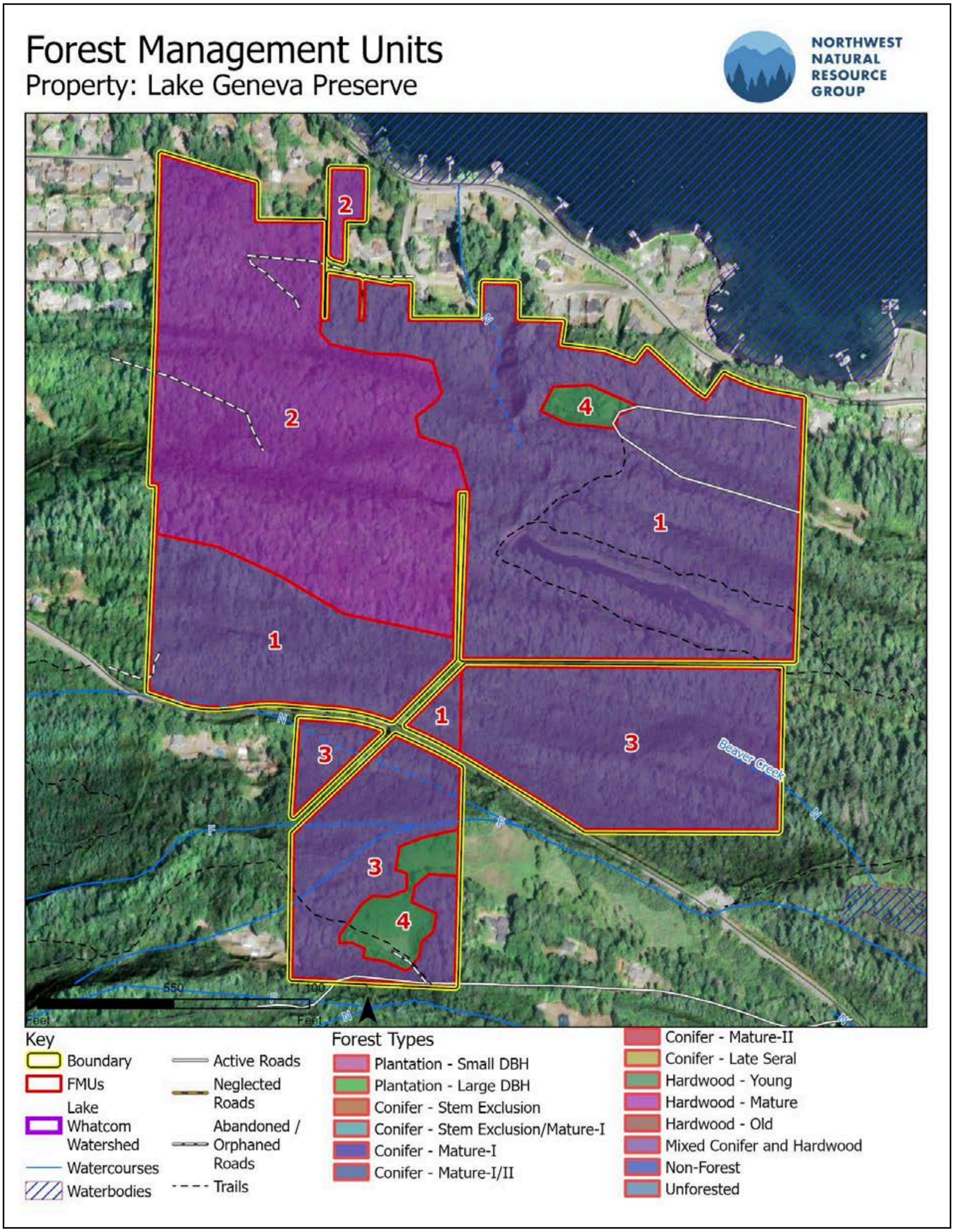
Management Units

Forest cover was delineated into the forest management units (FMUs) using both remotely sensed data, historic inventory units, and field inventory data. The forestland within these management units share similar forest characteristics and management recommendations. For each FMU, this plan describes the geophysical attributes and forest conditions and assesses the unit against the plans management objectives using the previously described framework by forest type. Recommendations are then given by FMU, typically referencing general recommendations by forest type, but more information is given as needed. Finally, a schedule of management activities by year and FMU is given at the end of this section.

Summary of Forest Management Units

FMU	Acres	Forest Type	Management
1	55	Mixed Conifer and Hardwood	None
2	37	Mixed Hardwood - Mature	None
3	29	Mixed Conifer and Hardwood	None
4	4	Mixed Hardwood - Young	Thinning & Planting
Total	**125**		

Map of Forest Management Units



FMU 1 - Mixed Conifer and Hardwood

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	BM	38	61	66	44	8	14	20	134
		RC	48	91	108		10	16	30	127
		WH	41	67	95		8	17	30	131
	Minor	DF	19	28	44		10	17	30	123
	All	All	148	250	313		4	16	30	129
Midstory	Major	RC	44	18	34	9	2	8	12	46
		WH	44	18	34		2	8	12	46
	All	All	94	38	71		2	8	12	46
Total	All	All	242	288	383	53	2	13	30	97
Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.										

This FMU is the largest on the property and represents most of the northeast corner that surrounds Geneva Pond. The unit also includes a smaller area on the west side. The topography is mostly rolling with steeper north-facing slopes on the north side. The soil productivity rating ranges from site class II to III. The unit consists of mixed second-growth forest that likely naturally regenerated following a clearcut harvest in the early 1900s. Total stocking is approximately 242 TPA. The overstory contains approximately 148 TPA and is primarily composed of western hemlock, bigleaf maple and western redcedar, with a small component of Douglas-fir. Overstory redcedar average 16 inches DBH and 127 ft tall, hemlock average 17 inches DBH and 131 ft tall, and maple average 14 inches DBH and 134 ft tall. The midstory contains approximately 94 TPA and is primarily composed of western hemlock and western redcedar that both average 8 inches DBH and 46 ft tall. No forest health concerns were observed in this unit and the forest is diverse in species and structure. Per the earlier discussion on mixed hardwood and conifer forests with no health concerns, no management activities are recommended.

FMU 2 - Mixed Hardwood - Mature

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	BM	49	64	102	40	8	16	24	112
		RA	49	64	102		8	16	24	112
	Minor	CW	19	16	25		8	12	18	100
	All	All	116	144	229		8	15	24	110
Midstory	Major	RC	13	4	9	3	4	8	12	49
		WH	23	8	12		2	7	12	45

	All	All	36	12	21		2	7	12	47
Total	All	All	152	156	250	42	2	13	24	95
Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.										

This FMU is in the northwest corner of the preserve on variable rolling terrain. The soil productivity rating ranges from site class II to III. It is estimated that the unit regenerated naturally following a clearcut around the 1960s. Total stocking is approximately 152 TPA. The overstory contains approximately 116 TPA and is primarily composed of bigleaf maple and red alder, with a small component of black cottonwood. Overstory maple and alder average 16 inches DBH and 112 ft tall. The midstory contains approximately 36 TPA and is primarily composed of western hemlock and western redcedar. Midstory redcedar average 8 inches DBH and 49 ft tall, and hemlock average 7 inches DBH and 45 ft tall. This mature mixed hardwood stand is at a healthy density, as previously discussed for this forest type. Additionally, the presence of conifer species in the midstory and understory ensures that there will likely be sufficient forest cover once the alder and cottonwood begin to decline. Based on the healthy density and presence of conifer regeneration, no management activities are recommended.

FMU 3 - Mixed Conifer and Hardwood

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	BM	72	114	153	58	8	16	24	122
		RC	49	79	120		8	18	24	124
	Minor	DF	29	46	77		12	19	28	122
	All	All	162	262	376		8	17	28	124
Midstory	Major	RC	72	40	63	9	4	9	12	52
Total	All	All	234	302	439	67	4	14	28	102
Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.										

This FMU is on the south side of the preserve on variable rolling terrain that generally slopes to the east. The soil productivity rating ranges from site class II to III. The unit consists of mixed second-growth forest that likely naturally regenerated following a clearcut harvest in the mid-1900s. This unit is slightly younger than the adjacent FMU-1 with stumps cut by power saws suggesting a more recent origin. Total stocking is approximately 234 TPA. The overstory contains approximately 162 TPA and is primarily composed of bigleaf maple and western redcedar, with a small component of Douglas-fir. Overstory redcedar average 18 inches DBH and 124 ft tall, and maple average 16 inches DBH and 122 ft tall. The midstory contains approximately 72 TPA and is primarily composed of western redcedar that average 9 inches DBH and 52 ft tall. This is a mixed conifer and hardwood forest with shade-tolerant conifers regenerating in the midstory and understory and no health concerns. Per the earlier discussion of this stand type, no management activities are recommended.

FMU 4 - Mixed Hardwood - Young

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	RA	520	56	119	25	2	4	6	40
	Minor	CW	40	8	9		2	4	6	40
	All	All	560	64	129		2	4	6	40
Midstory	Major	RA	90	8	21	4	2	4	6	20
	All	All	100	9	23		2	4	6	20
Total	All	All	660	73	152	29	2	4	6	37

Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.

This FMU consists of two small areas on the north and south sides of the preserve that have been more recently disturbed and are dominated by young hardwoods. Both areas have mild rolling terrain and a soil productivity rating that ranges from site class II to III. The northern area likely used to be a road that naturally filled in with alder, and the southern area was possibly cleared for a homesite. Part of the southern area is a field and currently unforested. Total stocking is approximately 660 TPA. The overstory contains approximately 560 TPA and is primarily composed of red alder, with a small component of black cottonwood. Overstory red alder average 4 inches DBH and 40 ft tall. The midstory contains approximately 100 TPA and is primarily composed of red alder. Midstory red alder average 4 inches DBH and 20 ft tall. This young hardwood stand is growing at high densities and precluding the establishment of long-lived conifer species. Per the earlier discussion of this stand type, pre-commercial thinning is recommended followed by underplanting. The field in the southern area should also be planted.

Management Activity Schedule

Timeline	Activity	Priority	FMU	Prescription
2025 to 2030	Thinning (PCT)	2	4	Pre-commercially thin to a target density of 150 to 200 TPA.
	Planting	2	4	Underplant thinned areas with 150-250 TPA of shade-tolerant conifers suitable to site conditions. Plant open areas with 250 to 300 TPA of a mix of species suitable to the site conditions
Notes: PCT - Pre-commercial Thinning. Priority Levels: 1 - High, 2 - Moderately High, 3 - Moderate, 4 - Low. Additional thinning and planting considerations are identified in Section 1 of this document as well as in the FMU-specific section above.				

Parcel Table

Owner	Parcel ID	Year Acquired	Previous Owner
City	3803353173470000	2002	Private
City	3803353213150000	2002	Private
City	3803353361300000	2014	Private
City	3803353503300000	2003	Private
City	3803353652310000	2001	Private
City	3803353751710000	2001	Private
City	3803353753400000	2003	Private
City	3803353783100000	2003	Private
City	3803353793560000	2018	Private
City	3803353873070000	2003	Private
City	3803353983070000	2022	Private
City	3803354021180000	2002	Private
City	3803354030810000	2002	Private
City	3803354040380000	2020	Private
City	3803354413070000	2022	Private
City	3803354481060000	2018	Private
City	3803354820990000	2018	Private
City	3803354921900000	2004	Private
City	3803355140950000	2018	Private
City	3803355382300000	2024	Private
City	3803355442260000	2014	Private
City	3803355460950000	2018	Private
City	3803355522230000	2014	Private
City	3803355622000000	2019	Private

North Beaver Creek Preserve

Overview

Site Description

North Beaver Creek Preserve is a 371-acre property owned by the City of Bellingham on the northwest side of Lake Whatcom. It is located above the Geneva neighborhood and along Lake Louise Road.

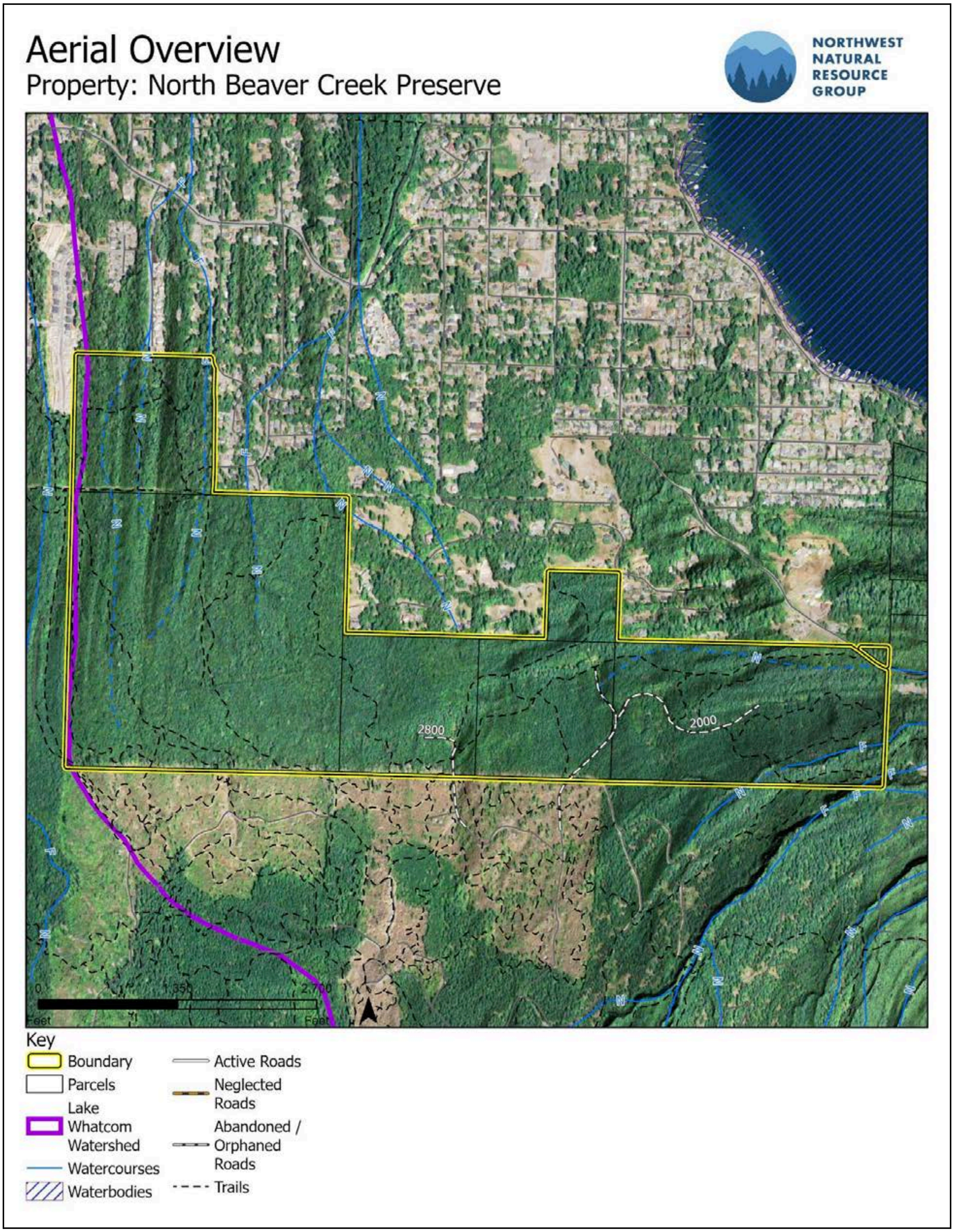
Property Information

This forest is located in Sections 34 and 35, Township 38N, Range 03E of the US Public Land Survey System and includes six parcels that are listed in the table at the end of this section.

Management History

North Beaver Creek Preserve contains parcels that were acquired by the city in three different purchases. The west side of the preserve contains two parcels that were acquired in 2002 and 2004 that were previously privately owned. The remaining part of the preserve was acquired in 2012 as part of the Lake Whatcom Land Acquisition and Preservation Program. These parcels were previously owned by Polygon Financials LLC and used for commercial timber production.

Property Overview Map



Assessment

Topoclimate

The topography of the preserve is variable, with a plateau in the middle of the preserve surrounded by steeper slopes. The majority of the property slopes to the north, resulting in cooler, moister conditions. There are some east-facing slopes on the east side of the property. The slopes contain several small drainages which create cooler microclimates.

Vegetation Zone

According to vegetation zone maps for North America, the following Ecological Systems were likely present prior to Euro-American settlement. More information on these maps and full descriptions of each system can be found in the discussion of Vegetation Zones in Section 2 of this document.

- North Pacific Maritime Mesic-Wet Douglas-fir-Western Hemlock Forest
- North Pacific Hypermaritime Western Red-cedar-Western Hemlock Forest

Soils

Data from the USDA Natural Resource Conservation Service (NRCS) Soil Surveys were used to identify the major soil types that underlay this forest, which are described in more detail in the discussion of Soil Productivity in Section 2. Information about specific soil units likely present at this property, including depth, drainage, productivity, and relevant management concerns are listed in the table below. The location of these soil units can be found in the accompanied map packet for this property.

Forest Soil Units Summary Table

<table>
<tr><th rowspan="2">Soil Unit</th><th colspan="2">Productivity</th><th colspan="5">Management Concerns</th><th rowspan="2">Acres (Pct)</th></tr>
<tr><th>Site Class</th><th>Max Growth</th><th>Drought Stress Hazard</th><th>Wind Throw Hazard</th><th>Mass Wasting Hazard</th><th>Logging Rutting Hazard</th><th>Logging Compact Hazard</th></tr>
<tr><td>Chuckanut Series
Gravelly Medial Loam on 15-30% Slopes
Deep (56in)
Well Drained</td><td>DF-2</td><td>186 ft3/ac/yr</td><td>Mod. High</td><td>Low</td><td>High</td><td>High</td><td>Mod.</td><td>207 (56%)</td></tr>
<tr><td>Nati Series
Ashy Loam on 15-30% Slopes
Mod. Deep (31in)
Well Drained</td><td>DF-2 / DF-3</td><td>172 ft3/ac/yr</td><td>Mod. High</td><td>Medium</td><td>High</td><td>High</td><td>High</td><td>55 (15%)</td></tr>
<tr><td>Nati Series
Ashy Loam on 5-15% Slopes
Mod. Deep (37in)</td><td>DF-2 / DF-3</td><td>172 ft3/ac/yr</td><td>Mod. High</td><td>Medium</td><td>High</td><td>High</td><td>High</td><td>54 (15%)</td></tr>
</table>

Soil Unit	Productivity		Management Concerns					Acres (Pct)
	Site Class	Max Growth	Drought Stress Hazard	Wind Throw Hazard	Mass Wasting Hazard	Logging Rutting Hazard	Logging Compact Hazard	
Well Drained								
Chuckanut Series Gravelly Medial Loam on 30-65% Slopes Deep (56in) Well Drained	DF-2	186 ft3/ac/yr	Mod. High	Low	High	High	Mod.	15 (4%)
Comar Series Ashy Silt Loam on 15-30% Slopes Deep (40in) Moderately Well Drained	DF-3	157 ft3/ac/yr	Mod. High	Medium	High	High	Mod.	14 (4%)
Comar Series Ashy Silt Loam on 5-15% Slopes Deep (40in) Moderately Well Drained	DF-3	157 ft3/ac/yr	Mod. High	Medium	High	High	Mod.	9 (2%)
Squalicum Series Gravelly Ashy Loam on 15-30% Slopes Deep (44in) Moderately Well Drained	DF-2	186 ft3/ac/yr	Mod.	Low	High	Mod.	High	8 (2%)

Slope Stability

As previously described in Section 2, this plan utilizes remotely mapped topographic data as well as hazard zones and historic landslides identified by the State of Washington Department of Natural Resources (DNR) to gauge the likelihood that unstable slopes will be found within a proposed management area. The presence of a mapped hazard zone or historic landslide does not preclude management, but indicates that further investigation is required.

The preserve contains moderate slopes that are generally less than 40%, but there are some areas that contain short steep sections with slopes greater than 70%. No known landslides have occurred, and there are no identified hazard zones. There is the potential for small areas of rule-identified landforms to exist on the site, particularly inner gorges in stream channels, but these can be easily avoided during future operations.

Hydrology

The west side of the preserve contains several drainages with seasonal streams. These eventually merge and flow into the northwest corner of Lake Whatcom. The east side of the property contains two streams that flow east into Beaver Creek, which eventually flows into the west side of Lake Whatcom. The southernmost stream on this side is identified as a fish-bearing stream by the DNR's hydrography database.

Roads and Access

There is a large network of public trails that goes through the North Beaver Creek Preserve. The trails are accessible from all sides of the property. Many of these trails run on old road beds that have been abandoned and converted to recreational use. The majority of the access on the north side of the property is through neighborhoods. The south side is accessible via Galbraith Mountain where the 2800 and 2000 roads provide access to the south central and southeastern portions of the property. These roads have been formally abandoned, but were used to harvest timber as recently as the early 1990s and can be restored to operation with minimal effort, providing the easiest access for heavy equipment into this area. During the assessment no concerns were found in the abandoned road system.

Health and Resiliency

Much of the North Beaver Creek Preserve is overstocked, particularly the east side of the property which is a Douglas-fir plantation. There is already a plan in place to address the overstocking in the Douglas-fir stand through a commercial thinning that is set to be completed in 2026. No other forest health concerns were observed on this property.

Wildlife Habitat

A review of the Washington State Department of Fish and Wildlife Priority Species Database identified little brown bat, big brown bat, and Yuma myotis bat as having been documented somewhere within the 23,000-acre township containing North Beaver Creek Preserve. The preserve is also identified as a part of a large biodiversity area and corridor that stretches south across Lookout Mountain.

Much of the preserve contains limited wildlife habitat features, but the northwest corner contains older forest that is more diverse in species and structure. This mixed stand contains larger downed wood and snags that offer habitat, as well as a healthy understory shrub layer with plants that provide food for wildlife. The young mixed hardwood stand on the west side of the preserve also contains many fruit-bearing trees and shrubs, but is lacking in large dead wood features as a result of more recent logging that removed much of the large woody material. The east side of the preserve that contains dense Douglas-fir is limited in wildlife habitat. It is lacking large woody structures and also has a very limited understory shrub layer due to overstocking.

Wildfire Susceptibility

Factors that increase the chance of ignition on this property include a close proximity to residential areas and high levels of recreation. The overstocking on much of the property contributes abundant woody material that could act as fuel sources for a wildfire. There is good road access to most sides of the property, however, which allows for a rapid response to wildfire.

Carbon Storage

The Douglas-fir stands that make up about half of the property have high carbon storage potential due to the long life-span of Douglas-fir trees. However, most of these stands are currently overstocked which results in a slower growth rate and, therefore, rates of carbon sequestration. The planned commercial thinning of these stands will stimulate further growth of the Douglas-fir and increase carbon sequestration rates. The rest of the property is mostly dominated by hardwood species which have lower carbon storage potential. Some of the property contains young hardwood trees which are growing rapidly and sequestering carbon, but these rates will slow down as the trees age, and the long-term carbon storage potential of the hardwoods is low due to their shorter life span than conifer species.

Cultural Resources

The Lake Whatcom watershed is a landscape rich with cultural significance for Indigenous peoples—particularly the Lummi Nation and the Nooksack and Swinomish Tribes—who have maintained deep spiritual, cultural, and subsistence connections to the landscape. Although a review of the Washington State Department of Archaeology and Historic Preservation Wisaard online database did not identify any known historical sites on this property and none were encountered while developing this plan, this property has a long history of human use and artifacts may be present. Please see the previous discussion about cultural use practices in the Lake Whatcom Watershed for a more detailed assessment of best management practices moving forward.

Recreation

The North Beaver Creek Preserve has high recreational use for mountain biking and hiking on an extensive trail network throughout the property. Main access for recreational users is from the neighborhoods to the north of the preserve and from neighboring Galbraith Mountain trails to the south and west.

Recommendations

Roads and Access

Restoring the formally abandoned 2000 and 2800 roads from adjacent Galbraith Mountain timberlands will provide access into stands requiring heavy machinery access for forest management interventions. These roads should be actively maintained between thinning interventions to ensure all active roads maintain a high standard of function. See the best management practices identified in Section 2. Otherwise, no new road construction is needed at this site.

Health and Resiliency

Recommendations for addressing observed overstocking are given at the management unit level below.

Wildfire Susceptibility

Shaded fuel breaks are recommended within 100 feet of public roads and existing structures which are designed to keep fires on the ground and slow their spread until firefighting resources can arrive. For additional details on implementation, see the description of a shaded fuel break given in the discussion of Wildfire Susceptibility in Section 2 of this document.

Forest Types

All recommendations for this property follow the previous discussion of forest-types in section 3 and are discussed by management unit below.

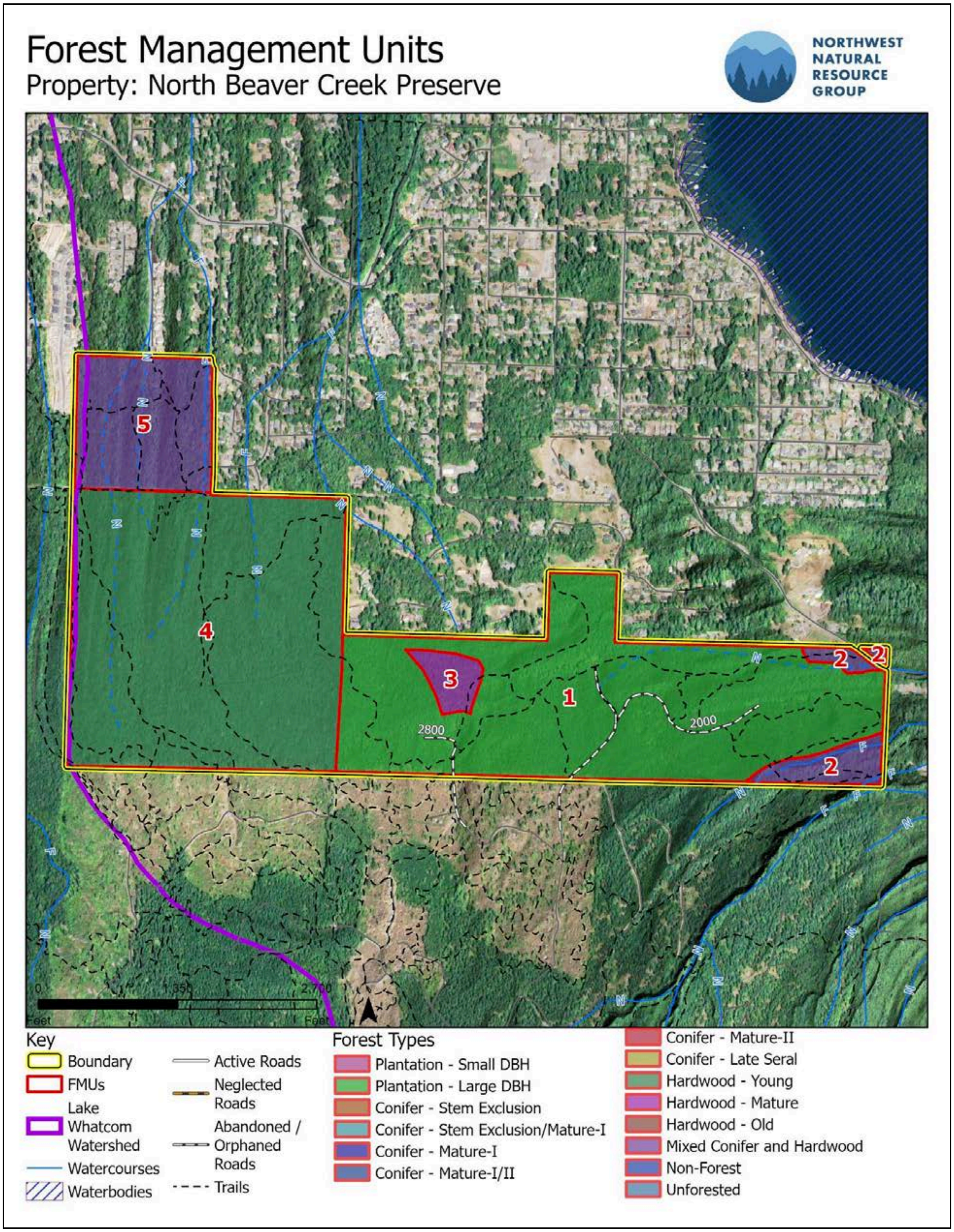
Management Units

Forest cover was delineated into the forest management units (FMUs) using both remotely sensed data, historic inventory units, and field inventory data. The forestland within these management units share similar forest characteristics and management recommendations. For each FMU, this plan describes the geophysical attributes and forest conditions and assesses the unit against the plans management objectives using the previously described framework by forest type. Recommendations are then given by FMU, typically referencing general recommendations by forest type, but more information is given as needed. Finally, a schedule of management activities by year and FMU is given at the end of this section.

Summary of Forest Management Units

FMU	Acres	Forest Type	Management
1	152	Conifer Plantation - Large DBH	Thinning
2	12	Mixed Conifer and Hardwood	None
3	6	Mixed Hardwood - Mature	Monitoring
4	161	Mixed Hardwood - Young	Thinning and Planting
5	39	Mixed Conifer and Hardwood	None
Total	**371**		

Map of Forest Management Units



FMU 1 - Conifer Plantation - Large DBH

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	DF	213	210	404	79	8	15	22	90
	All	All	230	217	411		2	14	22	89
Midstory	Major	BM	12	1	3	1	2	4	6	40
	All	All	16	2	6		2	5	14	40
Total	All	All	246	219	417	80	2	14	22	86

Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.

FMU 1 was acquired by the City of Bellingham in 2012 and was previously managed as commercial timberland. There is an old road bed that runs from the southern part of the unit through the east side on a central ridgeline, with moderate slopes surrounding the ridge. The west side of the unit contains moderate slopes to the north. The unit was clearcut about 35 years ago and replanted with Douglas-fir. It has a soil productivity rating of site class II. Total stocking is approximately 246 TPA. The overstory contains approximately 230 TPA and is primarily composed of Douglas-fir that average 15 inches DBH and 90 ft tall. The midstory contains approximately 16 TPA and is primarily composed of bigleaf maple that average 4 inches DBH and 40 ft tall. The stand is overstocked in the Stem Exclusion phase of development with a high relative density of 79 and has low species diversity due to being primarily composed of Douglas-fir. Per the earlier discussion on Douglas-fir plantations, a series of variable density commercial thinnings is recommended followed by potential underplanting once density has been sufficiently reduced. The City is planning to conduct a commercial thinning across this unit in 2026.

FMU 2 - Mixed Conifer and Hardwood

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	RC	96	80	501	82	24	28	36	100
	Minor	BM	12	10	49		18	24	30	100
		RA	12	10	21		10	14	24	100
	All	All	120	100	571		10	26	36	100
Midstory	Major	RC	100	20	70	10	4	8	12	40
Total	All	All	220	120	641	92	4	18	36	73

Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.

FMU 2 represents two small areas in the northeast and southeast corners of the preserve that are part of the area that was purchased by the city in 2012. They both have streams that run through the center and were left out of the harvest that occurred on this side of the property 35 years ago. The northeast area is primarily flat with a soil productivity rating of site class RA, and the southeast area contains a larger stream and ravine with moderate slope and a soil productivity rating of site class II. Total stocking is approximately 220 TPA. The overstory contains approximately 120 TPA and is primarily composed of western redcedar, with small components of bigleaf maple and red alder. Overstory redcedar average 28 inches DBH and 100 ft tall. The midstory contains approximately 100 TPA and is primarily composed of western redcedar that average 8 inches DBH and 40 ft tall. Because these units are primarily riparian areas with wet soils, the habitat is suitable for the western redcedar and red alder. No forest health concerns were observed. Due to the stand being composed of riparian areas with mixed conifer and hardwood forests, no management activities are recommended.

FMU 3 - Mixed Hardwood - Mature

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	RA	144	128	247	54	10	14	16	80
	Minor	BM	36	32	48		6	12	18	80
	All	All	180	160	295		6	14	18	80
Midstory	Major	BM	40	3	9	1	2	4	6	40
Total	All	All	220	163	305	56	2	12	18	73

Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.

FMU 3 is a small area composed of mixed hardwoods that lies within the Douglas-fir plantation on the east side of the preserve. This area was likely part of the harvest that occurred 35 years ago, but the survival of the planted Douglas-fir was low, and the area primarily naturally regenerated with hardwoods. The unit has a soil productivity rating of site class II. Total stocking is approximately 220 TPA. The overstory contains approximately 180 TPA and is primarily composed of red alder, with a small component of bigleaf maple. Overstory red alder average 14 inches DBH and 80 ft tall. The midstory contains approximately 40 TPA and is primarily composed of bigleaf maple that averages 4 inches DBH and 40 ft tall. Douglas-fir can occasionally be found in the overstory and western redcedar is starting to establish in the understory, but conifer presence is generally low in this unit. This hardwood-dominant stand adds diversity to a landscape that is primarily a Douglas-fir plantation. The planned commercial thinning in FMU 1 will exclude this FMU since Douglas-fir is the only species that will be harvested and its presence is low in this unit. The red alder that dominates the site will start to decline and likely begin to die off in another 30 years. This will open up the canopy and allow for a successional transition towards shade-tolerant species like western redcedar which is starting to establish on the site. Regeneration should be monitored in 10-15 years to ensure this transition is successful.

FMU 4 - Mixed Hardwood - Young

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	BM	131	63	109	41	4	9	38	80
		RA	93	41	65		4	8	12	80
	Minor	DF	32	17	22		6	8	12	74
	All	All	272	128	244		4	9	38	79
Midstory	Major	BM	46	10	11	2	2	4	6	40
	All	All	48	10	11		2	4	6	40
Total	All	All	320	138	255	43	2	8	38	73

Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.

FMU 4 consists of a parcel that was acquired by the City of Bellingham in 2004. It is the larger square parcel on the west side of the preserve. It contains mostly moderate north-facing slopes and has a soil productivity rating that ranges from site class II to III. The forest is primarily young hardwoods with occasional older bigleaf maples and conifers, suggesting that it was high-graded which removed the most valuable conifer species from the overstory. Total stocking is approximately 320 TPA. The overstory contains approximately 272 TPA and is primarily composed of red alder and bigleaf maple, with a small component of Douglas-fir. Overstory bigleaf maple average 9 inches DBH and 80 ft tall, and red alder average 8 inches DBH and 80 ft tall. The midstory contains approximately 48 TPA and is primarily composed of bigleaf maple that average 4 inches DBH and 40 ft tall. Other minor species are also present in the younger cohort of trees including black cottonwood and bitter cherry. This forest is currently very dominant to hardwood species due to the selective logging of conifer species that occurred. While relative density is currently in an optimal range, it will significantly increase as the trees reach a DBH of greater than 10 inches. Additionally, establishing additional conifer species will improve the diversity of the stand and ensure long term forest cover once the short-lived red alder declines. It is recommended to pre-commercially thin the younger cohort of hardwood species followed by underplanting of conifers.

FMU 5 - Mixed Conifer and Hardwood

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	BM	43	75	115	48	10	18	26	100
		RC	36	60	140		18	23	30	100
	Minor	RA	11	18	19		10	14	20	100
	All	All	98	171	311		10	20	30	103
Midstory	Major	BM	26	14	13	5	4	6	14	47

		RC	26	14	22		6	9	14	47
	All	All	51	29	35		4	8	14	47
Total	All	All	149	200	346	53	4	16	30	84

Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.

FMU 5 consists of a square parcel in the northwest corner of the preserve that was acquired by the City of Bellingham in 2002. The exact history of the site is unknown, but it likely was clearcut in the early to mid-1900s and then naturally regenerated with several different species. The unit has a soil productivity rating of site class III. It is diverse in species and structure, consisting of a mix of conifer and hardwood species of different ages. Total stocking is approximately 149 TPA. The overstory contains approximately 98 TPA and is primarily composed of western redcedar and bigleaf maple, with a small component of red alder. Douglas-fir and black cottonwood are also present in minor amounts. Overstory western redcedar average 23 inches DBH and 100 ft tall, and maple average 18 inches DBH and 100 ft tall. The midstory contains approximately 51 TPA and includes western redcedar and bigleaf maple. Most of the red alder that used to occupy some of the overstory of this stand has died off, opening up gaps in the canopy where the redcedar and maple have regenerated. Per the earlier discussion on mixed conifer and hardwood forests with no health concerns, no management activities are recommended.

Management Activity Schedule

Timeline	Activity	Priority	FMU	Prescription
2025 to 2030	Thinning (PCT)	2	4	Pre-commercially thin to a target density of 150 to 200 TPA.
	Thinning (CT / NCT)	1	1	Thin to an initial target density of 140 to 170 TPA.
	Planting	2	4	Underplant after thinning with 150 TPA shade-tolerant conifers suitable to site conditions or wait 5-10 years and assess natural regeneration, planting if necessary.
2035 to 2040	Thinning (CT / NCT)	2	1	Thin to a final target density of 80 to 110 TPA within 10-15 years after the last thinning entry.
	Planting	3	1	Underplant after thinning with 150 TPA shade-tolerant conifers suitable to site conditions or wait 5-10 years and assess natural regeneration, planting if necessary.
			3	Monitor the stand for natural regeneration, and, if necessary, underplant with 150 TPA of shade-tolerant conifers suitable to site conditions

Notes: PCT - Pre-commercial Thinning, CT - Commercial Thinning, NCT - Non-commercial Thinning. Priority

Levels: 1 - High, 2 - Moderately High, 3 - Moderate, 4 - Low. Additional thinning and planting considerations are identified in Section 1 of this document as well as in the FMU-specific section above.

Parcel Table

Owner	Parcel ID	Year Acquired	Previous Owner
City	3803340693700000	2002	Private
City	3803341271360000	2004	Private
City	3803343280700000	2012	Polygon
City	3803344590670000	2012	Polygon
City	3803344961620000	2012	Polygon
City	3803351290710000	2012	Polygon

Olsen Creek Preserve

Overview

Site Description

Olsen Creek Preserve is a 71-acre property owned by the City of Bellingham on the northeast side of Lake Whatcom. It is located along Y Road and North Shore Road.

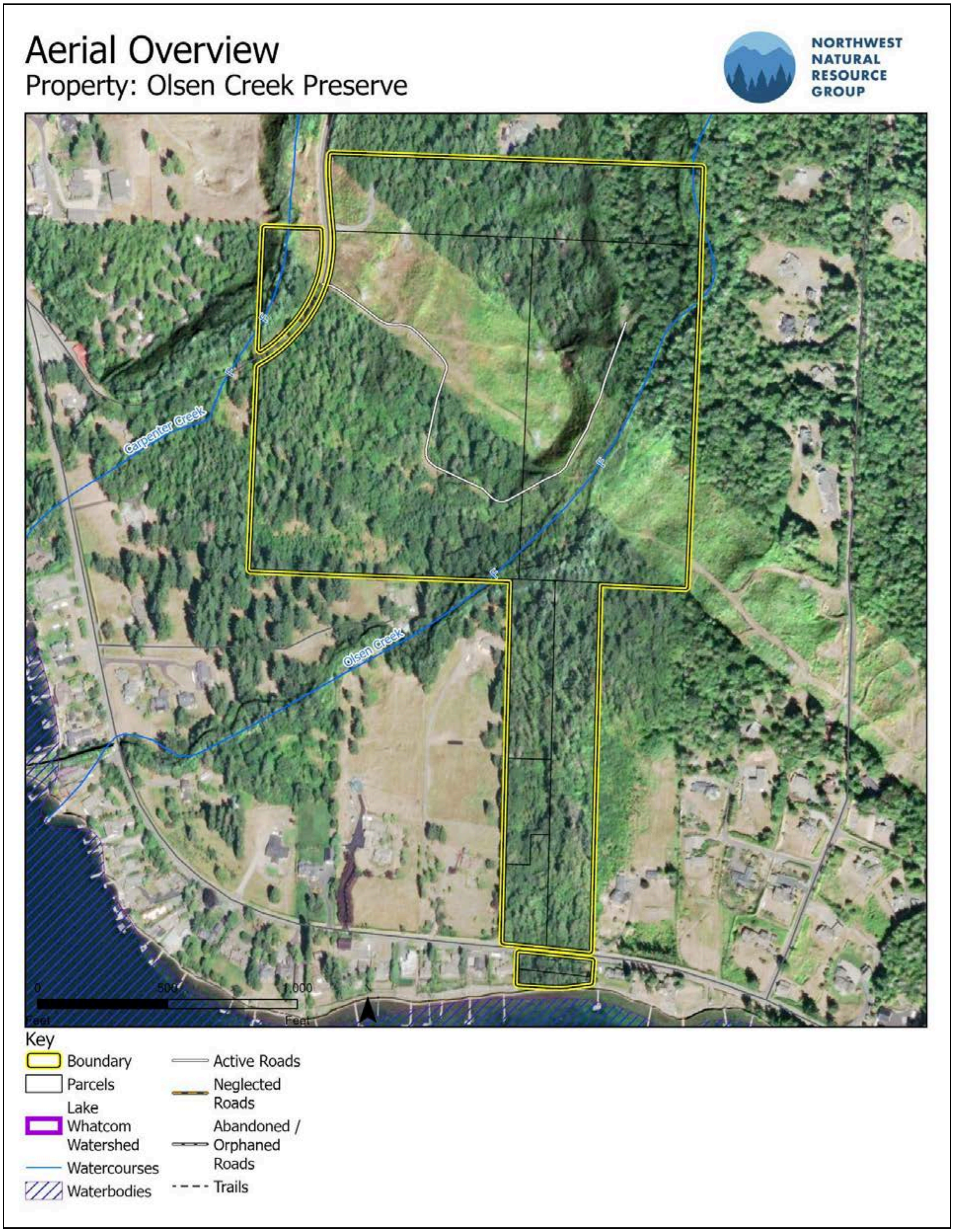
Property Information

This forest is located in Section 30, Township 3N, Range 04E of the US Public Land Survey System and includes eight parcels that are listed in the table at the end of this section.

Management History

The multiple parcels of this site were acquired by the city in 2006-2008, with one additional parcel acquired in 2017. This site was previously used for residential land and a house can be found on site. It is estimated that most of the forest on the property naturally regenerated following clearcut harvests in the early to mid-1900s.

Property Overview Map



Assessment

Topoclimate

Olsen Creek Preserve is a fairly flat site with gentle slopes of less than 40%, except for a small area that runs parallel to the creek. The site is mostly dry and uniform in topoclimate conditions. The Olsen Creek itself provides cool and moist conditions to its surroundings.

Vegetation Zone

According to vegetation zone maps for North America, the following Ecological Systems were likely present prior to Euro-American settlement. More information on these maps and full descriptions of each system can be found in the discussion of Vegetation Zones in Section 2 of this document.

- North Pacific Maritime Mesic-Wet Douglas-fir-Western Hemlock Forest
- North Pacific Lowland Riparian Forest and Shrubland
- North Pacific Seasonal Sitka Spruce Forest

Soils

Data from the USDA Natural Resource Conservation Service (NRCS) Soil Surveys were used to identify the major soil types that underlay this forest, which are described in more detail in the discussion of Soil Productivity in Section 2. Information about specific soil units likely present at this property, including depth, drainage, productivity, and relevant management concerns are listed in the table below. The location of these soil units can be found in the accompanied map packet for this property.

Forest Soil Units Summary Table

Soil Unit	Productivity		Management Concerns					Acres (Pct)
	Site Class	Max Growth	Drought Stress Hazard	Wind Throw Hazard	Mass Wasting Hazard	Logging Rutting Hazard	Logging Compact Hazard	
Everett Series Very Gravelly Ashy Sandy Loam on 2-8% Slopes Shallow (18in) Somewhat Excessively Drained	DF-3	143 ft3/ac/yr	High	Low	Mod.	Low	Mod.	43 (62%)
Kline Series Stratified Extremely Cobbly Sand To Very Gravelly Loamy Sand on 2-8% Slopes Moderately Well Drained	DF-3	143 ft3/ac/yr	High	Low	Mod.	Mod.	Mod.	12 (17%)

Soil Unit	Productivity		Management Concerns					Acres (Pct)
	Site Class	Max Growth	Drought Stress Hazard	Wind Throw Hazard	Mass Wasting Hazard	Logging Rutting Hazard	Logging Compact Hazard	
Squalicum Series Gravelly Ashy Loam on 15-30% Slopes Deep (44in) Moderately Well Drained	DF-2	186 ft3/ac/yr	Mod.	Low	High	Mod.	High	11 (15%)
Whitehorn Series Ashy Silt Loam on 0-2% Slopes Poorly Drained	RA-4	100 ft3/ac/yr	Mod. High	High	Low	High	High	3 (5%)

Slope Stability

As previously described in Section 2, this plan utilizes remotely mapped topographic data as well as hazard zones and historic landslides identified by the State of Washington Department of Natural Resources (DNR) to gauge the likelihood that unstable slopes will be found within a proposed management area. The presence of a mapped hazard zone or historic landslide does not preclude management, but indicates that further investigation is required.

Within the Olsen Creek Preserve, there is a known prehistoric landslide that ran through the Olsen Creek itself. This was likely caused by a greater geologic event occurring upstream of the site which deposited soil down the Olsen Creek. The steepest part of the unit is a narrow strip that runs from the powerline easement north in parallel with Olsen Creek, at a slope of 70%. This small section will need to be evaluated for soil movement and may have to be excluded from harvest operations. The rest of the unit is under 40% slope and has no signs of instability.

Hydrology

The only hydrologic feature on the site is its namesake, Olsen Creek. It was observed to be running in late summer 2025 and is identified as fish-bearing by the DNR's hydrography database. This designation is likely correct, given the lack of fish passage barriers and low gradient to Lake Whatcom. The creek runs on the eastern side of the site and through residential land before flowing into the lake.

Roads and Access

The main access point for the Olsen Creek Preserve is directly off Y Road, where the road meets the powerline easement. There is a gated road that is partially rocked and leads uphill to the previous homesite. This road is very flat and crosses no water features. The property also intersects with North Shore Road on the south side, but there is no designated parking for access at this point. During the assessment no concerns were found in the current road system.

Health and Resiliency

The majority of the Olsen Creek Preserve is either a naturally regenerated second growth forest or a 50- to 80-year-old forest with diverse stand characteristics, aside from a small area of overstocked conifers that were planted about 10 years ago. Aside from this overstocking, no other health concerns were observed.

Wildlife Habitat

A review of the Washington State Department of Fish and Wildlife Priority Species Database identified gray wolf as having been documented somewhere within the 23,000-acre township containing Olsen Creek Preserve. Olsen Creek is identified as habitat for cutthroat trout. The property provides diverse wildlife habitat supported by a mix of forest types and species. Mature forest areas with large woody debris offer valuable cover and structural complexity. The understory shrub layer provides food sources for wildlife. Olsen Creek and its riparian area provide habitat for aquatic species and amphibians.

Wildfire Susceptibility

The greatest risk of wildfire to this site is a fire igniting from a neighboring parcel, due to the prevalence of residential homes surrounding the site. The forest as a whole does not have high fuel loads, so fire would likely not spread easily through the site. If any fire were to occur, the Olsen Creek Preserve is easily accessible from Y Road.

Carbon Storage

The preserve has mostly second growth forest that is at healthy stocking levels with large conifer components that have high carbon storage potential. Thinning the young stands as they reach the stem exclusion phase will ensure optimal growth rates and, therefore, carbon sequestration rates.

Cultural Resources

The Lake Whatcom watershed is a landscape rich with cultural significance for Indigenous peoples—particularly the Lummi Nation and the Nooksack and Swinomish Tribes—who have maintained deep spiritual, cultural, and subsistence connections to the landscape. Though a review of the Washington State Department of Archaeology and Historic Preservation Wisaard online database did not identify any known historical sites on this property and none were encountered while developing this plan, this property has a long history of human use and artifacts may be present. Please see the previous discussion about cultural use practices in the Lake Whatcom Watershed for a more detailed assessment of best management practices moving forward.

Recreation

There is no developed recreational access at Olsen Creek Preserve, but a small foot-trail was observed passing through the powerline right-of-way.

Recommendations

Roads and Access

The main access road should be maintained to ensure easy access for future management activities. Implement a maintenance plan for ditches, culverts, and road grades to ensure all active roads maintain a high standard of function. See the best management practices identified in Section 2. Given the flat terrain and lack of water crossings, maintaining this road should pose few challenges other than removing encroaching vegetation at the time of management activity.

Health and Resiliency

Recommendations for addressing observed overstocking are given at the management unit level below.

Wildfire Susceptibility

Shaded fuel breaks are recommended within 100 feet of public roads and existing structures which are designed to keep fires on the ground and slow their spread until firefighting resources can arrive. For additional details on implementation, see the description of a shaded fuel break given in the discussion of Wildfire Susceptibility in Section 2 of this document.

Forest Types

All recommendations for this property follow the previous discussion of forest-types in section 3 and are discussed by management unit below.

Management Units

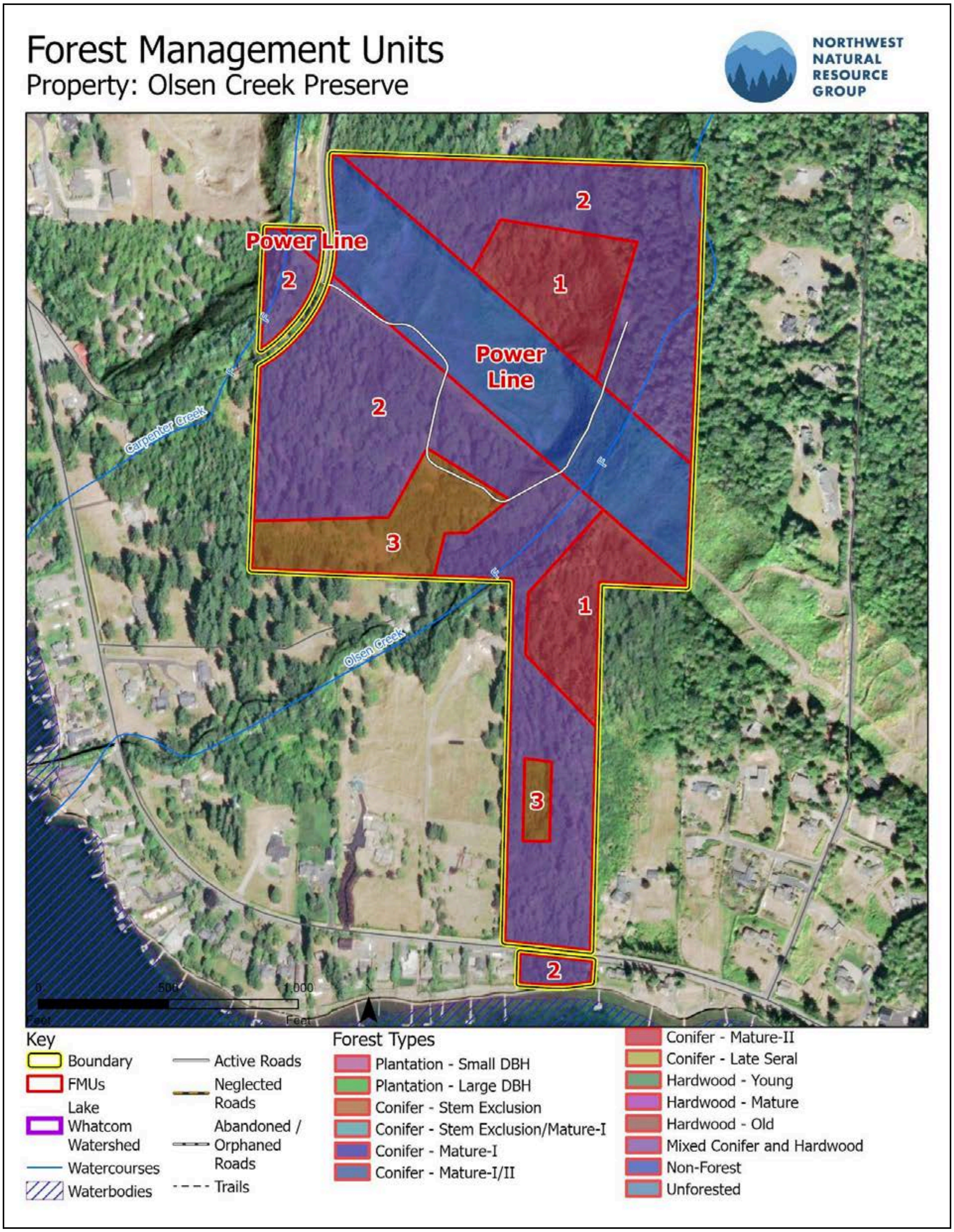
Forest cover was delineated into the forest management units (FMUs) using both remotely sensed data, historic inventory units, and field inventory data. The forestland within these management units share similar forest characteristics and management recommendations. For each FMU, this plan describes the geophysical attributes and forest conditions and assesses the unit against the plans management objectives using the previously described framework by forest type. Recommendations are then given by FMU, typically referencing general recommendations by forest type, but more information is given as needed. Finally, a schedule of management activities by year and FMU is given at the end of this section.

Summary of Forest Management Units

FMU	Acres	Forest Type	Management
1	10	Mixed Conifer - Mature-II	None
2	40	Mixed Conifer and Hardwood	None
3	6	Mixed Conifer - Stem Exclusion	Thinning
Power Line	15	Unforested	Not Applicable

FMU	Acres	Forest Type	Management
Total	**71**		

Map of Forest Management Units



FMU 1 - Mixed Conifer - Mature-II

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	DF	72	228	293	67	16	24	32	160
	Minor	BM	12	38	26		12	16	24	160
		RC	18	57	46		10	18	24	160
		WH	18	57	46		10	18	24	160
	All	All	120	380	411		10	21	32	160
Midstory	Major	BM	20	7	9	4	2	6	8	60
		RC	20	7	9		2	6	8	60
		WH	20	7	9		2	6	8	60
	All	All	60	20	26		2	6	8	60
Total	All	All	180	400	438	71	2	16	32	127

Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.

FMU 1 consists of two non-contiguous areas within the Olsen Creek Preserve. They appear to be naturally regenerated second growth forests. The southern section is moderately flat with mild slopes and a soil productivity rating of site class II. The northern portion is mostly flat with a small section of slope that is 40-65% and a soil productivity rating of site class III. Total stocking is approximately 180 TPA. The overstory contains approximately 120 TPA and is primarily composed of Douglas-fir, with small components of bigleaf maple, western redcedar and western hemlock. Overstory Douglas-fir average 24 inches DBH and 160 ft tall. The midstory contains approximately 60 TPA and is primarily composed of western hemlock, bigleaf maple and western redcedar that all average 6 inches DBH and 60 ft tall. The forest here is developed and structurally diverse and in the Mature-II phase of development. Per the earlier discussion of stands in this stage, no management activities are recommended for this unit. There is no current road access to this unit.

FMU 2 - Mixed Conifer and Hardwood

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	DF	32	55	76	50	8	17	32	131
		RC	48	75	102		8	16	32	119
	Minor	BM	16	25	27		6	14	20	111
		GF	11	22	38		8	22	32	133
		WH	27	47	60		8	16	32	135
	All	All	150	254	328		6	16	32	125

Midstory	Major	GF	13	4	6	4	2	6	10	40
		RC	34	9	15		2	6	10	39
	All	All	62	16	26		2	6	10	38
Total	All	All	212	270	354	54	2	13	32	100
Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.										

FMU 2 includes the majority of the preserve and also contains the riparian area of Olsen Creek. Most of this unit was clearcut before the 1950s and left to naturally regenerate. There is also a small section that was cut out in the early 1970s for a homesite, which currently remains in the preserve. The soil productivity rating of the site ranges from site class II to III. The stand is variable in species composition, structure, and density. Total stocking is approximately 212 TPA. The overstory contains approximately 150 TPA and is primarily composed of western redcedar and Douglas-fir, with small components of bigleaf maple, grand fir and western hemlock. Overstory Douglas-fir average 17 inches DBH and 131 ft tall, and redcedar average 16 inches DBH and 119 ft tall. The midstory contains approximately 62 TPA and is primarily composed of western redcedar and grand fir. Midstory grand fir average 6 inches DBH and 40 ft tall, and redcedar average 6 inches DBH and 39 ft tall. Species occur in clumps, with small natural gaps providing structural diversity and regeneration throughout. This is a mixed conifer and hardwood forest with no health concerns. Per the earlier discussion of this type of forest, no management activities are recommended for this unit. Parts of this unit are accessible from the gravel road that runs through the preserve to the homesite.

FMU 3 - Mixed Conifer - Stem Exclusion

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	DF	172	49	115	31	2	8	10	40
	Minor	GF	71	17	20		2	5	8	26
		RC	51	16	12		2	4	6	20
		SS	71	17	20		2	5	8	26
		WP	20	1	9		2	6	8	40
	All	All	384	100	176		2	6	10	32
Total	All	All	384	100	176	31	2	6	10	32
Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.										

This unit was cleared and used as a field from at least the early 1950s until 2015 to 2017, when it was replanted with a conifer mix. As such, the unit is very flat. The soil productivity rating of the unit is site class II. The stand is approaching the Stem Exclusion phase, and as a result the canopy is very tight and the understory is bare. Total stocking is approximately 384 TPA. The overstory is primarily composed of Douglas-fir, with small components of grand fir, western redcedar, Sitka spruce and western white pine. Overstory Douglas-fir average 8 inches DBH and 40 ft tall. No midstory is currently present in this stand.

Per the earlier discussion of mixed conifer stands in Stem Exclusion, a series of thinnings are recommended starting with a pre-commercial thinning. Given the small size of the stand, subsequent thinnings will be non-commercial. The unit is accessible from the gravel road that runs through the preserve.

Management Activity Schedule

Timeline	Activity	Priority	FMU	Prescription
2030 to 2035	Thinning (PCT)	1	3	Pre-commercially thin to a target density of 250 to 300 TPA.
2040 to 2045	Thinning (CT / NCT)	2	3	Thin to an initial target density of 140 to 170 TPA within 10-15 years after the last thinning entry.
2050 to 2055	Thinning (CT / NCT)	3	3	Evaluate the stand for a second thinning and, if necessary, thin to a final target density 80 to 110 TPA within 10-15 years after the last thinning entry.
Notes: PCT - Pre-commercial Thinning, CT - Commercial Thinning, NCT - Non-commercial Thinning. Priority Levels: 1 - High, 2 - Moderately High, 3 - Moderate, 4 - Low. Additional thinning and planting considerations are identified in Section 1 of this document as well as in the FMU-specific section above.				

Parcel Table

Owner	Parcel ID	Year Acquired	Previous Owner
City	3804301493260000	2007	Private
City	3804301971820000	2006	Private
City	3804301971900000	2006	Private
City	3804301984000000	2017	Private
City	3804302121160000	2008	Private
City	3804302141960000	2006	Private
City	3804302201200000	2008	Private
City	3804302333240000	2007	Private

Silver Beach Preserve

Overview

Site Description

Silver Beach Preserve is a 42-acre property owned by the City of Bellingham near the northwest shore of Lake Whatcom. It is located in the middle of the Silver Beach neighborhood and near the Silver Beach Elementary School.

Property Information

This forest is located in Sections 21 and 22, Township 38N, Range 03E of the US Public Land Survey System and includes 38 parcels that are listed in the table at the end of this section.

Management History

The preserve is composed of multiple parcels acquired by the City of Bellingham over several decades to limit development around the lake. Acquisitions began in 1988 and continued through 2017. The parcels were previously in private ownership, including some held by development companies, so their exact land-use history is uncertain. Most of the area was likely clearcut 80–120 years ago, consistent with regional logging patterns, though some parcels may have experienced more recent disturbances.

Property Overview Map

Assessment

Topoclimate

This property lies at low elevation near the shores of Lake Whatcom, where the moderating influence of the lake creates relatively mild conditions with reduced temperature extremes and slightly higher humidity. The rolling terrain and gentle slopes offer little variation in aspect or exposure, resulting in a generally uniform topoclimate across the site.

Vegetation Zone

According to vegetation zone maps for North America, the following Ecological Systems were likely present prior to Euro-American settlement. More information on these maps and full descriptions of each system can be found in the discussion of Vegetation Zones in Section 2 of this document.

- North Pacific Maritime Mesic-Wet Douglas-fir-Western Hemlock Forest
- North Pacific Seasonal Sitka Spruce Forest
- North Pacific Lowland Riparian Forest and Shrubland

Soils

Data from the USDA Natural Resource Conservation Service (NRCS) Soil Surveys were used to identify the major soil types that underlay this forest, which are described in more detail in the discussion of Soil Productivity in Section 2. Information about specific soil units likely present at this property, including depth, drainage, productivity, and relevant management concerns are listed in the table below. The location of these soil units can be found in the accompanied map packet for this property.

Forest Soil Units Summary Table

Soil Unit	Productivity		Management Concerns					Acres (Pct)
	Site Class	Max Growth	Drought Stress Hazard	Wind Throw Hazard	Mass Wasting Hazard	Logging Rutting Hazard	Logging Compact Hazard	
Squalicum Series Gravelly Ashy Loam on 5-15% Slopes Deep (44in) Moderately Well Drained	DF-2	186 ft3/ac/yr	Mod.	Low	Mod.	Mod.	High	38 (92%)
Chuckanut Series Gravelly Medial Loam on 15-30% Slopes Deep (56in) Well Drained	DF-2	186 ft3/ac/yr	Mod. High	Low	High	High	Mod.	3 (7%)

Slope Stability

As previously described in Section 2, this plan utilizes remotely mapped topographic data as well as hazard zones and historic landslides identified by the State of Washington Department of Natural Resources (DNR) to gauge the likelihood that unstable slopes will be found within a proposed management area. The presence of a mapped hazard zone or historic landslide does not preclude management, but indicates that further investigation is required.

The preserve contains mild slopes that are less than 40% throughout most of the property, but there are some steeper shelves by the small lake on the west side. No known landslides have occurred, and there are no identified hazard zones.

Hydrology

The DNR's hydrography database identifies two non-fish-bearing streams on the east side of the preserve that flow into Lake Whatcom. Invasive Himalayan blackberry is growing in the riparian area of the southernmost stream. There is also a pond on the west side of the property.

Roads and Access

The preserve is surrounded by neighborhoods and has a network of trails throughout that is accessible from many access points. There are no roads that go through the property.

Health and Resiliency

The preserve's forests are structurally and compositionally diverse which provides good ecological resiliency. Invasive Himalayan blackberry is present along edges and in riparian areas. The risk of invasive species spread is high given the preserve's proximity to residential development and its high level of recreational use. However, the forest canopy is well developed in most areas which should protect against large infestations of shade-intolerant invasive species like Himalayan blackberry, but shade-tolerant species like English ivy and English holly could still spread.

Wildlife Habitat

A review of the Washington State Department of Fish and Wildlife Priority Species Database identified big brown bat, little brown bat, and myotis bat as having been documented somewhere within the 23,000-acre township containing Silver Beach Preserve. The pond on the west side is identified as a priority area for aquatic habitat.

The property provides diverse wildlife habitat supported by a mix of forest types and species. Mature forest areas with large woody debris offer valuable cover and structural complexity, while scattered canopy gaps support a variety of shrubs that provide important food sources. Aquatic features, including a stream and pond, further enhance habitat diversity and support a range of terrestrial and aquatic species.

Wildfire Susceptibility

Ignition probability of wildfire on the preserve is high due to the close proximity to residential areas and heavy recreational use. Overall hazard is moderated by low levels of ladder fuels, the presence of larger, more fire-resilient trees, and a substantial hardwood component that is less prone to burning. Additionally, there is good access for wildfire response with neighborhood roads surrounding the preserve and providing multiple entry points.

Carbon Storage

The preserve has strong carbon storage potential due to its healthy conifer component, including some large trees that already store significant amounts of carbon. Most of the forest is not overstocked, allowing conifers to maintain good growth rates and continue sequestering carbon effectively into the future.

Cultural Resources

The Lake Whatcom watershed is a landscape rich with cultural significance for Indigenous peoples—particularly the Lummi Nation and the Nooksack and Swinomish Tribes—who have maintained deep spiritual, cultural, and subsistence connections to the landscape. Although a review of the Washington State Department of Archaeology and Historic Preservation Wisaard online database did not identify any known historical sites on this property and none were encountered while developing this plan, this property has a long history of human use and artifacts may be present. Please see the previous discussion about cultural use practices in the Lake Whatcom Watershed for a more detailed assessment of best management practices moving forward.

Recreation

The trails in the preserve experience high levels of recreation due to the close proximity to neighborhoods and schools. There are several access points from the surrounding neighborhoods

Recommendations

Roads and Access

There are no existing roads within the preserve, and no new road construction is recommended.

Health and Resiliency

Restoration of the riparian area along the southern stream within the preserve is recommended. Remove the Himalayan blackberry and replant with a mix of native trees and shrubs. Ongoing monitoring for invasive species along both streams and throughout the park is also recommended, as the forest's proximity to neighborhoods and heavy recreational use make it susceptible to new infestations.

Wildfire Susceptibility

Shaded fuel breaks are recommended within 100 feet of public roads and existing structures which are designed to keep fires on the ground and slow their spread until firefighting resources can arrive. For additional details on implementation, see the description of a shaded fuel break given in the discussion of Wildfire Susceptibility in Section 2 of this document.

Forest Types

All recommendations for this property follow the previous discussion of forest-types in section 3 and are discussed by management unit below.

Management Units

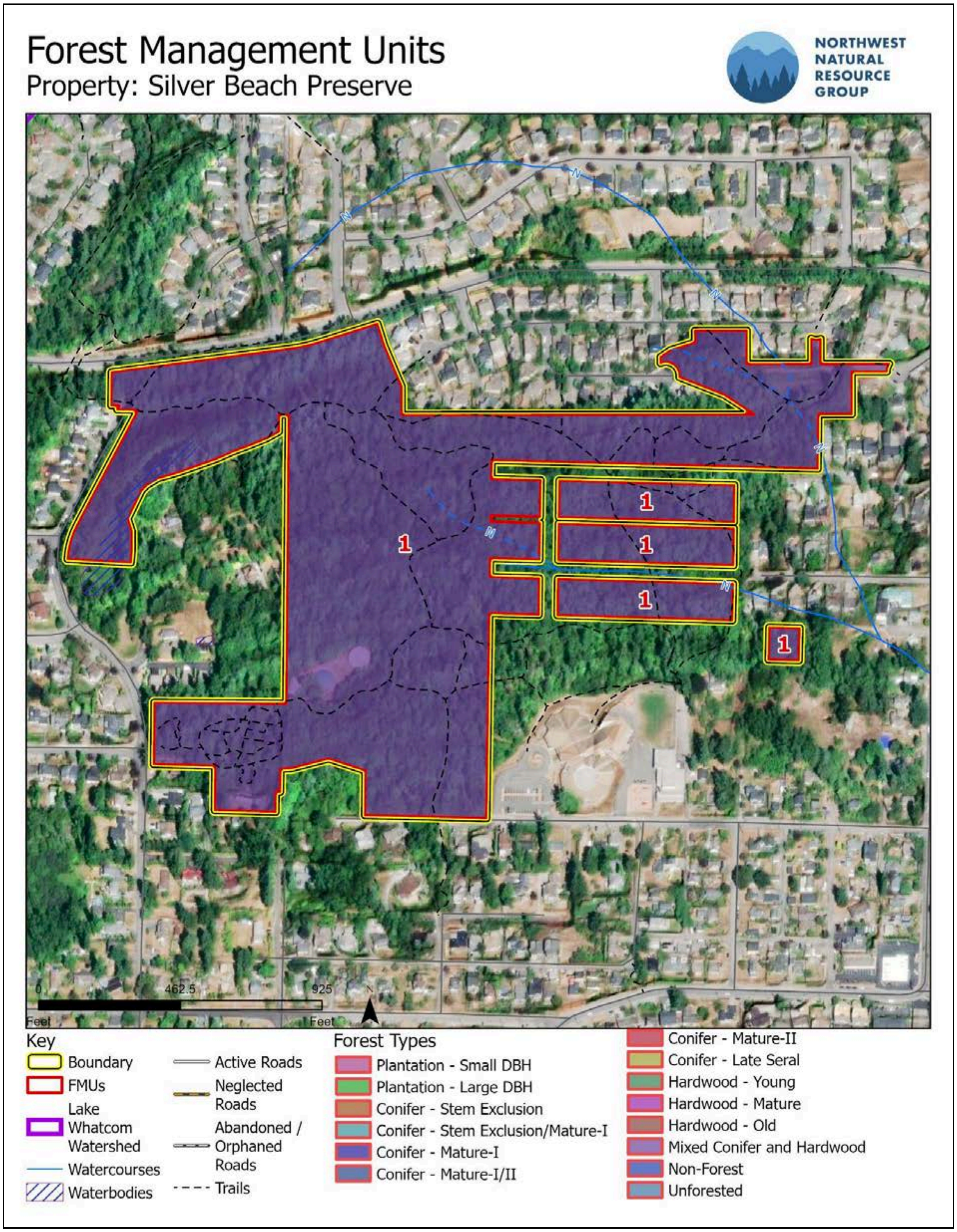
Forest cover was delineated into the forest management units (FMUs) using both remotely sensed data, historic inventory units, and field inventory data. The forestland within these management units share similar forest characteristics and management recommendations. For each FMU, this plan describes the geophysical attributes and forest conditions and assesses the unit against the plans management objectives using the previously described framework by forest type. Recommendations are then given by FMU, typically referencing general recommendations by forest type, but more information is given as needed. Finally, a schedule of management activities by year and FMU is given at the end of this section.

Summary of Forest Management Units

FMU	Acres	Forest Type	Management
1	42	Mixed Conifer and Hardwood	None

FMU	Acres	Forest Type	Management
Total	**42**		

Map of Forest Management Units



FMU 1 - Mixed Conifer and Hardwood

Stand Composition Summary

<table>
<tr><th>Canopy Position</th><th>Cohort Type</th><th>Species</th><th>TPA</th><th>BAA</th><th>SDI</th><th>RD</th><th>Min DBH</th><th>Avg DBH</th><th>Max DBH</th><th>Avg HT</th></tr>
<tr><td rowspan="4">Overstory</td><td rowspan="3">Major</td><td>BM</td><td>38</td><td>75</td><td>116</td><td rowspan="4">57</td><td>12</td><td>20</td><td>32</td><td>111</td></tr>
<tr><td>DF</td><td>29</td><td>59</td><td>113</td><td>16</td><td>23</td><td>36</td><td>119</td></tr>
<tr><td>RC</td><td>32</td><td>70</td><td>132</td><td>20</td><td>24</td><td>34</td><td>120</td></tr>
<tr><td>All</td><td>All</td><td>100</td><td>204</td><td>361</td><td>12</td><td>22</td><td>36</td><td>116</td></tr>
<tr><td rowspan="3">Midstory</td><td rowspan="2">Major</td><td>BM</td><td>16</td><td>19</td><td>13</td><td rowspan="3">13</td><td>2</td><td>8</td><td>18</td><td>51</td></tr>
<tr><td>RC</td><td>44</td><td>29</td><td>62</td><td>8</td><td>12</td><td>18</td><td>57</td></tr>
<tr><td>All</td><td>All</td><td>69</td><td>55</td><td>86</td><td>2</td><td>11</td><td>18</td><td>56</td></tr>
<tr><td>Total</td><td>All</td><td>All</td><td>169</td><td>259</td><td>447</td><td>69</td><td>2</td><td>18</td><td>36</td><td>91</td></tr>
<tr><td colspan="11">Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.</td></tr>
</table>

This property has been designated as a single FMU. Species composition varies across the site, and while there are some areas dominated by conifers and others by hardwoods, no portion is large enough to require separate management as its own unit. Total stocking is approximately 169 TPA. The overstory contains approximately 100 TPA and is primarily composed of bigleaf maple, western redcedar and Douglas-fir. Overstory Douglas-fir average 23 inches DBH and 119 ft tall, western redcedar average 24 inches DBH and 120 ft tall, and bigleaf maple average 20 inches DBH and 111 ft tall. The midstory contains approximately 69 TPA and is primarily composed of western redcedar and bigleaf maple. Midstory western redcedar average 12 inches DBH and 57 ft tall, maple average 8 inches DBH and 51 ft tall. The forest is diverse in both composition and structure, containing some canopy gaps, understory shrubs and trees, and occasional denser pockets of conifers. Per the earlier discussion of mixed conifer and hardwood forests, no large-scale management activities are recommended in this forest.

Parcel Table

Owner	Parcel ID	Year Acquired	Previous Owner
City	3803214953840000	1988	Private
City	3803215214160000	1988	Private
City	3803215404430000	Unknown	Unknown
City	3803215423250000	1992	Private
City	3803215493090000	1992	Private
City	3803220173500000	Unknown	Unknown

Owner	Parcel ID	Year Acquired	Previous Owner
City	3803220184460000	1988	Private
City	3803220334010000	2002	Private
City	3803220423240000	2006	Private
City	3803220423330000	1992	Private
City	3803220684060000	2002	Private
City	3803220703730000	2002	Private
City	3803220743920000	2002	Private
City	3803220754230000	2006	Private
City	3803220774060000	2022	Private
City	3803220793730000	2002	Private
City	3803220933720000	2002	Private
City	3803221023720000	2002	Private
City	3803221074280000	2002	Private
City	3803221114050000	2002	Private
City	3803221143720000	2002	Private
City	3803221213720000	2002	Private
City	3803221263720000	2017	Private
City	3803221314260000	2006	Private
City	3803221364530000	Unknown	Unknown
City	3803221373920000	2019	Private
City	3803221393740000	2002	Private
City	3803221404260000	2005	Private
City	3803221484270000	2023	Private
City	3803221484400000	Unknown	Unknown

Owner	Parcel ID	Year Acquired	Previous Owner
City	3803221554240000	2002	Private
City	3803221593600000	2023	Private
City	3803221604250000	2002	Private
City	3803221653600000	2023	Private
City	3803221684260000	2002	Private
City	3803221684400000	Unknown	Unknown
City	3803221714530000	Unknown	Unknown

Soto Rynders Preserve

Overview

Site Description

Soto Rynders Preserve is a 20-acre property owned by the City of Bellingham on the north side of Lake Whatcom. It is located off E 36th Terrace off Agate Bay Lane, north of the city owned Agate Creek Preserve and south of the Agate Pond Preserve.

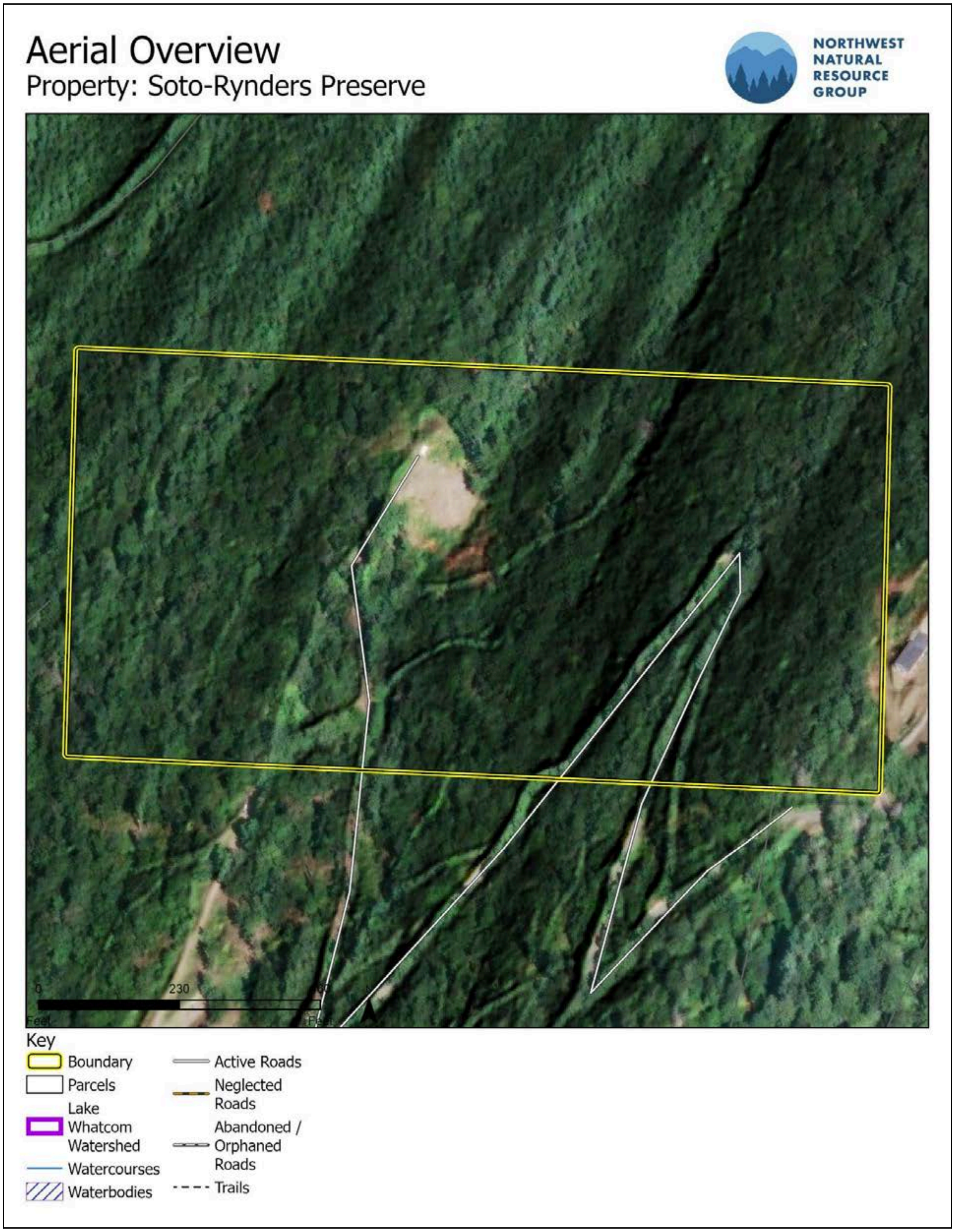
Property Information

This forest is located in Section 24, Township 38N, Range 03E of the US Public Land Survey System and includes one parcel that is listed in the table at the end of this section.

Management History

The preserve was acquired by the City in 2023. The exact history of the site is unknown, but it is estimated that the forest naturally regenerated following a clearcut harvest 80-100 years ago, consistent with regional logging patterns. There is a former homesite on the property that has been cleared of all structures and is now an open field.

Property Overview Map



Assessment

Topoclimate

The preserve is located on the southeast side of Squalicum Mountain on moderate to steep southeast-facing slopes. This aspect receives somewhat consistent sun exposure, resulting in generally drier soil conditions and a relatively uniform microclimate across the site.

Vegetation Zone

According to vegetation zone maps for North America, the following Ecological Systems were likely present prior to Euro-American settlement. More information on these maps and full descriptions of each system can be found in the discussion of Vegetation Zones in Section 2 of this document.

- North Pacific Hypermaritime Western Red-cedar-Western Hemlock Forest
- North Pacific Maritime Mesic-Wet Douglas-fir-Western Hemlock Forest
- North Pacific Seasonal Sitka Spruce Forest

Soils

Data from the USDA Natural Resource Conservation Service (NRCS) Soil Surveys were used to identify the major soil types that underlay this forest, which are described in more detail in the discussion of Soil Productivity in Section 2. Information about specific soil units likely present at this property, including depth, drainage, productivity, and relevant management concerns are listed in the table below. The location of these soil units can be found in the accompanied map packet for this property.

Forest Soil Units Summary Table

Soil Unit	Productivity		Management Concerns					Acres (Pct)
	Site Class	Max Growth	Drought Stress Hazard	Wind Throw Hazard	Mass Wasting Hazard	Logging Rutting Hazard	Logging Compact Hazard	
Squalicum Series Gravelly Ashy Loam on 15-30% Slopes Deep (44in) Moderately Well Drained	DF-2	186 ft3/ac/yr	Mod.	Low	High	Mod.	High	19 (93%)
Everett Series Very Gravelly Ashy Sandy Loam on 15-35% Slopes Shallow (18in) Somewhat Excessively Drained	DF-3	143 ft3/ac/yr	High	Low	High	Low	Mod.	1 (7%)

Slope Stability

As previously described in Section 2, this plan utilizes remotely mapped topographic data as well as hazard zones and historic landslides identified by the State of Washington Department of Natural Resources (DNR) to gauge the likelihood that unstable slopes will be found within a proposed management area. The presence of a mapped hazard zone or historic landslide does not preclude management, but indicates that further investigation is required.

The preserve mostly contains slopes over 40%, with some steeper sections over 70%. No known landslides have occurred, and there are no identified hazard zones.

Hydrology

According to the DNR's hydrography database, there are no hydrology features on this property.

Roads and Access

The property is accessed by the private East 36th Terrace road off Agate Bay Lane. This private road switch backs up portions of the property, providing access to nearby residential properties and terminating at the old homesite. This road is currently drivable and in good condition. There are no other known roads on this property and no road issues were identified during this assessment.

Health and Resiliency

Invasive Himalayan blackberry is present along the upper section of the road. It has the potential to spread into the canopy gaps of the uphill forested area and into the location of the former homesite which is currently an open field. No other forest health issues were observed.

Wildlife Habitat

A review of the Washington State Department of Fish and Wildlife Priority Species Database identified little brown bat, big brown bat, and Yuma myotis bat as having been documented somewhere within the 23,000-acre township containing Soto Rynders Preserve. A biodiversity area and corridor spans across the preserve that is a priority area for terrestrial habitat.

The property provides diverse wildlife habitat supported by a mix of forest types and species. Snags and downed logs were somewhat limited in number and/or size, but large woody habitat structures are expected to become more abundant as the forest continues to develop. Scattered canopy gaps support a variety of shrubs that provide important food sources.

Wildfire Susceptibility

Wildfire susceptibility at the preserve is generally low. Although a few nearby residences could slightly increase ignition risk, the surrounding forestland and lack of recreational access help keep ignition probability low. The mixed forest composition, with limited ladder fuels and a strong hardwood component, further reduces fire hazard. In the event of a fire, the road leading to the former homesite provides good access for firefighting efforts.

Carbon Storage

The preserve has good carbon storage potential due to its large component of Douglas-fir. Hardwood species are also present, but bigleaf maple is the dominant hardwood species which has decent carbon storage potential. The preserve is not overstocked, allowing trees to maintain good growth rates and continue sequestering carbon effectively into the future.

Cultural Resources

The Lake Whatcom watershed is a landscape rich with cultural significance for Indigenous peoples—particularly the Lummi Nation and the Nooksack and Swinomish Tribes—who have maintained deep spiritual, cultural, and subsistence connections to the landscape. Though a review of the Washington State Department of Archaeology and Historic Preservation Wisaard online database did not identify any known historical sites on this property and none were encountered while developing this plan, this property has a long history of human use and artifacts may be present. Please see the previous discussion about cultural use practices in the Lake Whatcom Watershed for a more detailed assessment of best management practices moving forward.

Recreation

There is no developed recreational access on this property.

Recommendations

Roads and Access

The final stretch of road providing access to the old homesite is not needed for management activities and can be formally decommissioned. At a minimum, culverts should be removed and permanent water bars installed to control drainage, and full restoration would include road grade restoration and reforestation.

Health and Resiliency

There are currently only minor forest health concerns at this property. Some invasive Himalayan blackberry was observed beginning to colonize road edges and at the old homesite. This infestation is currently minor and can be easily treated.

Wildfire Susceptibility

Shaded fuel breaks are recommended within 100 feet of public roads and existing structures which are designed to keep fires on the ground and slow their spread until firefighting resources can arrive. For

additional details on implementation, see the description of a shaded fuel break given in the discussion of Wildfire Susceptibility in Section 2 of this document.

Forest Types

All recommendations for this property follow the previous discussion of forest-types in section 3 and are discussed by management unit below.

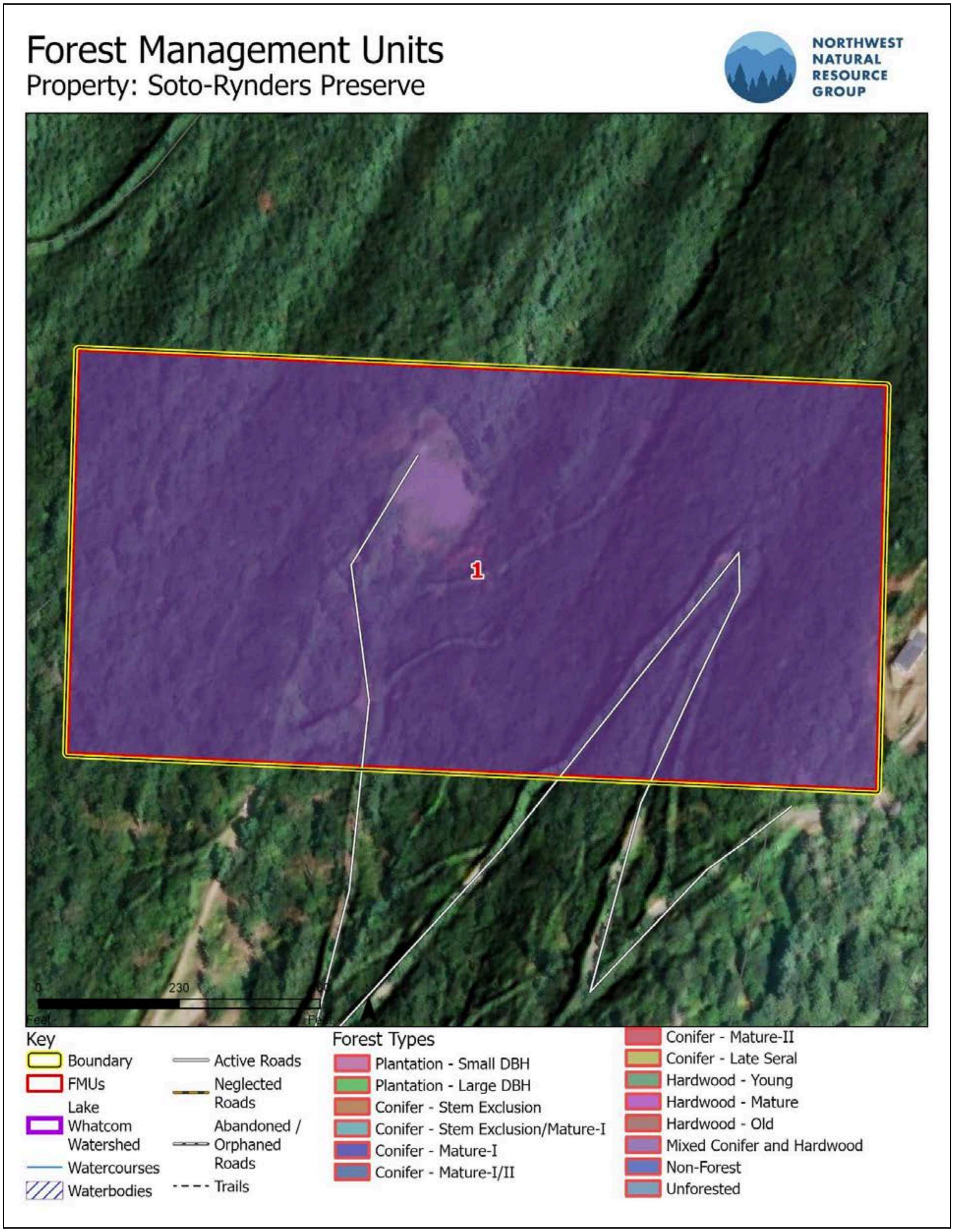
Management Units

Forest cover was delineated into the forest management units (FMUs) using both remotely sensed data, historic inventory units, and field inventory data. The forestland within these management units share similar forest characteristics and management recommendations. For each FMU, this plan describes the geophysical attributes and forest conditions and assesses the unit against the plans management objectives using the previously described framework by forest type. Recommendations are then given by FMU, typically referencing general recommendations by forest type, but more information is given as needed. Finally, a schedule of management activities by year and FMU is given at the end of this section.

Summary of Forest Management Units

FMU	Acres	Forest Type	Management
1	20	Mixed Conifer and Hardwood	None
Total	**20**		

Map of Forest Management Units



FMU 1 - Mixed Conifer and Hardwood

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	BM	29	43	50	49	8	14	24	108
		DF	74	115	176		10	17	24	112
	Minor	RA	18	24	31		8	14	24	100
	All	All	128	192	267		8	16	24	109
Midstory	Major	BM	12	6	8	6	4	8	12	40
		DF	36	22	25		4	8	12	53
	All	All	48	28	34		4	8	12	50
Total	All	All	176	220	301	55	4	14	24	93
Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.										

This property has been designated as a single FMU due to similar forest composition across the entire area. The soil productivity rating is mostly site class II with a small section that is site class III in the southeast corner. Total stocking is approximately 176 TPA. The overstory contains approximately 128 TPA and is primarily composed of bigleaf maple and Douglas-fir, with a small component of red alder. Overstory Douglas-fir average 17 inches DBH and 112 ft tall, and maple average 14 inches DBH and 108 ft tall. The midstory contains approximately 48 TPA and is primarily composed of bigleaf maple and Douglas-fir. Midstory Douglas-fir average 8 inches DBH and 53 ft tall, and maple average 8 inches DBH and 40 ft tall. The forest is diverse in both composition and structure, containing some canopy gaps, understory shrubs and trees, and occasional denser pockets of conifers. The Douglas-fir and bigleaf maple are well-suited for the dry soils of the site. Per the earlier discussion of mixed conifer and hardwood forests with no health concerns, no management activities are recommended in this forest.

Parcel Table

Owner	Parcel ID	Year Acquired	Previous Owner
City	3803243384890000	2023	Private

South Bay Preserve

Overview

Site Description

South Bay Preserve is a 38-acre property owned by the City of Bellingham on the southwest side of Lake Whatcom. It is located near Cain Lake Road.

Property Information

This forest is located in Section 29, Township 37N, Range 04E of the US Public Land Survey System and includes one parcel that is listed in the table at the end of this section. Property boundaries are marked with signs. Additional parcels were purchased by the City of Bellingham to the east of this single parcel in 2025, but they are not included in this assessment.

Management History

The South Bay Preserve was acquired by the City of Bellingham in 2008. It was previously owned by Three Rivers Timber Company. It is estimated that the property was clearcut harvested around 80-120 years ago, with some possible high-grading harvesting occurring in more recent years. Much of the surrounding land is still used as commercial timberland or for development. Unauthorized ATV use has been observed in the preserve, so the City has carried out efforts to identify and post the known boundary lines.

Property Overview Map

Assessment

Topoclimate

The preserve's topoclimate is influenced by its position near the south shore of Lake Whatcom, which influences air flow and moisture patterns. The east side is a mostly flat upper plateau, while the west side contains north-draining ravines with moderate slopes, creating subtle variations in temperature, drainage, and exposure across the site.

Vegetation Zone

According to vegetation zone maps for North America, the following Ecological Systems were likely present prior to Euro-American settlement. More information on these maps and full descriptions of each system can be found in the discussion of Vegetation Zones in Section 2 of this document.

- North Pacific Maritime Mesic-Wet Douglas-fir-Western Hemlock Forest
- North Pacific Seasonal Sitka Spruce Forest

Soils

Data from the USDA Natural Resource Conservation Service (NRCS) Soil Surveys were used to identify the major soil types that underlay this forest, which are described in more detail in the discussion of Soil Productivity in Section 2. Information about specific soil units likely present at this property, including depth, drainage, productivity, and relevant management concerns are listed in the table below. The location of these soil units can be found in the accompanied map packet for this property.

Forest Soil Units Summary Table

Soil Unit	Productivity		Management Concerns					Acres (Pct)
	Site Class	Max Growth	Drought Stress Hazard	Wind Throw Hazard	Mass Wasting Hazard	Logging Rutting Hazard	Logging Compact Hazard	
Sehome Series Medial Loam on 2-8% Slopes Mod. Deep (26in) Moderately Well Drained	DF-2	186 ft3/ac/yr	Mod. High	Medium	Mod.	High	Mod.	28 (73%)
Barneston Series Very Gravelly Ashy Loam on 30-65% Slopes Somewhat Excessively Drained	DF-3	157 ft3/ac/yr	Low.	Low	High	Low	Mod.	10 (27%)

Slope Stability

As previously described in Section 2, this plan utilizes remotely mapped topographic data as well as hazard zones and historic landslides identified by the State of Washington Department of Natural Resources (DNR) to gauge the likelihood that unstable slopes will be found within a proposed management area. The presence of a mapped hazard zone or historic landslide does not preclude management, but indicates that further investigation is required.

The preserve is mostly flat on the east side and contains moderate slopes that are mostly less than 40% of the west side near the stream channel. No known landslides have occurred, and there are no identified hazard zones. There is the potential for rule-identified landforms to exist on the site in the form of inner gorges in the stream channel that may impact future operations.

Hydrology

There is a ravine on the west side of the property that contains two small streams that converge into a large unnamed stream, which is identified as fish-bearing by the DNR's hydrography database. This stream flows into the southwest corner of Lake Whatcom.

Roads and Access

The preserve is accessible from the Iowa Heights Road off South Bay Drive. The private Blackjack Trail runs along the south side of the preserve. There are no official roads or trails within the preserve. Unauthorized ATV use has been observed and the City is taking efforts to close these trails and prevent unauthorized use.

Health and Resiliency

The upper plateau on the east side of the preserve consists primarily of aging red alder, and much of the species has died and fallen over, leaving a low stocked forest. A thick shrub layer is preventing regeneration, and it will likely take a long time for conifers to establish and for the next phase of the forest to begin without intervention. The west side of the forest is more diverse in structure and composition, which increases the resiliency of the forest.

Wildlife Habitat

A review of the Washington State Department of Fish and Wildlife Priority Species Database identified Townsend's big-eared bat and myotis bat as having been documented somewhere within the 23,000-acre township containing South Bay Preserve. The stream within the preserve is identified as habitat for cutthroat trout.

Features of the property that provide habitat for wildlife include a healthy shrub layer on much of the property, diverse forest types, and abundant downed wood. The shrubs are most abundant on the east side of the property and include many species that provide food for wildlife. In general, snags are lacking since most of the dead wood is red alder that has fallen over.

Wildfire Susceptibility

The close proximity to residential areas increases the risk of fire ignition on this property. The east side of the forest contains a thick shrub layer that could become a fuel source for fires if stems die or the plants become drought stressed. The hardwood component and presence of large trees on the west side that are likely to be more fire-resistant increases the resilience of the stand to wildfire. Additionally, the proximity to a road allows for a rapid response to wildfire

Carbon Storage

The carbon storage in the red alder dominant stand on the east side of the preserve is low due to the short life span of the species and low stocking. The west side of the property contains higher stocking with more conifers which gives it higher carbon storage potential. This area is also not overly stocked so the trees will continue to have good growth rates and sequester carbon.

Cultural Resources

The Lake Whatcom watershed is a landscape rich with cultural significance for Indigenous peoples—particularly the Lummi Nation and the Nooksack and Swinomish Tribes—who have maintained deep spiritual, cultural, and subsistence connections to the landscape. Though a review of the Washington State Department of Archaeology and Historic Preservation Wisaard online database did not identify any known historical sites on this property and none were encountered while developing this plan, this property has a long history of human use and artifacts may be present. Please see the previous discussion about cultural use practices in the Lake Whatcom Watershed for a more detailed assessment of best management practices moving forward.

Recreation

The preserve is located off a private neighborhood road and has no established trails so recreation levels are very low. The City has observed evidence of unauthorized ATV use and has put up signs along boundary lines to help prevent the unauthorized use.

Recommendations

Roads and Access

There are no existing roads or trails within the preserve, and no new road construction is recommended.

Health and Resiliency

Recommendations for addressing declining red alder are given at the management unit level below.

Wildfire Susceptibility

Shaded fuel breaks are recommended within 100 feet of public roads and existing structures which are designed to keep fires on the ground and slow their spread until firefighting resources can arrive. For additional details on implementation, see the description of a shaded fuel break given in the discussion of Wildfire Susceptibility in Section 2 of this document.

Forest Types

All recommendations for this property follow the previous discussion of forest-types in section 3 and are discussed by management unit below.

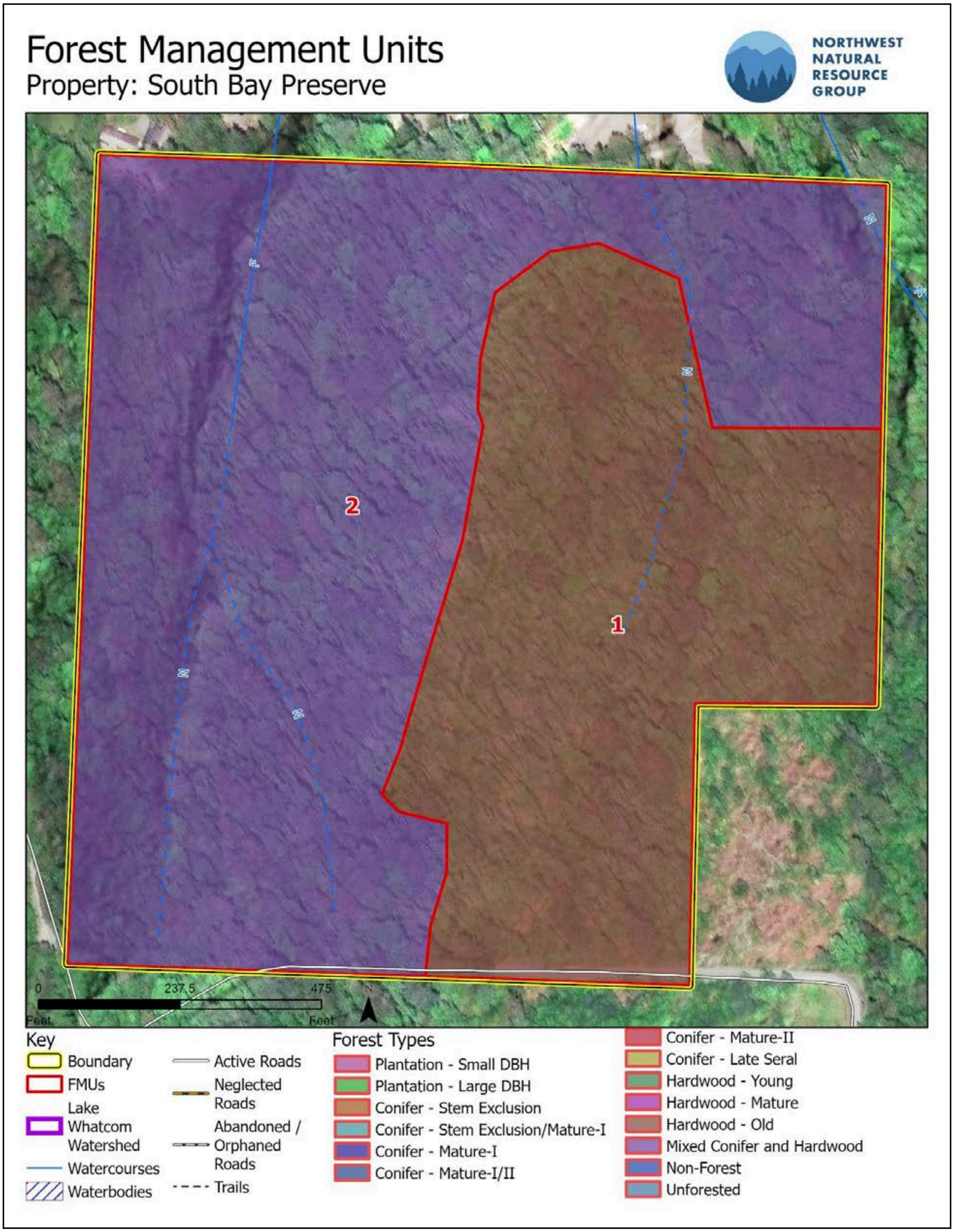
Management Units

Forest cover was delineated into the forest management units (FMUs) using both remotely sensed data, historic inventory units, and field inventory data. The forestland within these management units share similar forest characteristics and management recommendations. For each FMU, this plan describes the geophysical attributes and forest conditions and assesses the unit against the plans management objectives using the previously described framework by forest type. Recommendations are then given by FMU, typically referencing general recommendations by forest type, but more information is given as needed. Finally, a schedule of management activities by year and FMU is given at the end of this section.

Summary of Forest Management Units

FMU	Acres	Forest Type	Management
1	15	Mixed Hardwood - Old	Planting
2	24	Mixed Conifer and Hardwood	None
Total	**38**		

Map of Forest Management Units



FMU 1 - Mixed Hardwood - Old

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	RA	80	80	137	26	10	14	20	120
Total	All	All	80	80	137	26	10	14	20	120

Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.

FMU 1 is on the upper plateau on the east side of the preserve with a soil productivity rating of site class II. It is estimated that this unit was clearcut harvested around 80-100 years ago. The unit is composed of old red alder growing at a density of about 80 TPA. The red alder average 14 inches DBH and 120 feet tall. Recent mortality of the red alder has occurred as the species reaches the end of its lifespan. The stocking is expected to decrease further as mortality continues. A dense shrub understory is limiting natural regeneration, and while a few conifers are present in the midstory, they are sparse and scattered. Without intervention, the stand will likely remain understocked for an extended period. Per the earlier discussion on old hardwood stands, underplanting and gap planting with conifers is recommended to ensure long-term forest development and productivity.

FMU 2 - Mixed Conifer and Hardwood

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	DF	54	162	220	44	18	24	34	140
	All	All	60	180	228		10	23	34	140
Midstory	Major	WH	40	40	28	3	6	8	16	60
Total	All	All	100	220	256	44	6	17	34	108

Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.

FMU 2 contains the entire west side of the preserve as well as the northeast corner. This FMU is characterized by a ravine that runs north through the center of the unit and contains moderate slopes. The soil productivity rating ranges from site class II to III. Total stocking is approximately 100 TPA. The overstory contains approximately 60 TPA and is primarily composed of Douglas-fir that average 24 inches DBH and 140 ft tall. The midstory contains approximately 40 TPA and is primarily composed of western hemlock that average 8 inches DBH and 60 ft tall. Red alder used to be a larger component of the overstory, but mortality has occurred as it has declined due to its short lifespan. The Douglas-fir is expected to remain on the site for many years, and the shade-tolerant conifers should continue to regenerate and gradually become part of the overstory as the remaining red alder dies off. Scattered bigleaf maple further contributes to species diversity. Per the earlier discussion of mixed conifer and hardwood stands with no health concerns, no management is recommended.

Management Activity Schedule

Timeline	Activity	Priority	FMU	Prescription
2025 to 2030	Planting	1	1	Plant with 150-250 TPA of a mix of species suitable to the site conditions.
Notes: Priority Levels: 1 - High, 2 - Moderately High, 3 - Moderate, 4 - Low. Additional thinning and planting considerations are identified in Section 1 of this document as well as in the FMU-specific section above.				

Parcel Table

Owner	Parcel ID	Year Acquired	Previous Owner
City	3704295033750000	2008	Three Rivers Timber Company

South Lake Whatcom Preserve

Overview

Site Description

South Lake Whatcom Preserve is a 181-acre property owned by the City of Bellingham and located along South Lake Whatcom Boulevard. It is near the southwest shore of Lake Whatcom.

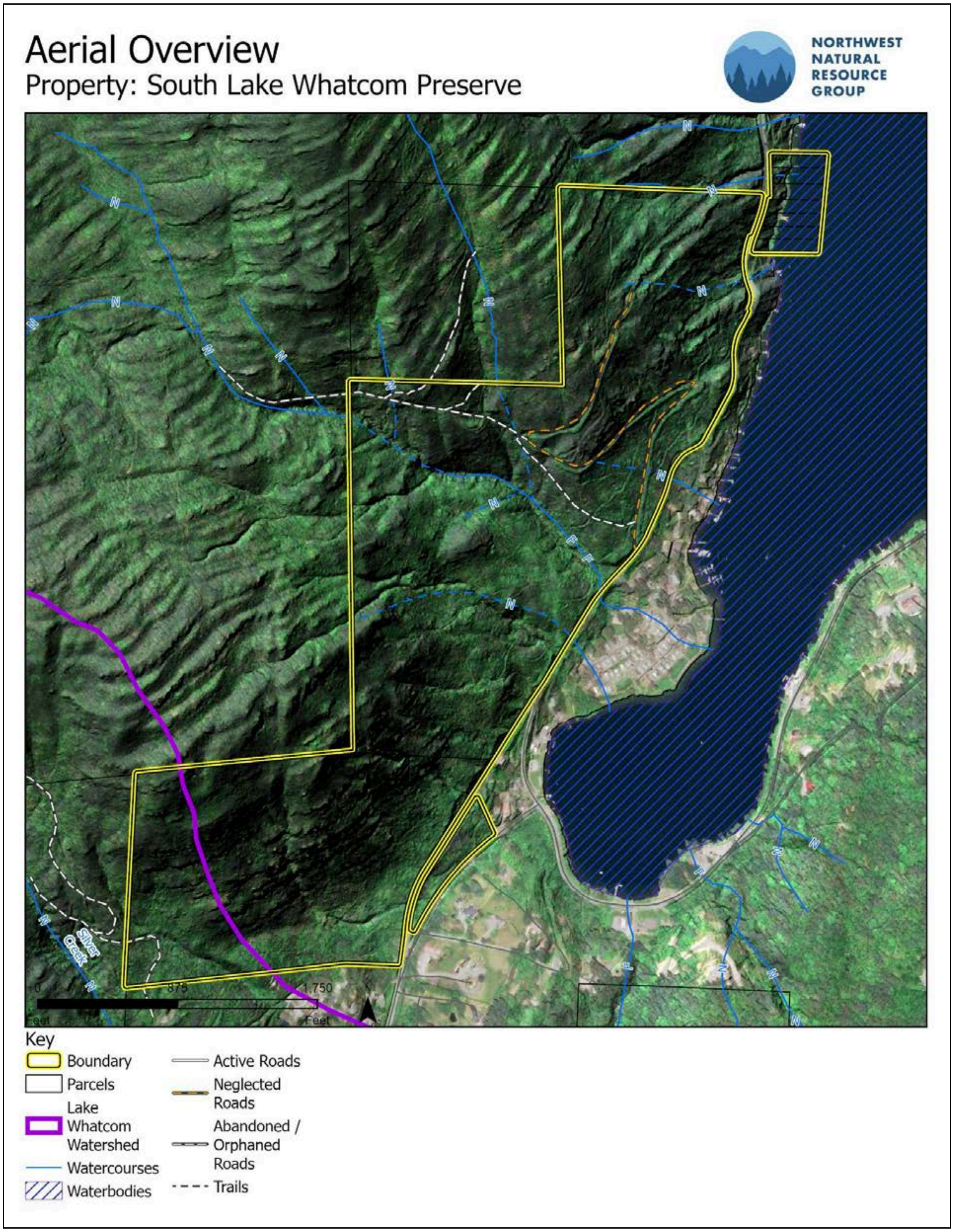
Property Information

This forest is located in Sections 20 and 29, Township 37N, Range 04E of the US Public Land Survey System and includes two parcels that are listed in the table at the end of this section.

Management History

Portions of South Lake Whatcom Preserve were donated to the City in 2021 and the remainder purchased in 2022 and 2023. The previous owners purchased the property in 2011 and worked with the Whatcom Land Trust and the City to preserve the forest. Prior to 2011, the property was managed as commercial timberland.

Property Overview Map



Assessment

Topoclimate

The preserve is dominated by steep southeast-facing slopes with a few ravines, though a flat plateau extends across the southern edge. Water drains rapidly from the slopes. The preserve is close to the shore of Lake Whatcom and therefore experiences the influence of lake breezes, slightly higher humidity, and smaller temperature fluctuations compared to forests at higher elevations.

Vegetation Zone

According to vegetation zone maps for North America, the following Ecological Systems were likely present prior to Euro-American settlement. More information on these maps and full descriptions of each system can be found in the discussion of Vegetation Zones in Section 2 of this document.

- North Pacific Hypermaritime Western Redcedar Western Hemlock Forest
- North Pacific Maritime Mesic-Wet Douglas-fir-Western Hemlock Forest
- North Pacific Seasonal Sitka Spruce Forest
- North Pacific Broadleaf Landslide Forest and Shrubland

Soils

Data from the USDA Natural Resource Conservation Service (NRCS) Soil Surveys were used to identify the major soil types that underlay this forest, which are described in more detail in the discussion of Soil Productivity in Section 2. Information about specific soil units likely present at this property, including depth, drainage, productivity, and relevant management concerns are listed in the table below. The location of these soil units can be found in the accompanied map packet for this property.

Forest Soil Units Summary Table

<table>
<tr><th rowspan="2">Soil Unit</th><th colspan="2">Productivity</th><th colspan="5">Management Concerns</th><th rowspan="2">Acres (Pct)</th></tr>
<tr><th>Site Class</th><th>Max Growth</th><th>Drought Stress Hazard</th><th>Wind Throw Hazard</th><th>Mass Wasting Hazard</th><th>Logging Rutting Hazard</th><th>Logging Compact Hazard</th></tr>
<tr><td>Andic Xerochrepts-Rock outcrop Complex
Ashy Loam on 60-90% Slopes
Mod. Deep (24in)
Well Drained</td><td>DF-3</td><td>143 ft3/ac/yr</td><td>High</td><td>High</td><td>High</td><td>High</td><td>High</td><td>141 (78%)</td></tr>
<tr><td>Nati Series
Ashy Loam on 30-60% Slopes
Mod. Deep (38in)</td><td>DF-3</td><td>129 ft3/ac/yr</td><td>Mod. High</td><td>High</td><td>High</td><td>High</td><td>High</td><td>17 (10%)</td></tr>
</table>

Soil Unit	Productivity		Management Concerns					Acres (Pct)
	Site Class	Max Growth	Drought Stress Hazard	Wind Throw Hazard	Mass Wasting Hazard	Logging Rutting Hazard	Logging Compact Hazard	
Well Drained								
Squalicum Series Gravelly Ashy Loam on 15-30% Slopes Deep (44in) Moderately Well Drained	DF-2	186 ft3/ac/yr	Mod.	Low	High	Mod.	High	8 (4%)
Chuckanut Series Gravelly Medial Loam on 15-30% Slopes Deep (56in) Well Drained	DF-2	186 ft3/ac/yr	Mod. High	Low	High	High	Mod.	6 (3%)
Nati Series Ashy Loam on 5-15% Slopes Mod. Deep (37in) Well Drained	DF-2 / DF-3	172 ft3/ac/yr	Mod. High	Medium	High	High	High	5 (3%)

Slope Stability

As previously described in Section 2, this plan utilizes remotely mapped topographic data as well as hazard zones and historic landslides identified by the State of Washington Department of Natural Resources (DNR) to gauge the likelihood that unstable slopes will be found within a proposed management area. The presence of a mapped hazard zone or historic landslide does not preclude management, but indicates that further investigation is required.

The preserve contains steep slopes that have an average grade of greater than 70%. Some flatter plateaus and more moderate slopes exist at the lower elevations near South Lake Whatcom Boulevard. A landslide likely occurred over 150 years ago on the southern end of the preserve. Additionally, several hazard zones are identified across the preserve and there is the potential for rule-identified landforms to exist in the form of inner gorges. Further review is needed before beginning harvest operations on the preserve.

Hydrology

The preserve contains a few unnamed streams located in the center area of the preserve that drain into Lake Whatcom. The DNR's hydrography database identifies the middle stream as fish-bearing in the lower portion near the lake.

Roads and Access

South Lake Whatcom Preserve is accessible from South Lake Whatcom Boulevard. A forest road accesses the north side of the preserve through a series of sharp switchbacks. This road is gated and currently overgrown with brush. This road has not been formally decommissioned and drainage culverts are still in place along the road bed. After the first switchback, the road is being used by mountain bikers riding down from Repeater Ridge to the north. There are no trails or roads that enter the middle or south sides of the preserve. An orphaned road once ran parallel to the main stream system, providing access into Lookout Mountain for historical logging operations. No problems were identified on this orphan road, which is quite old, overgrown, and difficult to follow at times.

Health and Resiliency

Most of the preserve is diverse in structure and composition with healthy stocking levels, aside from one area of concern on the south side of the preserve. Mortality of bigleaf maple trees is occurring on the steep slopes of this area. There was not a clear cause for the mortality, but the species may not be suitable for the soil on the slopes and/or it may be experiencing drought stress due to growing on well-draining steep slopes. Many of the bigleaf maples that are still alive are showing signs of stress through reduced live crowns. This part of the forest has low stocking due to the mortality and there is limited regeneration, likely due to a thick understory layer of sword fern and trailing blackberry. The site is about 90% bigleaf maple so there is some concern about the future forest cover of this site if mortality continues and regeneration is not occurring.

An additional forest health concern is the presence of Himalayan blackberry, but its presence is mostly limited to the old road bed and not a major concern at this time.

Wildlife Habitat

A review of the Washington State Department of Fish and Wildlife Priority Species Database identified Townsend’s big-eared bat and myotis bat as having been documented somewhere within the 23,000-acre township containing South Lake Whatcom Preserve. The preserve is also identified as a part of a large biodiversity area and corridor that spans Lookout Mountain and is a priority area for terrestrial habitat. The fish-bearing stream that flows through the middle of the preserve is habitat for cutthroat trout.

The preserve supports diverse wildlife habitat, with a mix of species, age classes, and forest structures that create a variety of habitat types. A healthy shrub layer is present throughout, offering abundant food sources. Large snags and downed logs are limited but beginning to develop as the forest matures.

Wildfire Susceptibility

The preserve has moderate wildfire risk due to its proximity to a major public road and nearby residential areas, though this also ensures good access for fire response. The strong hardwood component across much of the forest makes it more resistant to fire, and while some younger stands are present, there is little buildup of fine woody debris. However, the thick shrub layer throughout parts of the forest can act as fuel sources if they become dead or drought-stressed.

Carbon Storage

Carbon storage across the preserve varies by forest type and condition. The south side, dominated by hardwoods with low stocking and ongoing maple die-off, currently has low carbon storage potential. Establishing additional conifers will improve long-term carbon storage. In contrast, the north side contains a larger conifer component that is healthy, not overstocked, and continuing to grow, offering lasting carbon storage capacity.

Cultural Resources

The Lake Whatcom watershed is a landscape rich with cultural significance for Indigenous peoples—particularly the Lummi Nation and the Nooksack and Swinomish Tribes—who have maintained deep spiritual, cultural, and subsistence connections to the landscape. Though a review of the Washington State Department of Archaeology and Historic Preservation Wisaard online database did not identify any known historical sites on this property and none were encountered while developing this plan, this property has a long history of human use and artifacts may be present. Please see the previous discussion about cultural use practices in the Lake Whatcom Watershed for a more detailed assessment of best management practices moving forward.

Recreation

In general, the preserve has low recreational use. There is a trail on the north side of the property that is used for hiking and mountain biking, but it is becoming overgrown with Himalayan blackberry and other plants and likely does not receive much use. It runs from South Lake Whatcom Boulevard and connects onto the old road bed that switchbacks up through the preserve and continues towards Lookout Mountain.

Recommendations

Roads and Access

The neglected road on the north side of the property is not needed for management activities and should be formally decommissioned. At a minimum, culverts should be removed and permanent water bars installed to control drainage, and full restoration would include road grade restoration and reforestation. This may be an opportunity to manage the unsanctioned recreational trail usage in this vicinity.

Health and Resiliency

Recommendations for addressing declining bigleaf maple are given at the management unit level below.

Wildfire Susceptibility

Shaded fuel breaks are recommended within 100 feet of public roads and existing structures which are designed to keep fires on the ground and slow their spread until firefighting resources can arrive. For additional details on implementation, see the description of a shaded fuel break given in the discussion of Wildfire Susceptibility in Section 2 of this document.

Forest Types

All recommendations for this property follow the previous discussion of forest-types in section 3 and are discussed by management unit below.

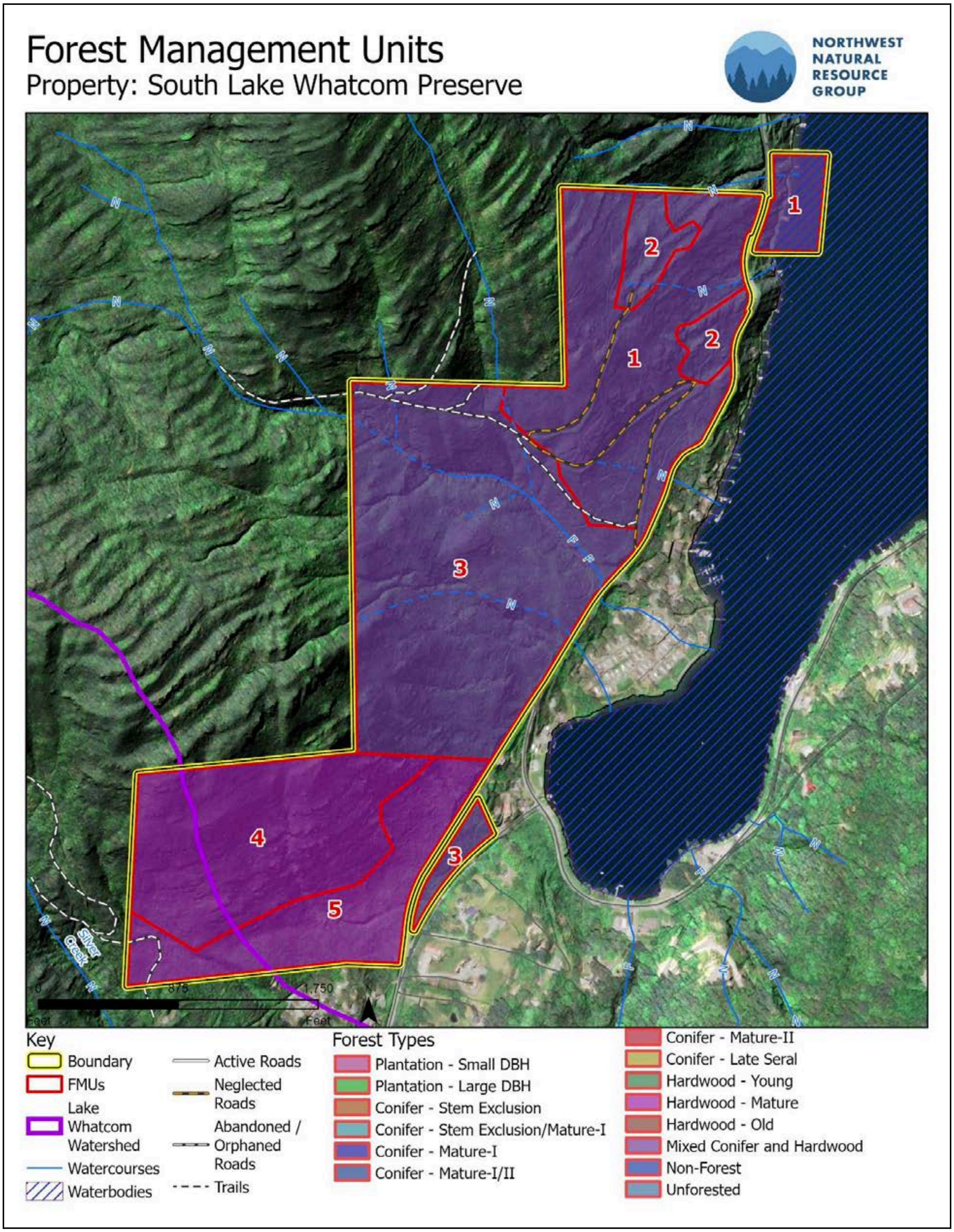
Management Units

Forest cover was delineated into the forest management units (FMUs) using both remotely sensed data, historic inventory units, and field inventory data. The forestland within these management units share similar forest characteristics and management recommendations. For each FMU, this plan describes the geophysical attributes and forest conditions and assesses the unit against the plans management objectives using the previously described framework by forest type. Recommendations are then given by FMU, typically referencing general recommendations by forest type, but more information is given as needed. Finally, a schedule of management activities by year and FMU is given at the end of this section.

Summary of Forest Management Units

FMU	Acres	Forest Type	Management
1	46	Mixed Conifer and Hardwood	None
2	8	Mixed Conifer and Hardwood	None
3	71	Mixed Conifer and Hardwood	None
4	35	Mixed Hardwood - Mature	Planting
5	22	Mixed Hardwood - Mature	Monitoring
Total	**181**		

Map of Forest Management Units



FMU 1 - Mixed Conifer and Hardwood

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	BM	40	64	130	48	8	21	30	113
		DF	30	39	74		10	18	30	103
		RC	30	33	80		8	18	30	102
	Minor	RA	11	8	15		8	12	16	80
	All	All	111	144	299		8	18	30	104
Midstory	Major	DF	9	3	6	2	4	8	14	60
		RC	6	4	4		4	7	10	49
		WH	10	8	9		4	9	12	40
	All	All	26	14	18		4	8	14	49
Total	All	All	137	158	318	50	4	16	30	94

Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.

FMU 1 is on the north side of the preserve and has a soil productivity rating of site class III. An old roadbed switch backs up through the unit. This part of the forest was likely clearcut 60–80 years ago and has since regenerated naturally into a diverse mixed-species forest. Total stocking is approximately 137 TPA. The overstory contains approximately 111 TPA and is primarily composed of bigleaf maple, western redcedar and Douglas-fir, with a small component of red alder. Overstory Douglas-fir average 18 inches DBH and 103 ft tall, redcedar average 18 inches DBH and 102 ft tall, and maple average 21 inches DBH and 113 ft tall. The midstory contains approximately 26 TPA and is primarily composed of western hemlock, western redcedar and Douglas-fir. The red alder is declining due to its short life span, and much of the species has died off. Regeneration is limited in much of the forest, but the overall species diversity and mosaic of forest types and densities suggest the stand is on a healthy trajectory and regeneration will likely occur as the forest continues to develop. No management activities are recommended.

FMU 2 - Mixed Conifer and Hardwood

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	BM	110	50	48	19	4	6	10	60
		RA	66	30	29		4	6	8	60
	Minor	DF	44	20	31		6	8	12	60
	All	All	220	100	108		4	6	12	60
Midstory	Major	RA	40	3	9	2	2	4	6	40
Total	All	All	260	103	117	20	2	6	12	57

Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.

FMU 2 consists of two small areas on the north side of the stand. The soil productivity rating of the unit is site class III. This unit is notably younger than FMU 1 which is why it is separated into a different unit. It was probably clearcut less than 40 years ago. Total stocking is approximately 260 TPA. The overstory contains approximately 220 TPA and is primarily composed of red alder and bigleaf maple, with a small component of Douglas-fir. Overstory bigleaf maple average 6 inches DBH and 60 ft tall, and alder average 6 inches DBH and 60 ft tall. The midstory contains approximately 40 TPA and is primarily composed of red alder that average 4 inches DBH and 40 ft tall. The overstory bigleaf maple is coppiced, growing in clumps. Stocking levels are moderate, so thinning is not necessary. Over time, the alder will eventually die off and open up the canopy, allowing for additional species to regenerate in the understory. Per the earlier discussion on mixed conifer and hardwood stands with no health concerns, no management activities are recommended.

FMU 3 - Mixed Conifer and Hardwood

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	BM	50	87	123	52	8	17	28	120
		RC	30	60	139		14	26	38	120
	Minor	DF	20	37	77		16	23	28	120
	All	All	100	184	339		8	21	38	120
Midstory	Major	RC	12	12	12	2	8	10	16	40
	All	All	20	14	16		4	8	16	40
Total	All	All	120	198	355	54	4	19	38	107

Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.

FMU 3 is located in the center of the preserve on steep southeast-facing slopes, the majority of which are over 70%, with more moderate slopes near the base. A large, steep stream channel cuts through the north side. The unit has a soil productivity rating of site class III. The stand was likely clearcut in the early to mid-1900s and naturally regenerated into a mixed overstory. Total stocking is approximately 120 TPA. The overstory contains approximately 100 TPA and is primarily composed of western redcedar and bigleaf maple, with a small component of Douglas-fir. Overstory redcedar average 26 inches DBH and 120 ft tall, and maple average 17 inches DBH and 120 ft tall. The midstory contains approximately 20 TPA and is primarily composed of western redcedar that average 10 inches DBH and 40 ft tall. The Douglas-fir is regenerating mainly in canopy gaps that have been created by the die off of red alder that used to have a more dominant presence on the site. Per the earlier discussion on mixed conifer and hardwood stands with no health concerns, no management activities are recommended.

FMU 4 - Mixed Hardwood - Mature

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	BM	72	144	153	26	4	16	22	100
	All	All	80	160	164		4	16	22	100
Midstory	Major	DF	7	7	5	2	6	8	10	40
		RC	6	6	4		6	8	14	40
		WH	7	7	5		6	8	10	40
	All	All	20	20	14		6	8	14	40
Total	All	All	100	180	178	28	4	14	22	88

Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.

FMU 4 is located on the steep southern slopes of the preserve. Slopes are greater than 70% across most of the unit, and the soil productivity rating is site class III. This area likely was clearcut in the early to mid-1900s and naturally regenerated with primarily bigleaf maple, red alder, and Douglas-fir. Red alder snags and downed logs are present, indicating that the species used to be a major component of the overstory but has now died off due to its short lifespan. Total stocking is approximately 100 TPA. The overstory contains approximately 80 TPA and is primarily composed of bigleaf maple with about 10% Douglas-fir. Overstory bigleaf maple average 16 inches DBH and 100 ft tall. The midstory contains approximately 20 TPA of Douglas-fir, western redcedar, and western hemlock. The bigleaf maple is showing signs of decline. Some trees are already dead and others are showing reduced live crowns. The exact cause of decline is unknown, but it’s possible the species is not compatible with the soils and is experiencing drought stress on the steep southeast-facing slopes. Despite an open canopy, regeneration is limited due to a dense understory layer of sword fern, salmonberry, and trailing blackberry. Without intervention, it may take a long time for additional trees to establish on the site. Given the steep terrain, management options are challenging, but underplanting and gap planting is recommended to maintain forest cover.

FMU 5 - Mixed Hardwood - Mature

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	BM	80	84	101	18	4	12	24	98
	Minor	RA	14	22	10		6	8	14	80
	All	All	94	106	111		4	11	24	95
Midstory	Major	BM	24	18	6	4	2	4	6	40
		RC	14	14	24		8	14	22	60

	All	All	38	32	30		2	8	22	47
Total	All	All	132	138	140	22	2	10	24	81
Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.										

FMU 5 is located on a lower plateau on the south side of the preserve and supports a younger forest than the adjacent steep slopes of FMU 4, indicating a more recent harvest likely took place on the flatter terrain that is easier for harvest equipment to operate on. The unit has a soil productivity rating of site class III. The stand appears to have been high-graded 20–30 years ago, with most high-value conifers removed and smaller western redcedar and bigleaf maple left behind. Total stocking is approximately 132 TPA. The overstory contains approximately 94 TPA and is primarily composed of bigleaf maple, with a small component of red alder. Overstory bigleaf maple average 12 inches DBH and 98 ft tall. The midstory contains approximately 38 TPA and is primarily composed of western redcedar and bigleaf maple. Midstory redcedar average 14 inches DBH and 60 ft tall, and maple average 4 inches DBH and 40 ft tall. Western redcedar and western hemlock are regenerating throughout the site. Compared to FMU 4, the maple here appears healthier, with larger live crowns and less mortality. While this stand could eventually follow a similar trajectory of alder decline and maple mortality, the stronger conifer component provides greater resilience. It is recommended to monitor the site in 15-20 years to ensure regeneration continues as the red alder ages and declines and to check for mortality or declining health of the bigleaf maple.

Management Activity Schedule

Timeline	Activity	Priority	FMU	Prescription
2025 to 2030	Planting	3	4	Plant with 150-250 TPA of a mix of species suitable to the site conditions.
2040 to 2045	Monitoring	3	5	Monitor the health of bigleaf maple and for natural regeneration, and, if necessary, underplant with 150-250 TPA of shade-tolerant conifers.
Notes: PCT - Pre-commercial Thinning, CT - Commercial Thinning, NCT - Non-commercial Thinning. Priority Levels: 1 - High, 2 - Moderately High, 3 - Moderate, 4 - Low. Additional thinning and planting considerations are identified in Section 1 of this document as well as in the FMU-specific section above.				

Parcel Table

Owner	Parcel ID	Year Acquired	Previous Owner
City	3704203601250000	2022	Private
City	3704205593910000	2023	Private
City	3704205633990000	2023	Private

Owner	Parcel ID	Year Acquired	Previous Owner
City	3704205684070000	2023	Private
City	3704205724160000	2023	Private
City	3704210163780000	2022	Private
City	3704210183690000	2022	Private
City	3704210183870000	2022	Private
City	3704292324950000	2021	Private
City	3704293745200000	2023	Private

Three Creeks Preserve

Overview

Site Description

Three Creeks Preserve is a 170-acre property owned by the City of Bellingham on the northeast side of Lake Whatcom. It is located off the private Sheridan Trail road via the Northshore Road.

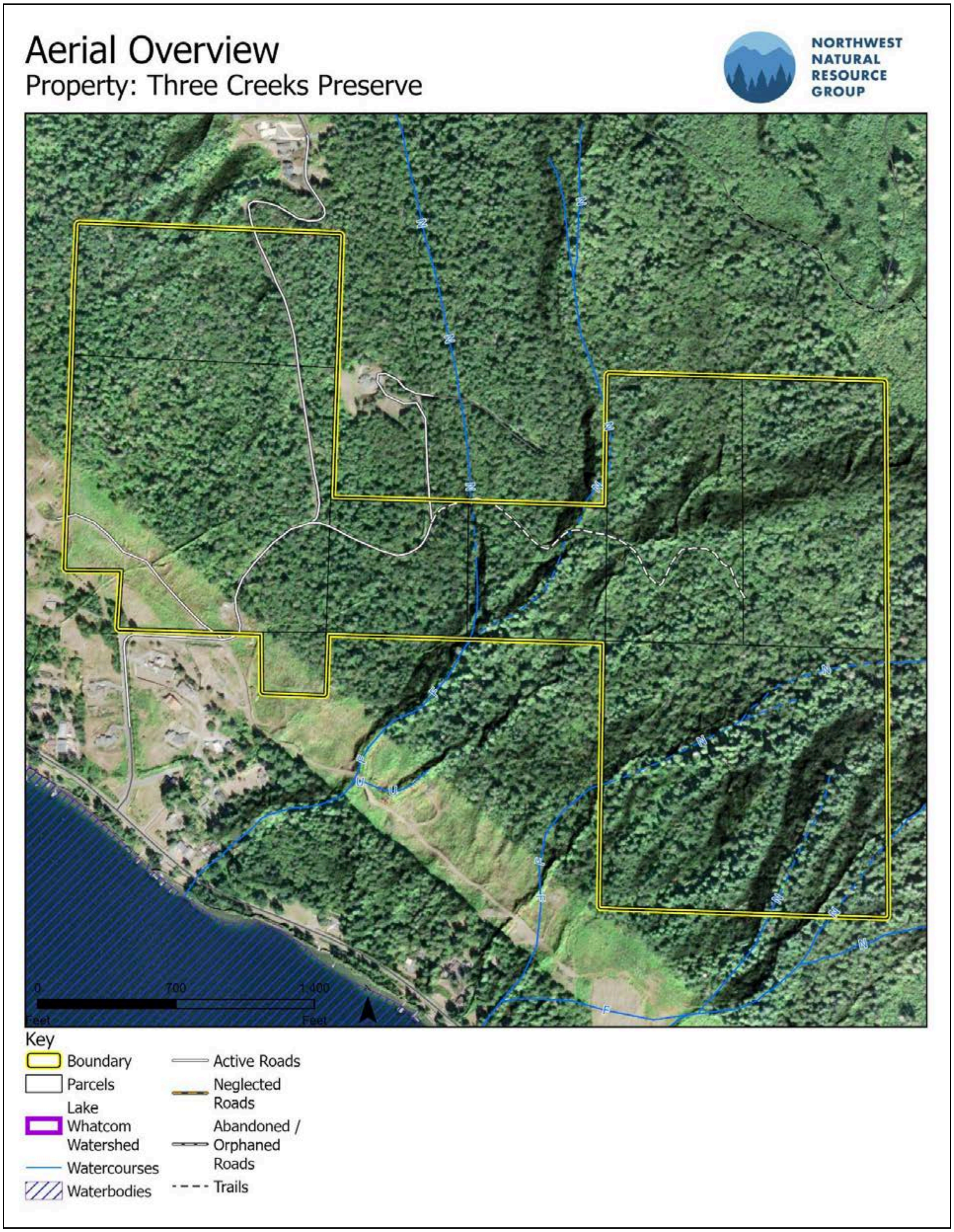
Property Information

This forest is located in Sections 29 and 30, Township 38N, Range 04E of the US Public Land Survey System and includes eight parcels that are listed in the table at the end of this section. Property corners and boundaries are not marked.

Management History

The original forestland at Three Creeks Preserve was likely clearcut harvested sometime in the last 80 to 120 years and left to regenerate naturally. The exact land use history in the intervening years is unclear, but the City of Bellingham purchased the eight parcels in the preserve between 2002 and 2008 from private landowners. Private properties to the north of the preserve have access easements and maintain road access through the preserve.

Forest Overview Map



Assessment

Topoclimate

The topography of Three Creeks Preserve is variable, with the western half of the property gently sloping to the southwest towards Lake Whatcom, and the eastern half of the property is much more rugged with inner gorges and steep slopes. The gentle-sloping portions of the property are temperate with plentiful sun exposure. The eastern half of the property tends to be cooler overall with a gentler slope and some north-facing slopes. Very cool and moist microclimates exist within the inner gorges and other streamside areas. Few areas of high exposure are present near the northeast corner of the preserve where an ancient landslide has formed steep south-facing slopes.

Vegetation Zone

According to vegetation zone maps for North America, the following Ecological Systems were likely present prior to Euro-American settlement. More information on these maps and full descriptions of each system can be found in the discussion of Vegetation Zones in Section 2 of this document.

- North Pacific Maritime Mesic-Wet Douglas-fir-Western Hemlock Forest
- North Pacific Seasonal Sitka Spruce Forest

Soils

Data from the USDA Natural Resource Conservation Service (NRCS) Soil Surveys were used to identify the major soil types that underlay this forest, which are described in more detail in the discussion of Soil Productivity in Section 2. Information about specific soil units likely present at this property, including depth, drainage, productivity, and relevant management concerns are listed in the table below. The location of these soil units can be found in the accompanied map packet for this property.

Forest Soil Units Summary Table

Soil Unit	Productivity		Management Concerns					Acres (Pct)
	Site Class	Max Growth	Drought Stress Hazard	Wind Throw Hazard	Mass Wasting Hazard	Logging Rutting Hazard	Logging Compact Hazard	
Squalicum Series Gravelly Ashy Loam on 30-60% Slopes Deep (44in) Moderately Well Drained	DF-2	186 ft3/ac/yr	Mod.	Low	High	Mod.	High	85 (50%)
Squalicum Series Gravelly Ashy Loam on 15-30% Slopes Deep (44in)	DF-2	186 ft3/ac/yr	Mod.	Low	High	Mod.	High	45 (26%)

Soil Unit	Productivity		Management Concerns					Acres (Pct)
	Site Class	Max Growth	Drought Stress Hazard	Wind Throw Hazard	Mass Wasting Hazard	Logging Rutting Hazard	Logging Compact Hazard	
Moderately Well Drained								
Andic Xerochrepts Taxon above family Ashy Loam on 60-90% Slopes Mod. Deep (27in) Well Drained	DF-3	143 ft3/ac/yr	High	High	High	High	High	29 (17%)
Andic Xerochrepts-Rock outcrop Complex Ashy Loam on 60-90% Slopes Mod. Deep (24in) Well Drained	DF-3	143 ft3/ac/yr	High	High	High	High	High	10 (6%)

Slope Stability

As previously described in Section 2, this plan utilizes remotely mapped topographic data as well as hazard zones and historic landslides identified by the State of Washington Department of Natural Resources (DNR) to gauge the likelihood that unstable slopes will be found within a proposed management area. The presence of a mapped hazard zone or historic landslide does not preclude management, but indicates that further investigation is required.

Inner gorges are a common feature along most of the perennial streams in the Three Creeks Preserve and should be avoided. An ancient landslide influences much of the topography of the eastern half of the property. The crown of the landslide cuts across the two parcels in the northeast part of the property, resulting in extremely steep slopes. Some signs of instability are still present in this area. Downslope from the crown is stable and much shallower with some ridges, which are stable as well.

Hydrology

There are three major perennial streams near the center of the property running toward Lake Whatcom. The two streams to the east converge immediately south of the property, with the third joining much later. Three more minor perennial streams are present in the southeast parcel of the preserve and drain into Lake Whatcom farther south. None of these streams are identified as fish-bearing in the DNR's hydrography database.

Roads and Access

Access to the western half of Three Creeks Preserve is excellent with the private Sheridan Trail road extending north through the property. The City has access rights to this road but maintenance is the responsibility of the property owners association. From this road, gravel road access extends west to the first stream. After this point, the road has been formally decommissioned with the culverts removed and stream crossings returned to normal function. As a result, access to the eastern half of the property is limited to foot traffic. No road issues were identified during this assessment.

Health and Resiliency

Invasive species presence is having a minor impact on forest health at the preserve. The species are colonizing roadsides, old roadbeds, and canopy gaps, and could spread farther into the forest where light conditions allow if not managed. Root rot is present in the northwest corner but at levels consistent with natural processes. Mortality due to root rot in these small pockets adds structural diversity to the landscape and is not a concern at this time.

Wildlife Habitat

A review of the Washington State Department of Fish and Wildlife Priority Species Database identified gray wolf as having been documented somewhere within the 23,000-acre township containing North Three Creeks Preserve. Wildlife habitat in the preserve includes a variety of features that support diverse species. Snags up to 20 inches DBH are present, primarily in the northwest corner, while large old-growth stumps are scattered throughout the property. Numerous forest gaps in the eastern half provide abundant foraging opportunities for wildlife.

Wildfire Susceptibility

Wildfire ignition probability is elevated in this forest due to being in close proximity to residences along the northern boundary and a powerline easement to the south, though recreation-related risk is limited. The forest is composed primarily of stands in the Mature-II phase with few ladder fuels, which helps reduce fire severity. Access for fire response is strong in the western half of the property but more limited in the eastern half, creating challenges for suppression efforts in that area.

Carbon Storage

The forest is primarily composed of mature conifer stands that have high carbon storage potential. Some conifers exceed 40 inches DBH and serve as significant carbon sinks, providing substantial long-term storage. Hardwoods are present in natural gaps created by disease, landslides, or along the decommissioned roadbed, where growth rates are faster but long-term carbon storage potential is lower compared to the conifer-dominated areas.

Cultural Resources

The Lake Whatcom watershed is a landscape rich with cultural significance for Indigenous peoples—particularly the Lummi Nation and the Nooksack and Swinomish Tribes—who have maintained deep spiritual, cultural, and subsistence connections to the landscape. Though a review of the Washington State Department of Archaeology and Historic Preservation Wisaard online database did not identify any known historical sites on this property and none were encountered while developing this plan, this property has a long history of human use and artifacts may be present. Please see the previous discussion about cultural use practices in the Lake Whatcom Watershed for a more detailed assessment of best management practices moving forward.

Recreation

Recreational use seems to be limited to the immediate residences to the Three Creeks Preserve. The only trail usage and maintenance observed seems to connect to the neighbor’s property north of the center of the preserve.

Recommendations

Roads and Access

There are no existing road maintenance concerns at this time and no new road construction is recommended. All roads except for those required to be maintained for local access have been properly decommissioned or are not the maintenance responsibility of the City.

Health and Resiliency

Invasive species management would be prudent along both existing and decommissioned roads. Along the Sheridan Trail road, there are occasional Himalayan blackberry thickets that may begin to spread into the forest as gaps form with time. Himalayan blackberry thickets and English ivy have also colonized abandoned roadbeds and have begun spreading into the forest.

Wildfire Susceptibility

Shaded fuel breaks are recommended within 100 feet of public roads and existing structures which are designed to keep fires on the ground and slow their spread until firefighting resources can arrive. For additional details on implementation, see the description of a shaded fuel break given in the discussion of Wildfire Susceptibility in Section 2 of this document.

Forest Types

All recommendations for this property follow the previous discussion of forest-types in section 3 and are discussed by management unit below.

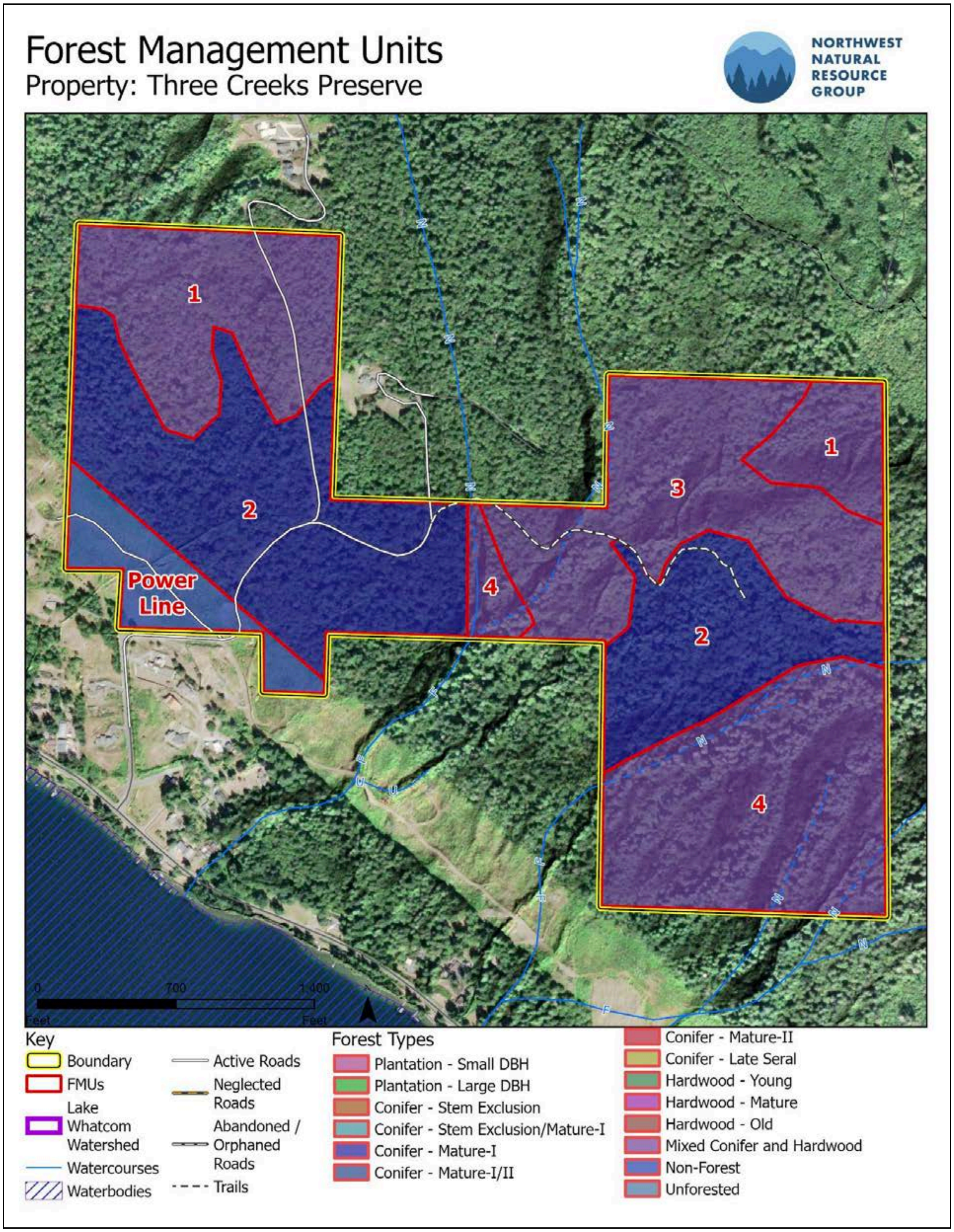
Management Units

Forest cover was delineated into the forest management units (FMUs) using both remotely sensed data, historic inventory units, and field inventory data. The forestland within these management units share similar forest characteristics and management recommendations. For each FMU, this plan describes the geophysical attributes and forest conditions and assesses the unit against the plans management objectives using the previously described framework by forest type. Recommendations are then given by FMU, typically referencing general recommendations by forest type, but more information is given as needed. Finally, a schedule of management activities by year and FMU is given at the end of this section.

Summary of Forest Management Units

FMU	Acres	Forest Type	Management
1	31	Mixed Conifer and Hardwood	None
2	60	Mixed Conifer - Mature-I	Invasive Species Management
3	33	Mixed Conifer and Hardwood	None
4	38	Mixed Conifer - Mature-II	None
Power Line	10	Unforested	Not Applicable
Total	**170**		

Map of Forest Management Units



FMU 1 - Mixed Conifer and Hardwood

Forest Structure and Composition Summary Table

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	BM	22	50	56	42	8	18	24	120
		DF	58	86	148		14	18	22	180
		RC	22	50	51		8	17	24	120
	All	All	104	196	258		8	17	24	163
Midstory	Major	RC	90	30	40	7	4	6	8	58
	Minor	BM	15	4	7		4	6	8	49
		DF	11	4	5		4	6	8	60
	All	All	116	38	51		4	6	8	57
Total	All	All	220	234	309	49	4	11	24	107

Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.

FMU 1 was acquired by the City of Bellingham in 2008 and had limited management activity over the past 100 years. Sheridan Trail is a road easement that runs north to south in the eastern half of the unit, providing excellent access. Moderate southwest-facing slopes are present throughout the unit, with occasional steep drops, corresponding to soil site class II. In the northeast corner of the property, the face of an ancient landslide forms a steep face with rock bluffs, corresponding to a soil site class III. The unit was likely clearcut between 80 and 125 years ago and allowed to naturally regenerate. Total stocking is approximately 220 TPA. The overstory contains approximately 104 TPA and is composed of Douglas-fir, bigleaf maple, and western redcedar. Overstory bigleaf maple average 18 inches DBH and 120 feet tall, Douglas-fir average 18 inches DBH and 180 feet tall, and redcedar average 17 inches DBH and 120 feet tall. The midstory contains approximately 116 TPA and is primarily composed of western redcedar, with minor components of Douglas-fir and bigleaf maple where gaps have been formed in the overstory. Midstory redcedar averages 6 inches DBH and 58 feet tall. This unit has a diverse species mix in both its overstory and midstory. Per the earlier discussion of mixed conifer and hardwood forests with no health concerns, no management is recommended.

FMU 2 - Mixed Conifer - Mature-I

Forest Structure and Composition Summary Table

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	DF	54	115	177	56	8	19	42	107
		RC	36	72	36		8	10	18	80
	Minor	WH	18	43	141		14	36	42	160
	All	All	112	240	359		8	18	42	109

Midstory	Major	DF	18	9	8	4	4	6	8	49
		RC	38	19	17		4	6	8	40
	All	All	64	32	28		4	6	8	45
Total	All	All	176	272	387	60	4	14	42	85

Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.

FMU 2 was acquired by the City of Bellingham between 2002 and 2008. Sheridan Trail is a road easement that runs north to south in most of the unit, providing excellent access to the western half. Abandoned roads are present in the eastern half of the unit. Gentle southwest-facing slopes are present throughout the unit, corresponding to a soil site class II. The unit was likely clearcut between 80 and 125 years ago and allowed to naturally regenerate. Total stocking is approximately 176 TPA. The overstory contains approximately 112 TPA and is primarily composed of Douglas-fir and western redcedar, with a small component of western hemlock. Overstory Douglas-fir average 19 inches DBH and 107 ft tall and redcedar average 10 inches DBH and 80 ft tall. The midstory contains approximately 64 TPA and is primarily composed of Douglas-fir and western redcedar. Midstory Douglas-fir average 6 inches DBH and 49 ft tall, and redcedar average 6 inches DBH and 40 ft tall. This mixed conifer forest is in the Mature-I phase of development with cohorts establishing in the understory and midstory. Per the earlier discussion of this forest type, no large-scale management is recommended. However, Himalayan blackberry is colonizing in canopy gaps which could outcompete the seedlings that are naturally regenerating. It is recommended to remove the blackberry to release the seedlings.

FMU 3 - Mixed Conifer and Hardwood

Forest Structure and Composition Summary Table

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	BM	29	34	44	40	8	13	18	100
		DF	39	58	119		12	20	38	106
		RA	29	34	44		8	13	18	100
	All	All	111	144	234		6	16	38	103
Midstory	Major	RC	40	26	28	6	4	8	10	44
	All	All	63	41	41		4	8	10	46
Total	All	All	174	185	275	45	4	13	38	82

Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.

FMU 3 was acquired by the City of Bellingham in 2002. Abandoned roads are present in the western half of the unit. Steep southwest-facing slopes are present in the center of the unit, with gentle slopes in the north and east, and inner gorges formed by perennial streams in the south, corresponding to a soil site class II. The unit was likely clearcut between 80 and 125 years ago and allowed to naturally regenerate. Total stocking is approximately 174 TPA. The overstory contains approximately 111 TPA and is primarily composed of Douglas-fir, red alder and bigleaf maple. Overstory Douglas-fir average 20 inches DBH and

106 ft tall, bigleaf maple average 13 inches DBH and 100 ft tall, and red alder average 13 inches DBH and 100 ft tall. The midstory contains approximately 63 TPA and is primarily composed of western redcedar that average 8 inches DBH and 44 ft tall. This forest has a diverse mix of conifer and hardwood species and no health concerns. Per the earlier discussion of this forest type, no management is recommended.

FMU 4 - Mixed Conifer - Mature-II

Forest Structure and Composition Summary Table

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	DF	56	132	196	58	8	22	26	139
	Minor	BM	10	6	7		6	8	10	60
		RC	14	29	113		30	36	46	140
	All	All	94	189	332		6	21	46	127
Midstory	Major	DF	30	20	21	5	6	8	14	60
	All	All	39	28	28		4	8	14	60
Total	All	All	133	217	360	63	4	17	46	108
Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.										

FMU 4 was acquired by the City of Bellingham between 2002 and 2003. Generally, slopes are southwest-facing and steep. Ridges and inner gorges define this unit, resulting in a mixture of sunny southern exposures with a soil site class III and cooler, darker pockets in gorges near streams with a soil site class II. The unit likely regenerated following clearcut harvests between 80 and 125 years ago. Total stocking is approximately 133 TPA. The overstory contains approximately 94 TPA and is primarily composed of Douglas-fir, with a small component of bigleaf maple. Overstory Douglas-fir average 22 inches DBH and 139 ft tall. Patches of large western redcedar are present near streams with an average DBH of 36 inches and averaging 140 feet tall. The midstory contains approximately 39 TPA and is primarily composed of Douglas-fir that average 8 inches DBH and 60 ft tall. This unit has characteristics of conifer forests in the Mature-II phase of development. Per the earlier discussion of this forest type, no management is recommended.

Management Activity Schedule

Timeline	Activity	Priority	FMU	Prescription
2025 to 2030	Invasive Species	3	2	Remove invasive species.
Notes: Priority Levels: 1 - High, 2 - Moderately High, 3 - Moderate, 4 - Low. Additional thinning and planting considerations are identified in Section 1 of this document as well as in the FMU-specific section above.				

Parcel Table

Owner	Parcel ID	Year Acquired	Previous Owner
City	3804290351600000	2002	Private
City	3804291001600000	2002	Private
City	3804291661990000	2002	Private
City	3804292010720000	2003	Private
City	3804292311990000	2002	Private
City	3804304552870000	2008	Woodstock International Inc
City	3804304951950000	2008	Woodstock International Inc
City	3804305501100000	2008	Woodstock International Inc

Watts-Lebeau Family Preserve

Overview

Site Description

Watts-Lebeau Family Preserve is a 29-acre property owned by the City of Bellingham. It is located along Lake Whatcom Blvd on the west shore of Lake Whatcom.

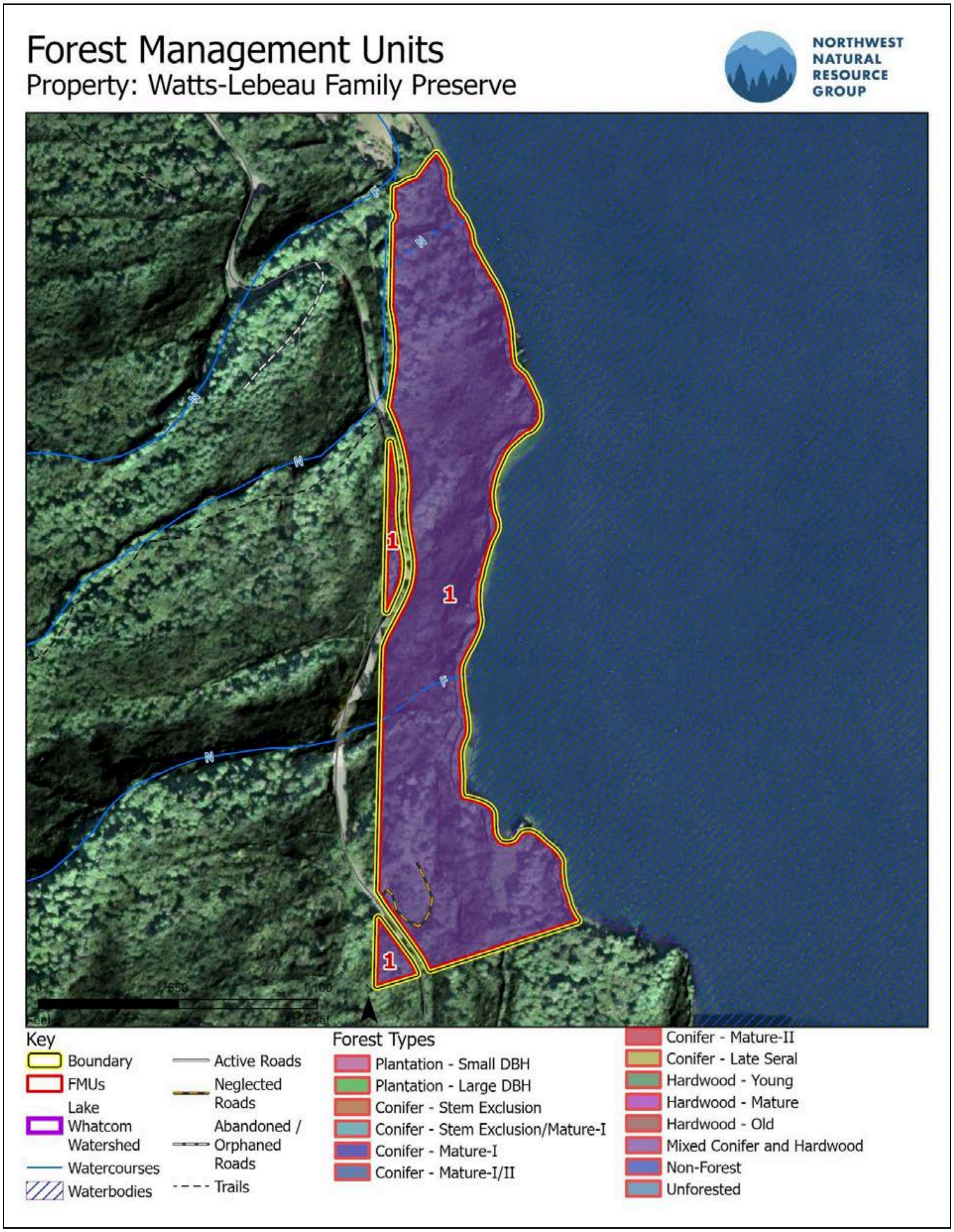
Property Information

This forest is located in Section 16, Township 37N, Range 04E of the US Public Land Survey System and includes three parcels that are listed in the table at the end of this section.

Management History

The preserve is made up of three parcels—two acquired by the City of Bellingham in 2019 and one in 2010. The land was previously privately owned, and although the exact history is unknown, the presence of old stumps indicates that most of the area was likely harvested 80–120 years ago.

Property Overview Map



Assessment

Topoclimate

This property lies at low elevation along the shores of Lake Whatcom with moderate to steep east-facing slopes. The moderating influence of the lake creates relatively mild conditions with reduced temperature extremes and slightly higher humidity.

Vegetation Zone

According to vegetation zone maps for North America, the following Ecological Systems were likely present prior to Euro-American settlement. More information on these maps and full descriptions of each system can be found in the discussion of Vegetation Zones in Section 2 of this document.

- North Pacific Lowland Riparian Forest and Shrubland
- North Pacific Maritime Mesic-Wet Douglas-fir-Western Hemlock Forest
- North Pacific Hypermaritime Western Red-cedar-Western Hemlock Forest

Soils

Data from the USDA Natural Resource Conservation Service (NRCS) Soil Surveys were used to identify the major soil types that underlay this forest, which are described in more detail in the discussion of Soil Productivity in Section 2. Information about specific soil units likely present at this property, including depth, drainage, productivity, and relevant management concerns are listed in the table below. The location of these soil units can be found in the accompanied map packet for this property.

Forest Soil Units Summary Table

Soil Unit	Productivity		Management Concerns					Acres (Pct)
	Site Class	Max Growth	Drought Stress Hazard	Wind Throw Hazard	Mass Wasting Hazard	Logging Rutting Hazard	Logging Compact Hazard	
Nati Series Ashy Loam on 15-30% Slopes Mod. Deep (31in) Well Drained	DF-2 / DF-3	172 ft3/ac/yr	Mod. High	Medium	High	High	High	15 (51%)
Andic Xerochrepts-Rock Outcrop Complex Ashy Loam on 60-90% Slopes Mod. Deep (24in) Well Drained	DF-3	143 ft3/ac/yr	High	High	High	High	High	12 (42%)

Slope Stability

As previously described in Section 2, this plan utilizes remotely mapped topographic data as well as hazard zones and historic landslides identified by the State of Washington Department of Natural Resources (DNR) to gauge the likelihood that unstable slopes will be found within a proposed management area. The presence of a mapped hazard zone or historic landslide does not preclude management, but indicates that further investigation is required.

The preserve contains mostly moderate slopes, but there are some steep slopes that exceed 70% right along the shore of Lake Whatcom. Hazard zones have been identified along the stream channel in the middle of the preserve, where a historic landslide has occurred, and along the stream channel on the north side of the preserve.

Hydrology

The preserve is along the west shore of Lake Whatcom, and there are two streams that flow through the preserve into the lake. The DNR's hydrography database identifies a non-fish-bearing stream on the north side and a fish-bearing stream in the middle area of the preserve.

Roads and Access

The preserve is accessible from Lake Whatcom Blvd. There are no active roads within the property. There is a short old road bed that curves down onto the property on the south side of the preserve. It is currently overgrown and gated at the entrance.

Health and Resiliency

The forest is a healthy mix of conifer and hardwood species with no signs of overstocking or other health issues. A few invasive species are present along the old road bed on the south side, but they are unlikely to spread into the shaded interior of the forest.

Wildlife Habitat

A review of the Washington State Department of Fish and Wildlife Priority Species Database identified Townsend's Big-eared Bat and myotis bat as having been documented somewhere within the 23,000-acre township containing the preserve. The property provides diverse wildlife habitat supported by a mix of forest types and species. Mature forest areas with large woody debris offer valuable cover and structural complexity. The understory shrub layer provides food sources for wildlife. The preserve also offers habitat for many aquatic species along the shore of Lake Whatcom.

Wildfire Susceptibility

The preserve is located near residential areas and a major road, but the absence of recreational access keeps ignition risk moderate. The mature forest has low surface fuel levels and lacks ladder fuels, reducing the likelihood of fire spread. Fire response access is good, with Lake Whatcom Boulevard providing direct access along the western boundary.

Carbon Storage

The forest contains a high proportion of conifers, particularly Douglas-fir, which have strong potential for long-term carbon storage. Healthy stocking levels indicate continued growth and carbon accumulation. Additionally, several large remnant Douglas-fir trees remain on the site, contributing significantly to overall carbon storage capacity.

Cultural Resources

The Lake Whatcom watershed is a landscape rich with cultural significance for Indigenous peoples—particularly the Lummi Nation and the Nooksack and Swinomish Tribes—who have maintained deep spiritual, cultural, and subsistence connections to the landscape. Although a review of the Washington State Department of Archaeology and Historic Preservation Wisaard online database did not identify any known historical sites on this property and none were encountered while developing this plan, this property has a long history of human use and artifacts may be present. Please see the previous discussion about cultural use practices in the Lake Whatcom Watershed for a more detailed assessment of best management practices moving forward.

Recreation

There is no developed recreational access at the Watts-Lebeau Family Preserve.

Recommendations

Roads and Access

The short segment of road on the south side of the property should be formally decommissioned. At a minimum, culverts should be removed and permanent water bars installed to control drainage. Since no future management activities are expected at this location, the road bed grade can be further restored and reforested.

Health and Resiliency

Aside from the invasive species already mentioned in the road recommendations, there are no forest health concerns that need to be addressed at this property.

Wildfire Susceptibility

Shaded fuel breaks are recommended within 100 feet of public roads and existing structures which are designed to keep fires on the ground and slow their spread until firefighting resources can arrive. For

additional details on implementation, see the description of a shaded fuel break given in the discussion of Wildfire Susceptibility in Section 2 of this document.

Forest Types

All recommendations for this property follow the previous discussion of forest-types in section 3 and are discussed by management unit below.

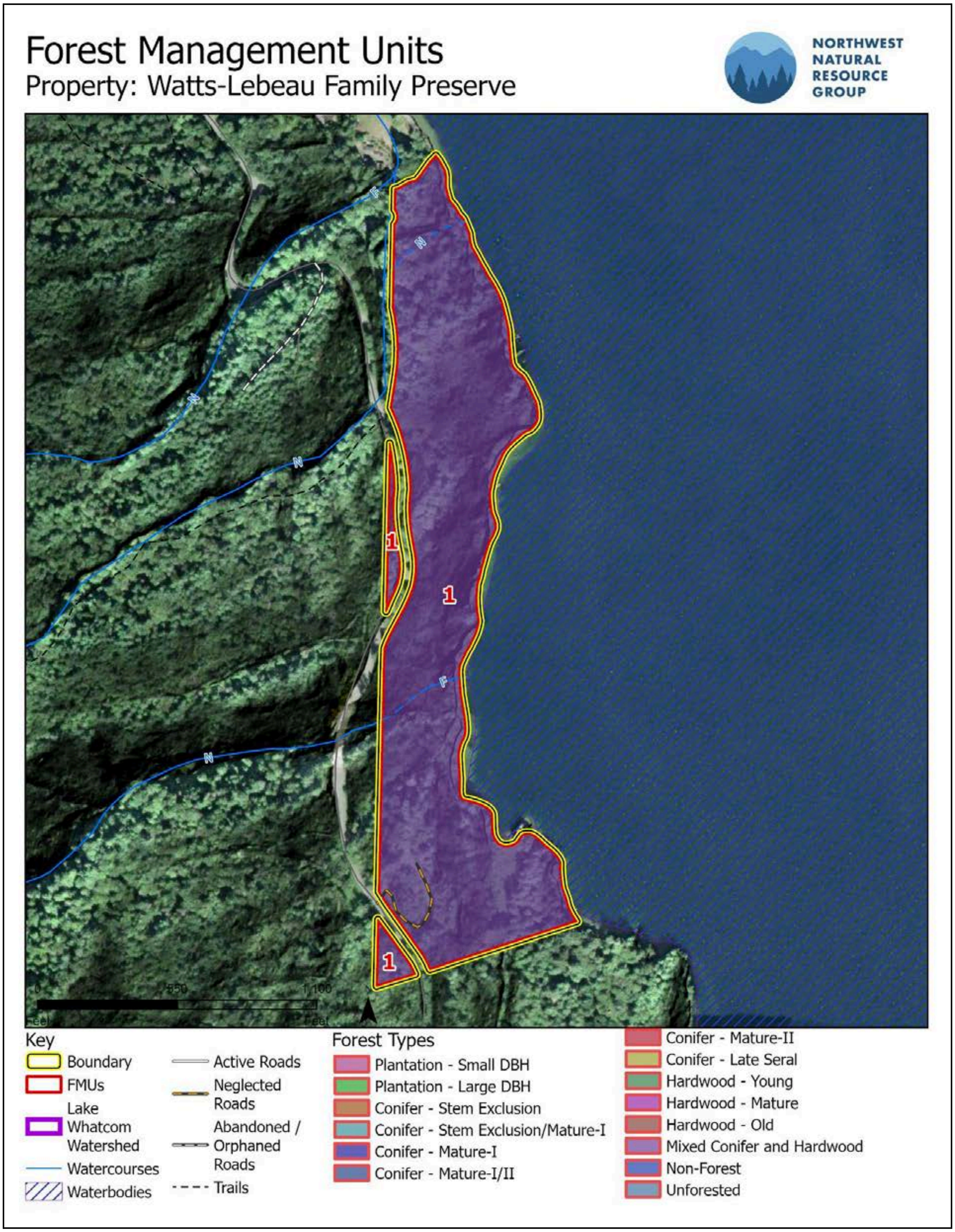
Management Units

Forest cover was delineated into the forest management units (FMUs) using both remotely sensed data, historic inventory units, and field inventory data. The forestland within these management units share similar forest characteristics and management recommendations. For each FMU, this plan describes the geophysical attributes and forest conditions and assesses the unit against the plans management objectives using the previously described framework by forest type. Recommendations are then given by FMU, typically referencing general recommendations by forest type, but more information is given as needed. Finally, a schedule of management activities by year and FMU is given at the end of this section.

Summary of Forest Management Units

FMU	Acres	Forest Type	Management
1	29	Mixed Conifer and Hardwood	None
Total	**29**		

Map of Forest Management Units



FMU 1 - Mixed Conifer and Hardwood

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	BM	32	64	98	45	12	20	30	130
		DF	32	68	109		16	22	40	135
	Minor	RC	16	28	65		16	24	32	120
	All	All	80	160	272		12	21	40	130
Midstory	Major	RC	44	26	37	6	6	9	14	60
	All	All	50	30	43		6	9	14	60
Total	All	All	130	190	315	51	6	17	40	103

Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.

This property has been designated as a single FMU, as forest composition is similar throughout the preserve. Total stocking is approximately 130 TPA. The overstory contains approximately 80 TPA and is primarily composed of bigleaf maple and Douglas-fir, with a small component of western redcedar. Overstory Douglas-fir average 22 inches DBH and 135 ft tall, and overstory bigleaf maple average 20 inches DBH and 130 ft tall. The midstory contains approximately 50 TPA and is primarily composed of western redcedar that average 9 inches DBH and 60 ft tall. This is a mature mixed conifer and hardwood forest with no health concerns. Per the earlier discussion of mixed conifer and hardwood forests, no management activities are recommended in this forest.

Parcel Table

Owner	Parcel ID	Year Acquired	Previous Owner
City	3704160172130000	2019	Private
City	3704160263250000	2010	Private
City	3704160381680000	2019	Private

West Beaver Creek Preserve

Overview

Site Description

West Beaver Creek Preserve is a 182-acre property owned by the City of Bellingham on the northwest side of Lake Whatcom. It is located west of Lake Louise Road, between North Beaver Creek Preserve to the north and Lookout Mountain Forest Preserve to the south.

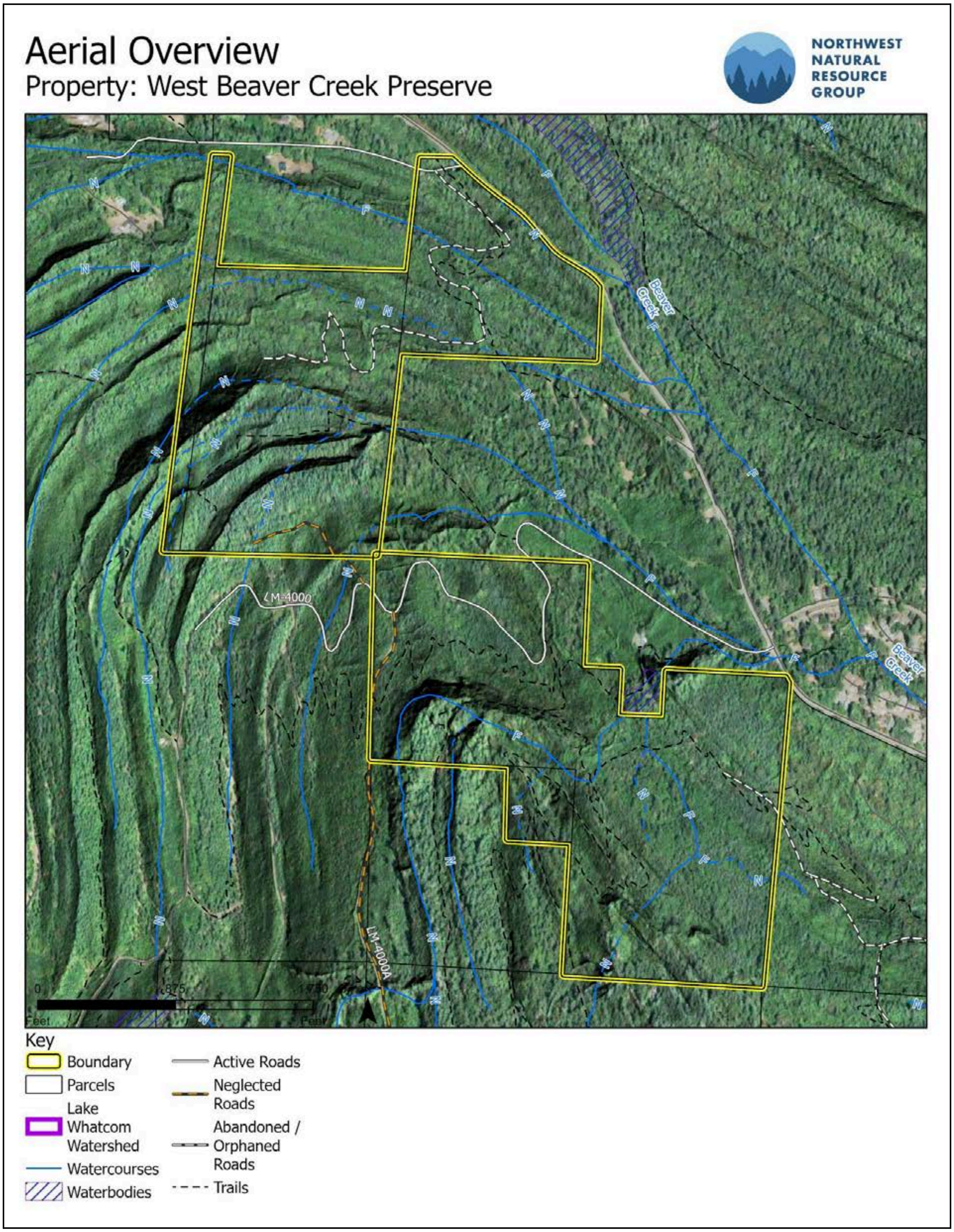
Property Information

This forest is located in Sections 01 and 02, Township 37N, Range 03E of the US Public Land Survey System and includes five parcels that are listed in the table at the end of this section. The parcels occur in two well defined blocks: 3 parcels in the northwest connected by a corner to 2 parcels in the southeast. Additional parcels were purchased by the City of Bellingham to the west of the site in 2025, but they are not included in this assessment.

Management History

The original forestland at the preserve was likely clearcut harvested sometime before 1940 and left to regenerate naturally. Subsequent harvests of these naturally regenerated forests began in the 1990s, establishing the Douglas-fir plantations but leaving some remnant second growth stands behind in riparian leave zones and inaccessible areas. The exact management history is unknown but the site was managed as commercial timberland for many years before the City of Bellingham acquired the five parcels in this assessment in 2012, 2013, and 2014.

Property Overview Map



Assessment

Topoclimate

The topography of the site is variable, but it generally contains moderate to steep slopes that face northeast, resulting in cooler, moister conditions. There are also several stream channels that create cooler microclimates. Steep shelves are present throughout the property, which can cause water to drain faster from the soils.

Vegetation Zone

According to vegetation zone maps for North America, the following Ecological Systems were likely present prior to Euro-American settlement. More information on these maps and full descriptions of each system can be found in the discussion of Vegetation Zones in Section 2 of this document.

- North Pacific Maritime Mesic-Wet Douglas-fir-Western Hemlock Forest
- North Pacific Hypermaritime Western Red-cedar-Western Hemlock Forest
- North Pacific Lowland Riparian Forest and Shrubland
- North Pacific Seasonal Sitka Spruce Forest

Soils

Data from the USDA Natural Resource Conservation Service (NRCS) Soil Surveys were used to identify the major soil types that underlay this forest, which are described in more detail in the discussion of Soil Productivity in Section 2. Information about specific soil units likely present at this property, including depth, drainage, productivity, and relevant management concerns are listed in the table below. The location of these soil units can be found in the accompanied map packet for this property.

Forest Soil Units Summary Table

Soil Unit	Productivity		Management Concerns					Acres (Pct)
	Site Class	Max Growth	Drought Stress Hazard	Wind Throw Hazard	Mass Wasting Hazard	Logging Rutting Hazard	Logging Compact Hazard	
Chuckanut Series Gravelly Medial Loam on 30-65% Slopes Deep (56in) Well Drained	DF-2	186 ft3/ac/yr	Mod. High	Low	High	High	Mod.	94 (52%)
Chuckanut Series Gravelly Medial Loam on 15-30% Slopes	DF-2	186 ft3/ac/yr	Mod. High	Low	High	High	Mod.	43 (24%)

Soil Unit	Productivity		Management Concerns					Acres (Pct)
	Site Class	Max Growth	Drought Stress Hazard	Wind Throw Hazard	Mass Wasting Hazard	Logging Rutting Hazard	Logging Compact Hazard	
Deep (56in) Well Drained								
Nati Series Ashy Loam on 30-60% Slopes Mod. Deep (38in) Well Drained	DF-3	129 ft3/ac/yr	Mod. High	High	High	High	High	31 (17%)
Chuckanut Series Gravelly Medial Loam on 5-15% Slopes Deep (56in) Well Drained	DF-2	186 ft3/ac/yr	Mod. High	Low	Mod.	High	Mod.	13 (7%)

Slope Stability

As previously described in Section 2, this plan utilizes remotely mapped topographic data as well as hazard zones and historic landslides identified by the Washington Department of Natural Resources (DNR) to gauge the likelihood that unstable slopes will be found within a proposed management area. The presence of a mapped hazard zone or historic landslide does not preclude management, but indicates that further investigation is required.

The site contains moderate to steep slopes. Generally, the lower elevations have more moderate slopes less than 40% and the higher elevations have slopes greater than 70%. The southern part of the property has a small hazard zone as well as a few small known historic landslides on the steep upper slopes. There is the potential for rule-identified landforms to exist on the site, particularly inner gorges in steam channels.

Hydrology

There are several streams throughout the property that descend from steep upper slopes and flow east towards Beaver Creek. Beaver Creek itself flows southeast and enters Austin Creek shortly before entering Lake Whatcom. The lowest stream on the northeast side of the property parallels the main fork of Beaver Creek and is identified as fish-bearing. There are also two streams on the southern part of the property that are identified as fish-bearing in the DNR's hydrography database. Water in these streams flows into a small pond that lies just outside of the property boundary before then flowing into Beaver Creek.

Roads and Access

There are two access points for this property. The northern part of the property is accessible from Valleybrook Lane where a now abandoned road bed once provided access to the lower half of the northern section of this property. The road has been decommissioned and is now a trail. The middle part of the property is accessible from the LM-4000 road and an unnamed spur off this road provides access to the top of the northern unit. This unnamed spur has not been officially abandoned but is in generally good condition with only some minor erosion identified at the end of the road segment. The LM-4000 road provides access into Galbraith Mountain timberlands and the exact access and maintenance arrangements on this road are unknown. One partially plugged cross-draining culvert and one segment of potential water on the roadway were identified, but the road remains in good condition. The southernmost area of the property was once accessible by forest roads through neighboring properties but does not currently have road access south of the fish-bearing stream draining into Beaver Creek. Old road beds in this area have been converted to recreational trail use and foot bridges have been placed over the stream crossings.

Health and Resiliency

Several of the forests at West Beaver Creek Preserve are overstocked Douglas-fir Plantations, and there are also some areas overstocked with hardwoods. These stands are in the Stem Exclusion stage of development and growing at unsustainable densities. Relative density values of over 60 are common, and the value will continue to increase as the trees grow larger. These stands also have low species diversity, which makes them less resilient to major disturbances.

Wildlife Habitat

A review of the Washington State Department of Fish and Wildlife Priority Species Database identified little brown bat, Townsend's Big-eared bat, and Yuma myotis bat as having been documented somewhere within the 23,000-acre township containing the property. A portion of the property is also identified as a part of a large biodiversity area and corridor that stretches south across Lookout Mountain. The fish-bearing streams are habitat for cutthroat trout.

The overstocked Douglas-fir plantations that dominate the property contain limited wildlife habitat features due to a lack of large woody structures and limited shrub layer, but there are some older mixed stands that are more diverse in species and structure. They contain larger downed wood and snags that offer habitat, as well as a healthy understory shrub layer with plants that provide food for wildlife.

Wildfire Susceptibility

The property has a moderate fire risk. Its proximity to residential areas increases ignition potential, though limited trail use and a lack of parking areas reduce overall human activity. Young plantations contain abundant woody debris and ladder fuels in some areas, raising fire risk, while the older mixed stands have lower fuel loads and are less susceptible. Firefighting access varies. There are no roads in the north section, while the south section has road access along the north edge but none on its southern side.

Carbon Storage

The property is dominant to Douglas-fir stands that have high carbon storage potential due to the long life-span of the species. However, most of these stands are currently overstocked which results in a slower growth rate and, therefore, rates of carbon sequestration. Thinning suppressed trees would result in a short-term reduction in stored carbon but would enhance growth of the remaining trees, accelerating sequestration and improving long-term carbon storage capacity.

Cultural Resources

The Lake Whatcom watershed is a landscape rich with cultural significance for Indigenous peoples—particularly the Lummi Nation and the Nooksack and Swinomish Tribes—who have maintained deep spiritual, cultural, and subsistence connections to the landscape. Although a review of the Washington State Department of Archaeology and Historic Preservation Wisaard online database did not identify any known historical sites on this property and none were encountered while developing this plan, this property has a long history of human use and artifacts may be present. Please see the previous discussion about cultural use practices in the Lake Whatcom Watershed for a more detailed assessment of best management practices moving forward.

Recreation

Recreational varies across the property. On the northern section, an overgrown trail runs along an abandoned road bed and some unsanctioned mountain biking trails provide access out of adjacent properties. On the southern section, several well-maintained and sanctioned recreational trails provide hiking and mountain biking access to Galbraith Mountain timberlands and Lookout Mountain Forest Preserve.

Recommendations

Roads and Access

This plan recommends the following actions be taken to improve the maintenance and function of the existing road system at West Beaver Creek Preserve:

- **Neglected and/or Improperly Abandoned Roads.** After management activities have concluded, pursue formal abandonment of the unnamed spur off the LM-4000 road which provides access into FMU-4. At a minimum, culverts should be removed and permanent water bars installed to control drainage, and full restoration would include road grade restoration and reforestation.
- **Drainage Control Issues on Active Roads.** Repair the plugged culvert identified on the LM-4000 road as it drains a long length of ditch and will absorb high water flows during storm events.

Implement a maintenance plan for ditches, culverts, and road grades to ensure all active roads maintain a high standard of function. See the best management practices identified in Section 2.

Without road access, heavy equipment cannot be used in forest management activities, and thinning recommendations must be implemented as non-commercial cut and drop. This greatly increases the cost of forest management and likely reduces the amount of the landscape that can be actively managed to reach its desired future condition. Given the challenges of properly maintaining roads on steep terrain, the decision to build new roads requires careful planning and should follow the guidelines identified in Section 2. Specific recommendations for creating or restoring temporary spur roads to facilitate forest management activities are given by FMU below.

Health and Resiliency

Recommendations for addressing observed overstocking are given at the management unit level below.

Wildfire Susceptibility

Create shaded fuel breaks within 100 feet of public roads and existing structures which are designed to keep fires on the ground and slow their spread until firefighting resources can arrive. For additional details on implementation, see the description of a shaded fuel break given in the discussion of Wildfire Susceptibility in Section 2 of this document.

Forest Types

All recommendations for this property follow the previous discussion of forest-types in section 3 and are discussed by management unit below.

Management Units

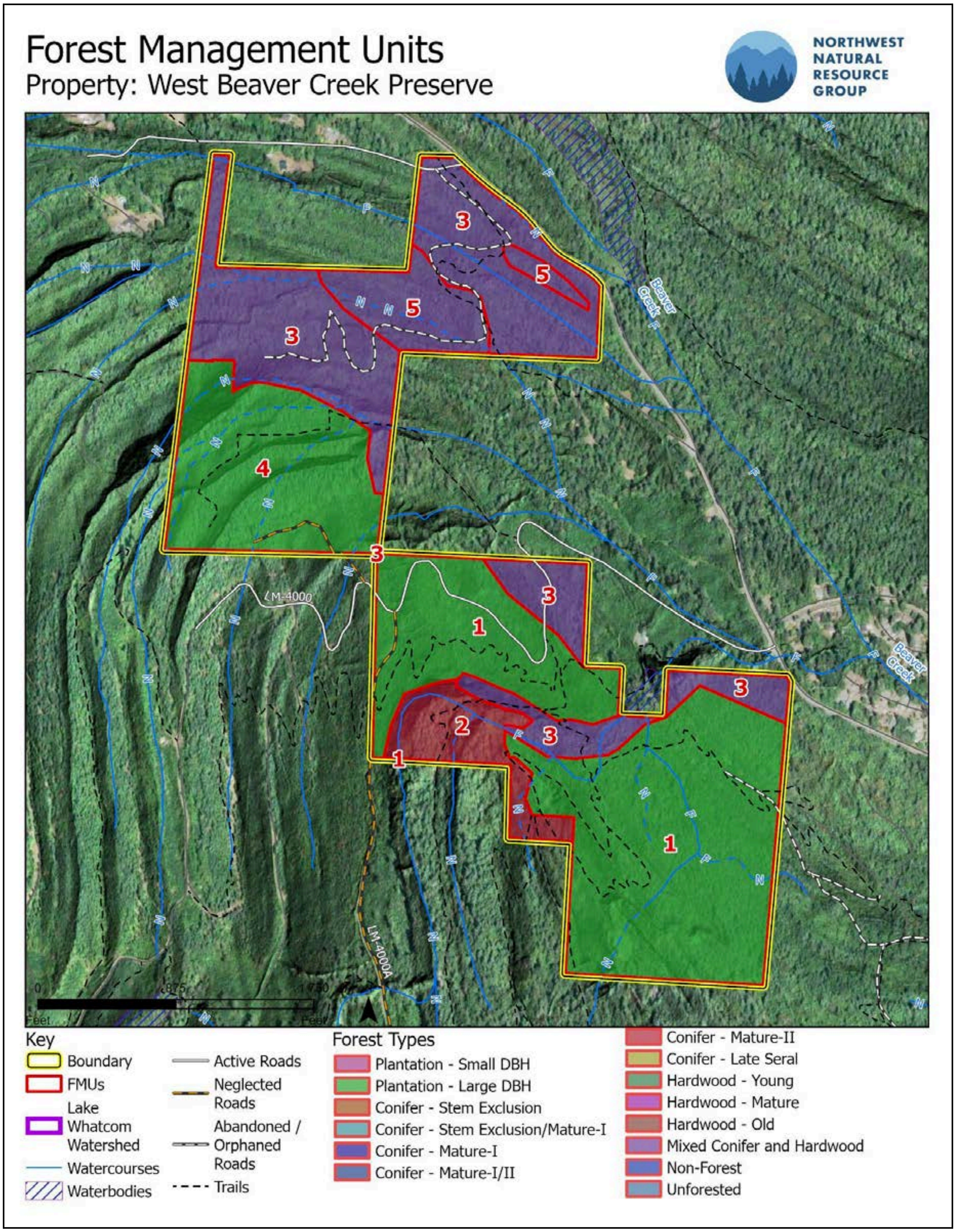
Forest cover was delineated into the forest management units (FMUs) using both remotely sensed data, historic inventory units, and field inventory data. The forestland within these management units share similar forest characteristics and management recommendations. For each FMU, this plan describes the geophysical attributes and forest conditions and assesses the unit against the plans management objectives using the previously described framework by forest type. Recommendations are then given by FMU, typically referencing general recommendations by forest type, but more information is given as needed. Finally, a schedule of management activities by year and FMU is given at the end of this section.

Summary of Forest Management Units

FMU	Acres	Forest Type	Management
1	76	Conifer Plantation - Large DBH	Thinning
2	10	Mixed Conifer - Mature-II	None
3	56	Mixed Conifer and Hardwood	None
4	30	Conifer Plantation - Large DBH	Thinning

FMU	Acres	Forest Type	Management
5	11	Mixed Conifer and Hardwood	Thinning
Total	**182**		

Map of Forest Management Units



FMU 1 - Conifer Plantation - Large DBH

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	DF	242	190	274	54	6	11	16	81
	All	All	258	200	282		2	10	16	83
Total	All	All	258	200	282	54	2	10	16	83

Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.

This FMU is located on the south side of the property and consists of two areas separated by a riparian zone. The terrain is mostly northeast-facing and includes plateaus, moderate slopes, and short steep slopes. The soil productivity rating is site class II. It is estimated that this unit was clearcut in the 1990s, replanted with Douglas-fir, and later pre-commercially thinned. Total stocking is approximately 258 TPA. The overstory is primarily composed of Douglas-fir that average 11 inches DBH and 81 ft tall. No midstory is currently present in this stand. The stand is currently stocked at an unsustainable density with low species and structural diversity common to plantations. Per the earlier discussion of overstocked, large-diameter plantations, a two-part sequence of variable density thinning is recommended, and potential underplanting once density has been sufficiently reduced. The north side of this unit is accessible from the LM-4000 road and the moderate slopes should enable ground-based commercial thinnings. The south side of the unit is across a stream channel with no current road access, so thinning will need to be non-commercial unless a new road is constructed.

FMU 2 - Mixed Conifer - Mature-II

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	DF	58	157	193	47	14	21	44	191
	Minor	RC	11	25	31		12	20	36	180
		WH	17	41	56		12	21	36	203
	All	All	88	228	285		10	21	44	191
Midstory	Major	RC	32	26	33	10	4	10	14	88
		WH	22	17	19		4	9	16	88
	Minor	DF	13	12	14		4	10	14	96
	All	All	71	58	69		4	10	16	89
Total	All	All	159	286	354	57	4	16	44	146

Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.

This FMU is on the upper slopes of the south side of the property. The terrain is mostly steep northeast-facing slopes with a couple stream channels, and the soil productivity rating is site class II. It is estimated that the unit regenerated naturally following a clearcut harvest around 1930. This unit was not harvested during the 1990s clearcut in the adjacent stand due to the steep terrain and stream channels. The overstory contains approximately 88 TPA and is primarily composed of Douglas-fir, with small components of western redcedar and western hemlock. Overstory Douglas-fir average 21 inches DBH and 191 ft tall. The midstory contains approximately 71 TPA and is primarily composed of western hemlock and western redcedar, with a small component of Douglas-fir. Midstory western redcedar average 10 inches DBH and 88 ft tall, and hemlock average 9 inches DBH and 88 ft tall. This unit is in the Mature-II stage of development. Per the earlier discussion of forests in this stage, no management is recommended. This stand can be partially accessed via a spur off the LM-4000 road that leads onto adjacent County-owned forestland.

FMU 3 - Mixed Conifer and Hardwood

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	RC	92	141	374	65	10	24	36	108
	Minor	BM	11	16	27		8	17	32	111
		RA	27	34	23		6	9	16	109
	All	All	139	208	445		6	20	36	109
Midstory	Major	RC	18	9	13	2	2	8	14	49
		WH	7	2	4		2	6	14	32
	All	All	29	14	18		2	7	14	43
Total	All	All	168	222	463	67	2	18	36	97

Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.

This FMU consists of two areas on the north side of the property. Most of the terrain is moderate northeast-facing slopes, but the lower area has a large stream channel that flows to the southeast and a flatter plateau. The soil productivity rating is site class II. The exact history of the unit is unknown, but it is estimated that it was clearcut harvested in the early 1900s, followed by a subsequent high-grade harvest around the 1990s that removed most of the high-value Douglas-fir. Total stocking is approximately 168 TPA. The overstory contains approximately 139 TPA and is primarily composed of western redcedar, with small components of bigleaf maple and red alder. Overstory western redcedar average 24 inches DBH and 108 ft tall. The midstory contains approximately 29 TPA and is primarily composed of western redcedar and western hemlock. Midstory redcedar average 8 inches DBH and 49 ft tall, and hemlock average 6 inches DBH and 32 ft tall. This is a mixed conifer and hardwood forest with no health concerns. Per the earlier discussion of this type of forest, no management activities are recommended for this unit. There is no current road access to this stand.

FMU 4 - Conifer Plantation - Large DBH

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	DF	340	200	340	65	8	10	14	80
Total	All	All	340	200	340	65	8	10	14	80

Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.

This FMU is on the upper slopes of the north section of the property. It has mostly steep northeast-facing terrain and a soil productivity rating that ranges from site class II to III. It is estimated that the unit was clearcut in the 1990s and replanted with Douglas-fir. Total stocking is approximately 340 TPA. The overstory is primarily composed of Douglas-fir that average 10 inches DBH and 80 ft tall. No midstory is currently present in this stand. It does not appear this stand was previously pre-commercially thinned, and the stand is currently overstocked in the Stem Exclusion phase of development with low species and structural diversity common to plantations. Per the earlier discussion of overstocked, large-diameter plantations, a two-part sequence of variable density thinning is recommended, and potential underplanting once density has been sufficiently reduced. There is no current road access to this stand, but a neglected spur road off of the LM-4000 road could be easily restored to access the upper portion of this unit. The steep slopes will likely require cable-yarding for commercial operations.

FMU 5 - Mixed Conifer and Hardwood

Stand Composition Summary

Canopy Position	Cohort Type	Species	TPA	BAA	SDI	RD	Min DBH	Avg DBH	Max DBH	Avg HT
Overstory	Major	DF	101	68	159	61	6	13	18	76
		RA	106	62	96		4	9	14	92
	Minor	WH	25	11	37		6	12	26	68
	All	All	246	150	340		4	12	28	84
Midstory	Major	BM	14	2	5	1	2	5	8	40
	All	All	20	3	7		2	5	10	40
Total	All	All	266	153	346	62	2	11	28	80

Note: TPA - Trees Per Acre, BAA - Basal Area (sq ft) Per Acre, SDI - Reineke Stand Density Index (i.e. equivalent 10in trees), RD - Relative Density, DBH - Diameter at Breast Height (in), HT - Height (ft). See appendix for species codes.

This FMU consists of a couple areas in the north section of the property. The terrain consists of central plateaus with northeast- and southeast-facing slopes on either side. The soil productivity rating is site class II. It is estimated that this unit was clearcut around the 1990s and replanted with Douglas-fir. Part of the unit had low survival and red alder naturally regenerated. Total stocking is approximately 266 TPA. The overstory contains approximately 246 TPA and is primarily composed of red alder and Douglas-fir, with a small component of western hemlock. Overstory Douglas-fir average 13 inches DBH and 76 ft tall, and alder average 9 inches DBH and 92 ft tall. The midstory contains approximately 20 TPA and is primarily composed of bigleaf maple that average 5 inches DBH and 40 ft tall. This is a mixed stand that is overstocked with Douglas-fir and red alder. The Douglas-fir-dominant areas are similar to plantations, and the alder-dominant areas are similar to young hardwood stands, and per the earlier descriptions of these two types of overstocked stands, thinning is recommended followed by possible planting in the alder dominant areas if natural regeneration does not occur. Because the stand as a whole has a mix of species, subsequent thinnings are likely not necessary. There is no current road access to this stand, so thinnings will be non-commercial.

Management Activity Schedule

<table>
<tr><th>Timeline</th><th>Activity</th><th>Priority</th><th>FMU</th><th>Prescription</th></tr>
<tr><td rowspan="3">2025 to 2030</td><td rowspan="2">Thinning (CT / NCT)</td><td>1</td><td>1, 4</td><td>Thin to an initial target density of 140 to 170 TPA.</td></tr>
<tr><td>2</td><td>5</td><td>Thin to an initial target density of 140 to 170 TPA.</td></tr>
<tr><td>Planting</td><td>3</td><td>5</td><td>Underplant after thinning with 150 TPA shade-tolerant conifers suitable to site conditions or wait 5-10 years and assess natural regeneration, planting if necessary.</td></tr>
<tr><td rowspan="2">2035 to 2040</td><td>Thinning (CT / NCT)</td><td>2</td><td>1, 4</td><td>Thin to a final target density of 80 to 110 TPA within 10-15 years after the last thinning entry.</td></tr>
<tr><td>Planting</td><td>3</td><td>1, 4</td><td>Underplant after thinning with 150 TPA shade-tolerant conifers suitable to site conditions or wait 5-10 years and assess natural regeneration, planting if necessary.</td></tr>
<tr><td colspan="5">Notes: CT - Commercial Thinning, NCT - Non-commercial Thinning. Priority Levels: 1 - High, 2 - Moderately High, 3 - Moderate, 4 - Low. Additional thinning and planting considerations are identified in Section 1 of this document as well as in the FMU-specific section above.</td></tr>
</table>

Parcel Table

Owner	Parcel ID	Year Acquired	Previous Owner
City	3703010414810000	2013	Trillium
City	3703011071110000	2014	Trillium
City	3703011321450000	2012	Polygon
City	3703024003430000	2012	Polygon
City	3703024553400000	2012	Polygon

SECTION 5. APPENDICES

Appendix I. Economic Analysis of Management Recommendations

Forest management activities in the Lake Whatcom watershed to address management objectives including water quality and ecological health should be economically viable. Ecologically-based forest management aims to maintain water quality, protect ecosystems, and support sustainable human uses of the watershed, and revenue generation is subordinate to these primary goals. In order to achieve the goals and objectives of this forest management plan, a broad range of forest management activities have been proposed, including commercial ground-based and cable logging, non-commercial thinning, precommercial thinning, tree planting, fuels reduction, and forest road construction and maintenance, each with specific costs and economic implications.

Determining the costs of the specific management activities proposed in this plan, or the revenue that can be generated from commercial logging operations, is beyond the scope of this plan and are best determined during the planning stage of an actual forest management activity. Factors such as road construction costs, hauling or travel distances, fluctuating regional timber markets, available labor, and the design of either commercial or noncommercial forest management activities all influence both the cost of the activity and the potential revenue that can be generated. Therefore, the following analysis provides estimated costs, as well as current log values, as of 2025.

Commercial Logging: Ground-Based and Cable Systems

Commercial logging is proposed for areas of the forest that are readily accessible by road and where there will be minimal impacts to surface water and unstable slopes. As implied by the term, commercial logging produces merchantable timber that is sold to local mills, thereby offsetting the cost of removing the trees from the forest. Ground-based logging, typically used on gentle slopes of less than 40 percent gradient, can cost between $250 to $500 per thousand board feet (MBF) depending on the size and value of the timber and the harvest method used for removing the timber. Cable logging, suited for steeper terrains, is more expensive, averaging $450 to $650 per MBF due to specialized equipment and lower productivity. The timber revenue from these operations varies with market conditions; based on regional timber prices average around $400 to $800 per MBF. Cable logging's higher costs are offset by its ecological benefits, including reduced soil disturbance and sedimentation—crucial for maintaining water quality. Properly managed, commercial harvests can sustainably support local economies while providing forest products and generating jobs.

Non-commercial Thinning

Non-commercial thinning involves cutting merchantable size trees and leaving them to lay on the ground. This practice is rare, but can be an option for forest stands that are either inaccessible or occur in sensitive areas such as steep or unstable slopes. Costs for non-commercial thinning are highly variable and depend on access to the site, terrain, the density of the stand and size and quantity of trees to be cut, and the thinning prescription. Costs can be as low as $250/acre for young stands consisting of small diameter trees or in excess of $3,500/acre for stands of mature trees.

Precommercial Thinning

Precommercial thinning (PCT) involves removing young, competing trees to promote healthier growth of residual trees. The costs range from $250 to $450 per acre depending on the size and density of the trees and the steepness of the terrain. Although PCT does not generate immediate revenue, it enhances future timber yields by promoting faster growth and higher quality wood, potentially increasing long-term revenues by 20–30 percent. Additionally, PCT reduces fire risk and improves habitat quality, adding ecological value that aligns with watershed protection goals.

Tree Planting

Reforestation costs approximately $1,200 to $1,500 per acre, including tree seedlings, site preparation and planting labor (~$400 per acre), and materials (e.g. tree protectors). Following tree planting, seedlings must be maintained for a period typically of at least three years to ensure they achieve a free-to-grow height above competing vegetation. Annual seedling maintenance costs average $250/acre.

Fuels Reduction Practices

Fuels management involves a range of practices that can include thinning, pruning, and slash abatement. As such, costs will vary depending on the range of activities, the composition of the forest being treated, access and terrain. Costs for these treatments can be as low as $750/acre (pruning only) to more than $3,000/ acre (thinning, pruning, and slash abatement), depending on complexity and scope. Although not commercially productive in the short term, fuels reduction prevents wildfire damages—potentially saving millions in suppression costs and ecological restoration.

Forest Road Maintenance and Construction

Forest road maintenance will likely be one of the most expensive forest management activities within the Lake Whatcom watershed. By way of example, the WA DNR spent an average of $113,000/year between 2004-2011 on forest road maintenance alone across the 9,000 acres of former state-owned land in the watershed (Source: 2011 Landscape Management Plan). The majority of currently operable roads within the watershed are in good shape for day-to-day forest maintenance and monitoring purposes. The forest road survey conducted as part of the development of this plan did not identify any high priority road maintenance issues that require attention in order to maintain routine forest management operations. However, in order to support commercial timber harvest operations, or other forest management operations that require the use of heavy equipment, road improvements may be necessary in certain locations (see Roads section of this plan). Common road maintenance practices include: road resurfacing ($1,000/100’ of road), mowing of road margins ($2,600/mile - required every 2-3 years), and ditch cleaning ($3,000 - $4,000/mile - required every 5-10 years).

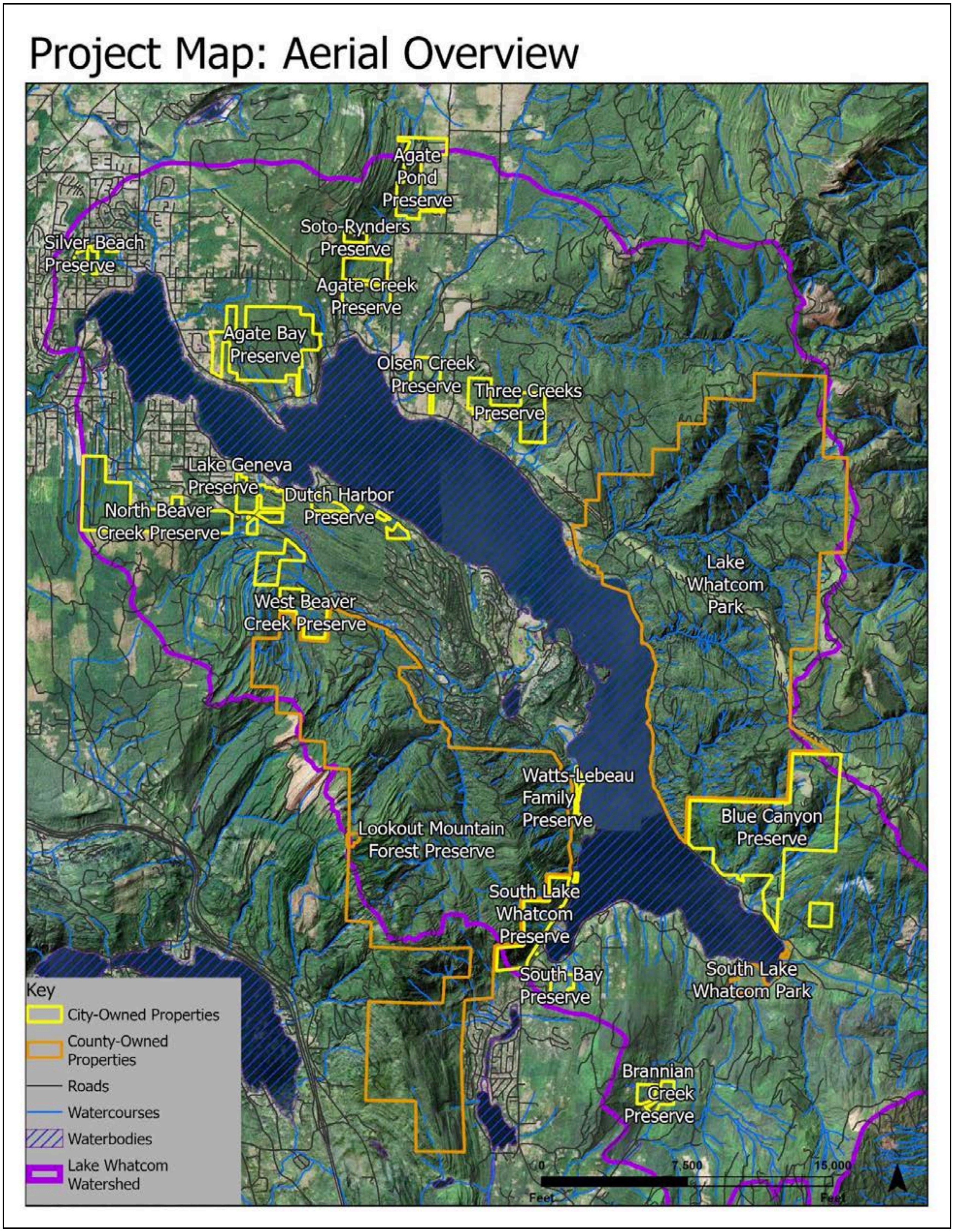
The cost of forest road construction, which may be necessary to open access to currently inaccessible areas of the forest, varies considerably depending on terrain, soil type, and whether the road will be designed for permanent, ongoing use, or only short-term use followed by decommissioning. Road construction for the purposes of conducting commercial timber harvesting is typically included in the timber sale bid, and the cost of construction deducted from the value of the harvested timber.

Economic Integration and Balancing Conservation with Revenue

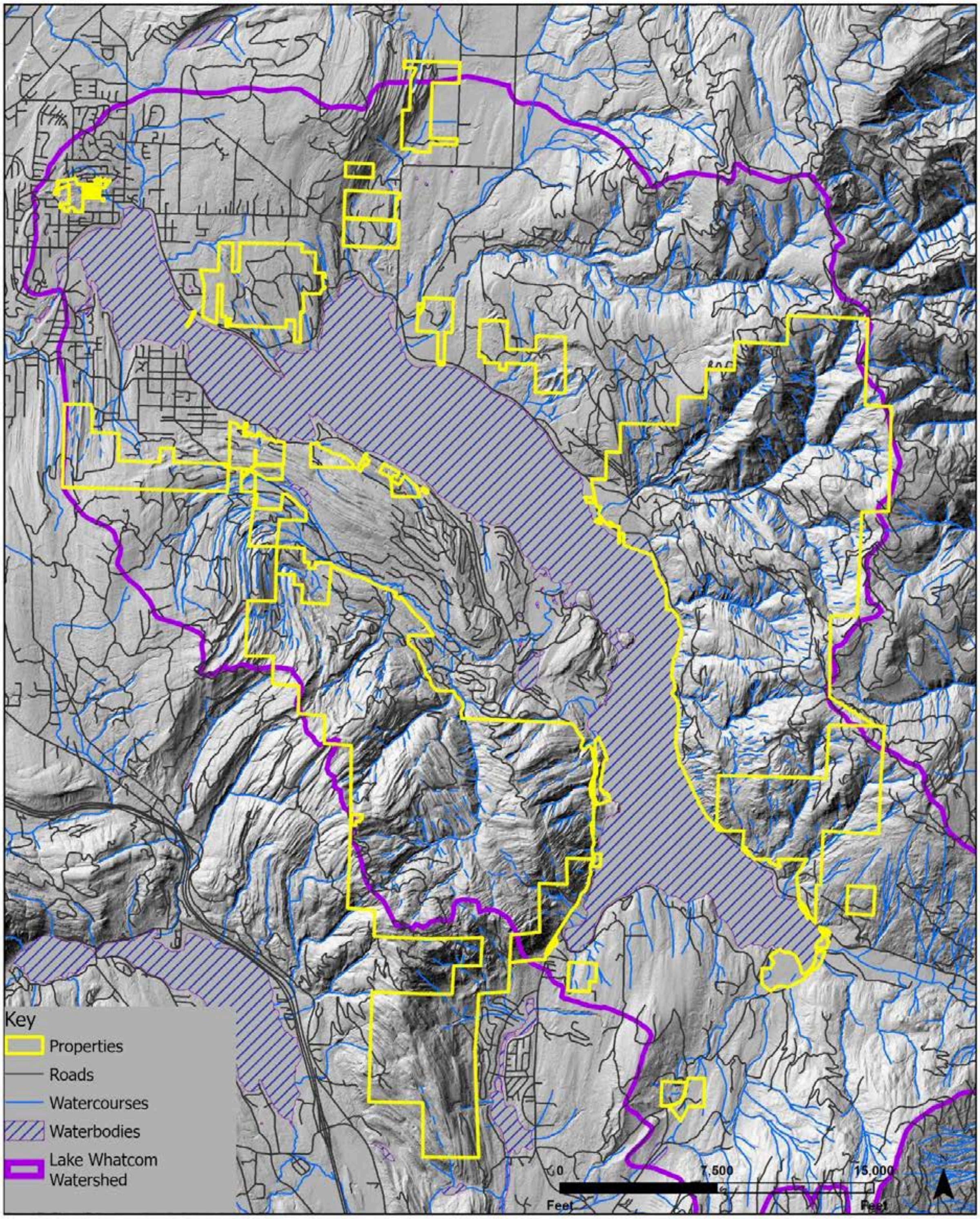
Effective forest management in the Lake Whatcom watershed requires integrating these practices to optimize ecological and economic outcomes. Commercial thinning provides direct revenue but must be balanced against the costs of other management activities and environmental protection. For example, investing in precommercial thinning and fuels reduction may incur costs ($300–$1,500 per acre), but these expenditures mitigate larger ecological and economic risks associated with erosion, sedimentation, and wildfire damage.

Given the complexities of managing forests in remote and steep terrain, such as occurs within the Lake Whatcom watershed, and the focus on least impactful forest management activities, it is unlikely that the sale of merchantable timber resulting from the ecologically-based thinning proposed in this plan will be sufficient to offset the total costs of forest management operations. The Lake Whatcom Management Program 2025 - 2029 Workplan estimated a $2.14 million forest management budget ($427K/year). Additional policy tools such as grant programs, carbon markets, and ecosystem service payments can further enhance economic sustainability. Overall, sustainable forest management in the watershed hinges on a strategic approach that aligns short-term economic gains with long-term ecological resilience and water quality protection.

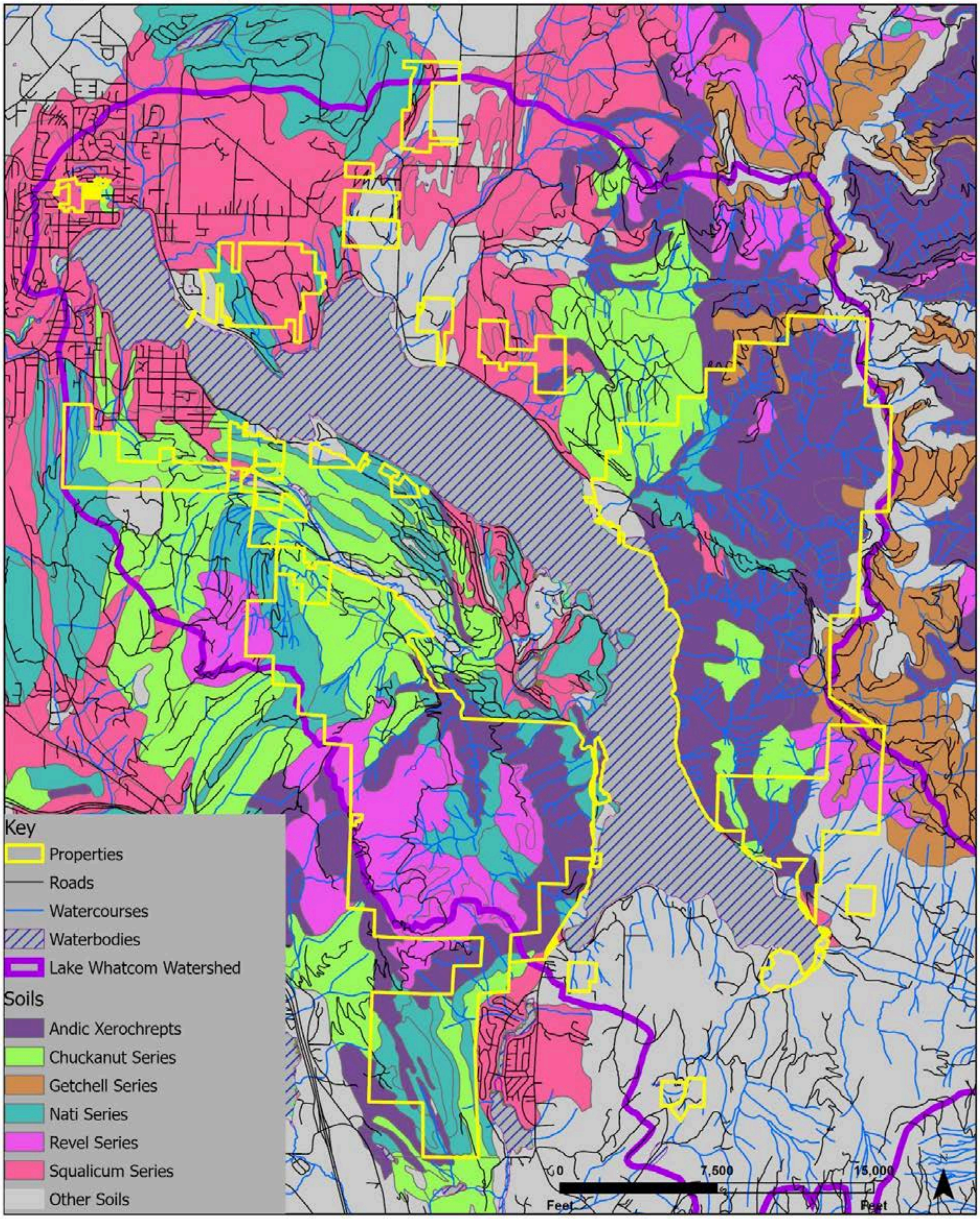
Appendix II. Project Maps



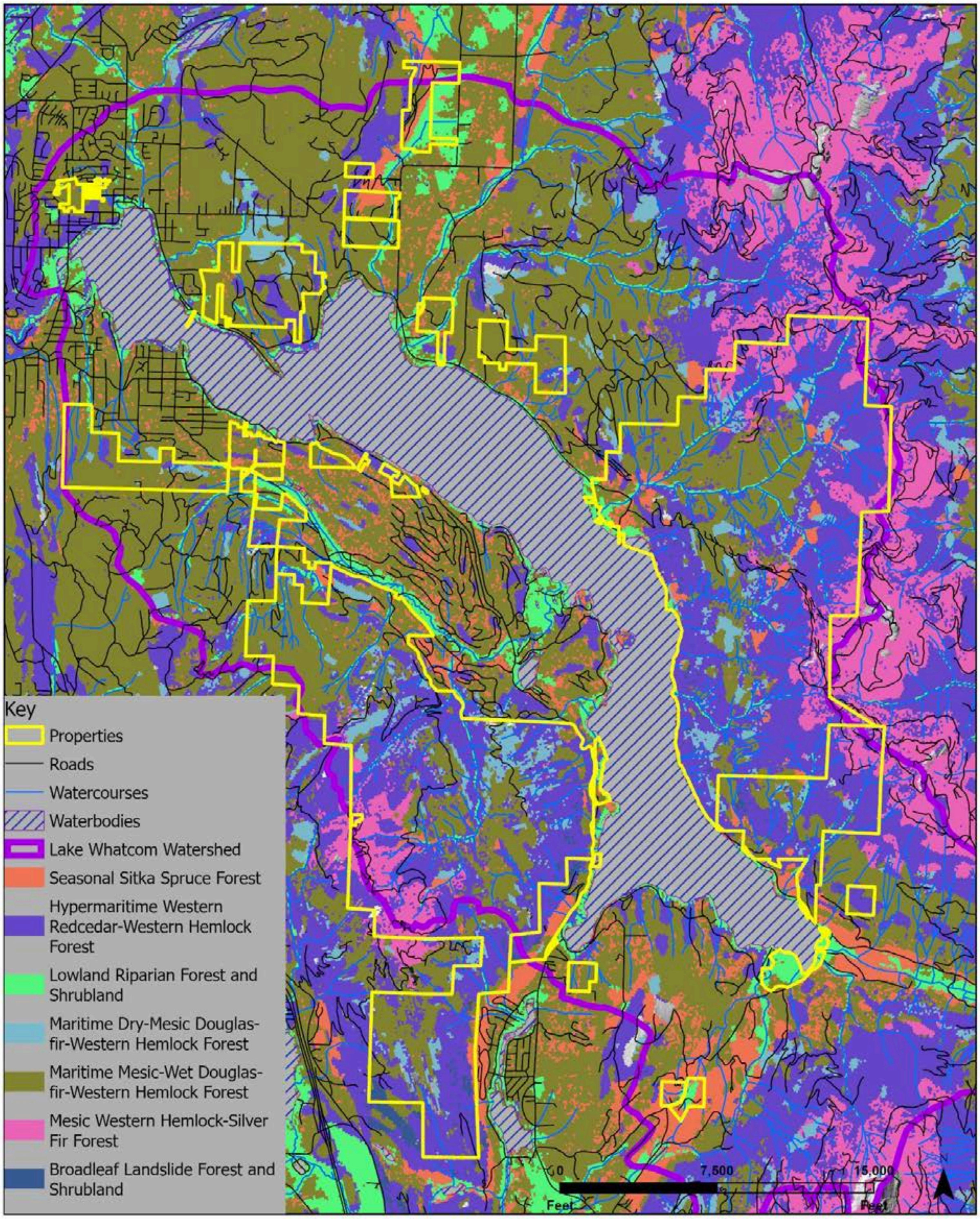
Project Map: Topographic Overview



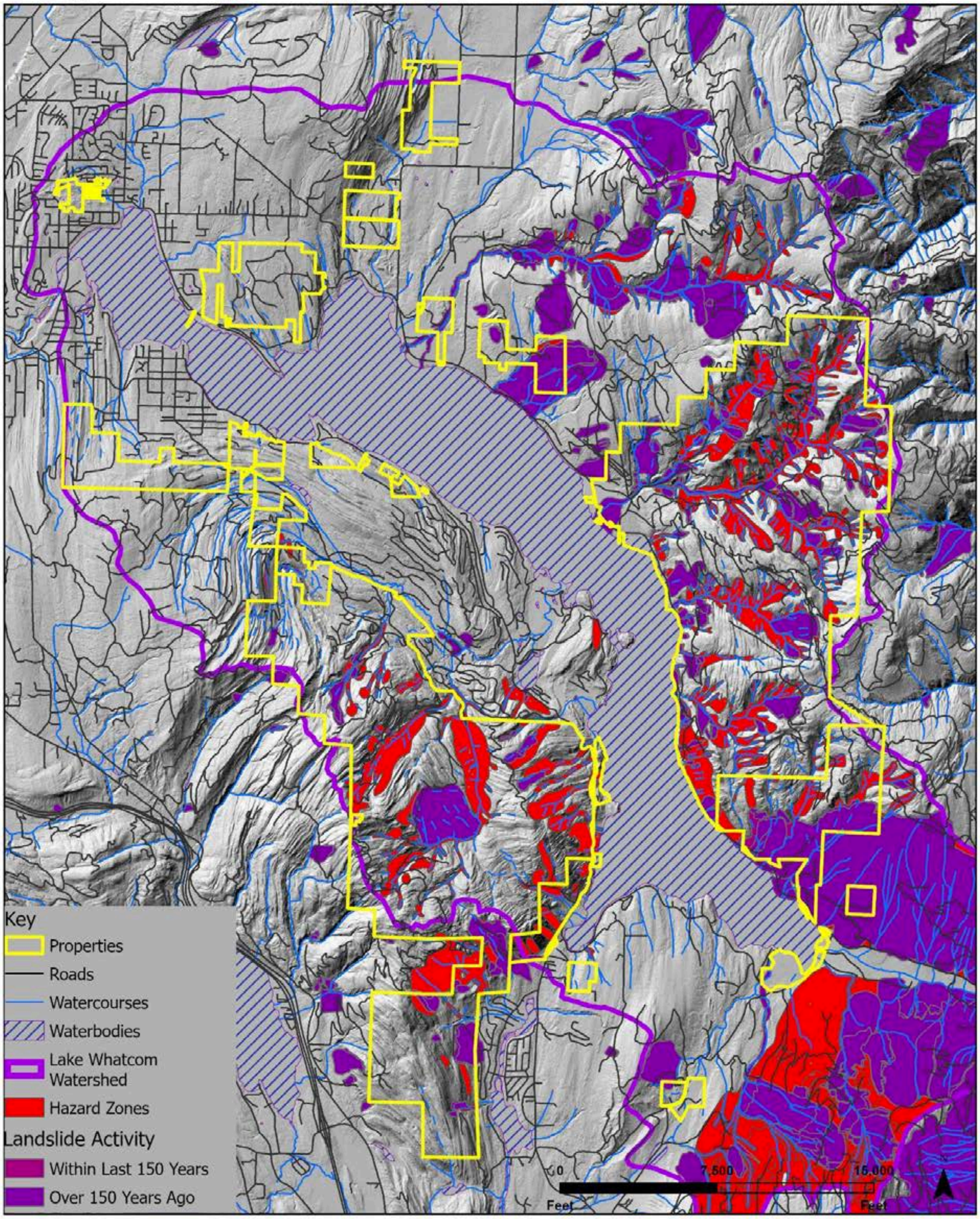
Project Map: Soils Overview



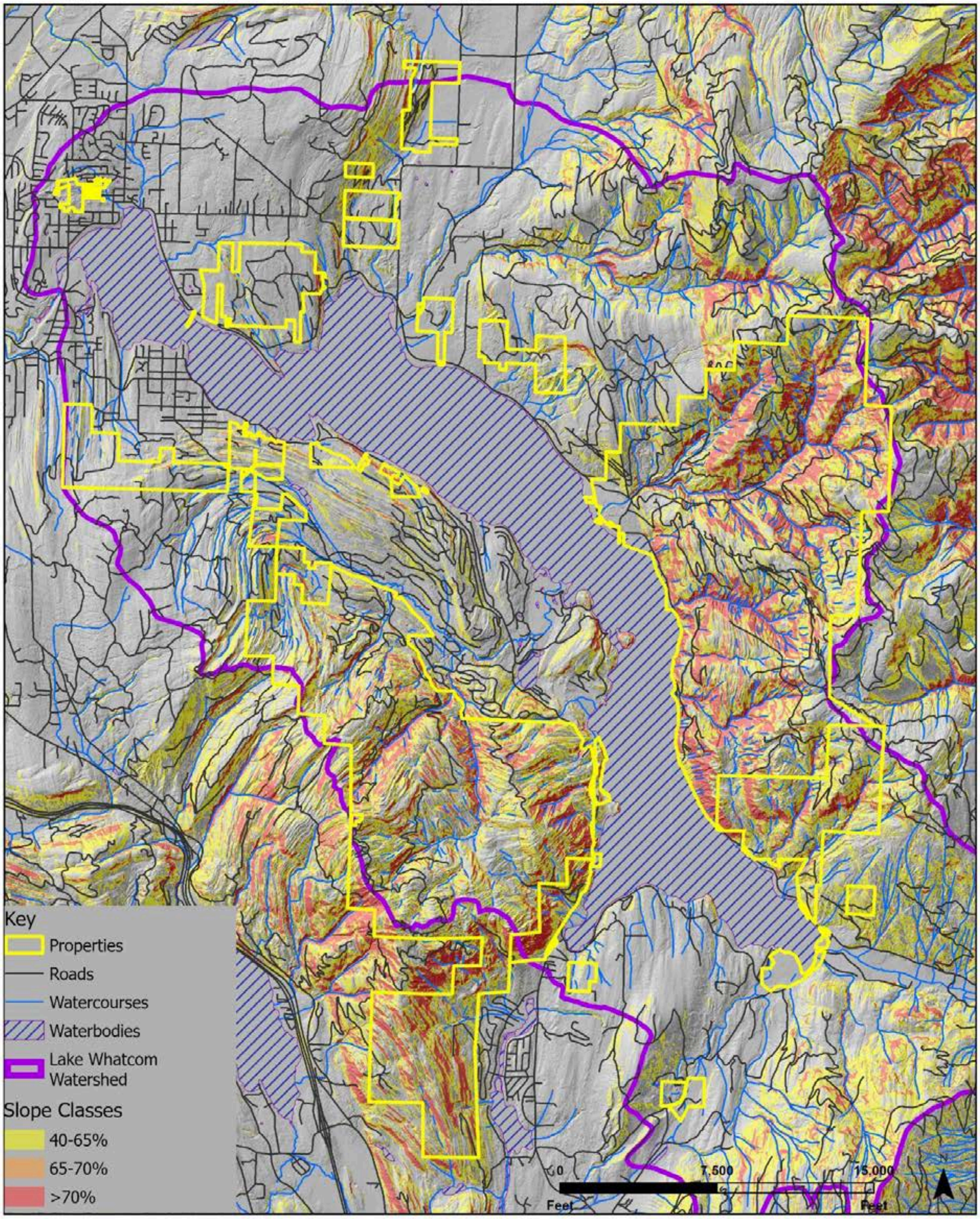
Project Map: Vegetation Zones Overview



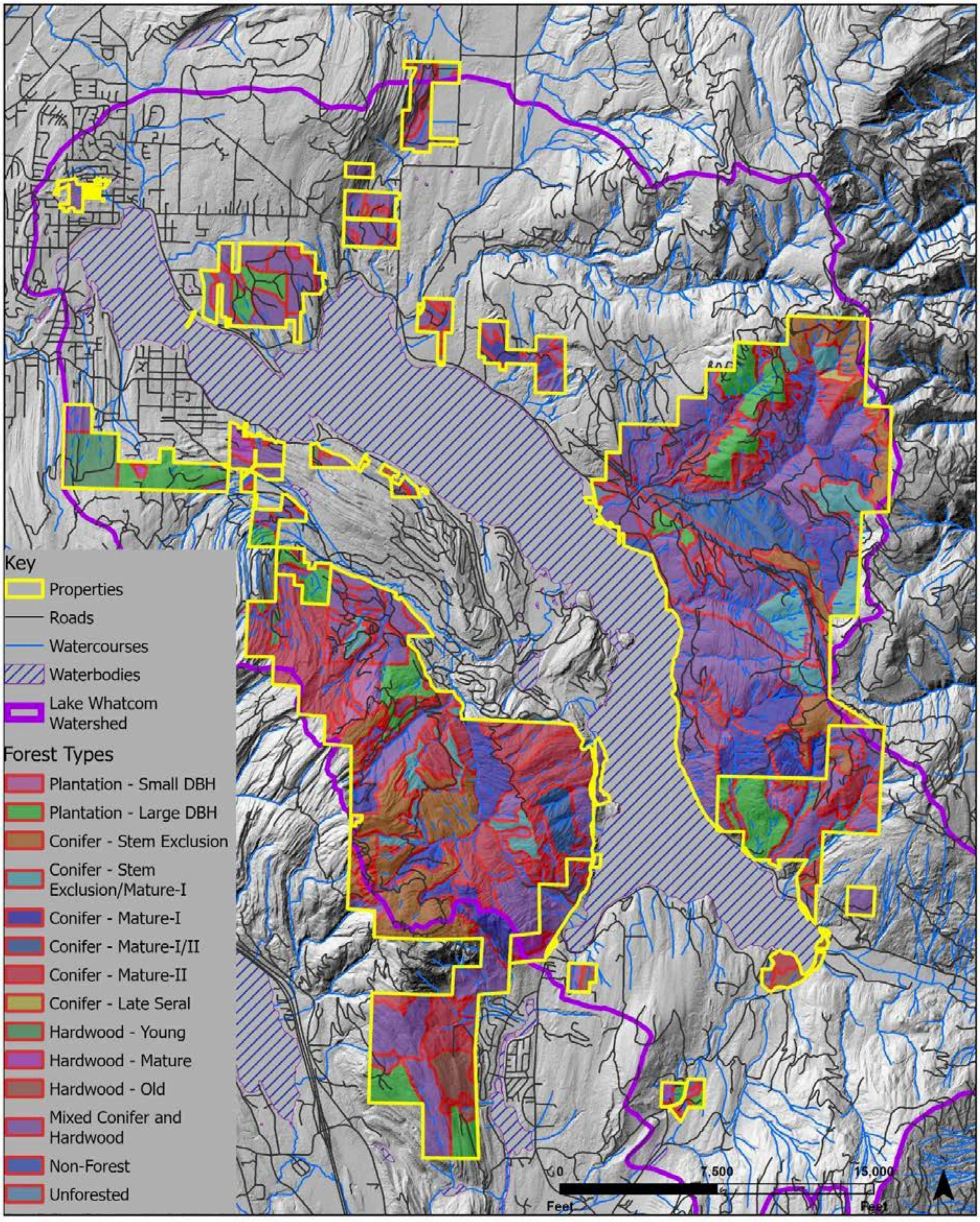
Project Map: Slope Stability Overview



Project Map: Slope Angle Overview



Project Map: Forest Types Overview



Appendix III. Drought and Shade Tolerance of Common Pacific Northwest Tree Species

Species	Drought Tolerance	Shade Tolerance
Garry Oak	High	Medium
Pacific Madrone	High	Medium
Douglas Fir	High	Medium
Lodgepole / Shore Pine	High	Low
Pacific Yew	Medium	High
Western Redcedar	Medium	High
Bigleaf Maple	Medium	High
Noble Fir	Medium	Medium
Red Alder	Medium	Medium
Western White Pine	Medium	Medium
Grand Fir	Medium	Medium
Oregon Ash	Medium	Medium
Paper Birch	Medium	Low
Western Hemlock	Low	High
Pacific Silver Fir	Low	High
Sitka Spruce	Low	Medium
Black Cottonwood	Low	Low

Appendix IV. Tree Species Codes

Code	Species
BM	Bigleaf Maple
CH	Bitter Cherry
CW	Black Cottonwood
DF	Douglas Fir
GF	Grand Fir
LP	Lodgepole / Shore Pine
PB	Paper Birch
PM	Pacific Madrone
RA	Red Alder
RC	Western Redcedar
SF	Pacific Silver Fir
SS	Sitka Spruce
WH	Western Hemlock
WO	Garry Oak / Oregon White Oak
WP	Western White Pine

Appendix V. Glossary of Forestry Terms

Age class: The organization of trees in a forest into discrete age intervals, usually 10 or 20 years.

DBH (diameter at breast height): The measurement of tree diameter at four and one-half (4.5) feet above the ground on the uphill side.

Buffer: A protective area of land or forest adjacent to an area requiring protection (e.g. stream, wetland, unstable slope, etc.).

Canopy: The layer of foliage and biomass in a forest formed collectively by tree crowns.

Canopy layers: The different horizontal layers of a forest comprised of multiple heights, ages or species of trees.

Clearcut: A timber harvest technique whereby all trees are removed from an area.

Coarse woody debris (CWD): Large sections of dead trees (e.g. logs) that provide wildlife habitat, nutrient retention, and other ecological functions.

Codominant trees: Trees that occupy the upper strata of a forest's canopy, but are subordinate in height to dominant trees.

Commercial thinning: Cutting and removing trees that have merchantable value.

Competition: The struggle for resources (e.g. water and light) between neighboring trees.

Conifer: A cone-bearing tree with needles, such as pine, spruce, fir, and larch.

Cover: Vegetation or other natural shelter serving to conceal wildlife from predators. Also refers to the protective shade that vegetation provides to wildlife, fish, and the forest floor.

Crown: The branches and foliage of a tree. The "live crown" refers to the portion of tree with living branches, needles or leaves.

Crown class: A relative designation of the crowns of individual trees by height in the forest canopy.

Crown or canopy closure: The growth phase of a forest (typically young) when the crowns of individual trees grow wide enough to begin to touch neighboring trees, and the canopy of the forest becomes increasingly dense.

Deciduous tree: A tree that loses its leaves or needles during the fall and winter.

Defect: That portion of a tree or log that makes it unusable for the intended solid wood product. Defects include rot, crookedness, cavities, and cracks. Severe defects cause the log to be classified as a cull.

Density: The number of trees per unit of area.

Disturbance: Events which significantly change forest structure and composition, changing the forest's development trajectory. In western Washington, the most common natural disturbances are windthrow and wildfire, but avalanches, landslides, insect infestations, and fungal diseases are all potential disturbance agents. These events can be widespread, removing almost all existing forest canopy over a large area, known as stand-replacing, or more localized, forming canopy gaps or killing off individual trees.

Dominant trees: Trees that occupy the uppermost horizontal strata of a forest's canopy.

Even-aged management: Forest management strategy to grow the same age, and typically the same species, of trees in a stand. Most trees are within 5 - 20 years of the same age.

Evergreen tree: A tree that retains some or most of its leaves, or needles, throughout the year.

Firebreak: A wildfire mitigation strategy that involves thinning the forest canopy to reduce connectivity between individual tree crowns, pruning the lower limbs on the remaining trees, removing fine woody fuels, and reducing the height and/or abundance of understory vegetation.

Forest Management Unit (FMU): A group of tree species, or area of forest, that is managed together.

Habitat: The environmental conditions that support a species or community of plants and animals.

Hardwood: A term describing broadleaf trees, usually deciduous, such as oaks, maples, cottonwood, ashes, alders, and elms.

Harvest: Cutting and removing trees for sale or use.

Herbicide: Chemical used for killing or controlling plants.

Intermediate trees: Trees that are subordinate in height to both dominant and codominant trees, but are taller than suppressed trees in the forest canopy.

Invasive species: An insect, plant, or animal that dominates an area and typically has a suppressive effect on other species.

Live crown ratio (LCR): A measure of the length of a tree's living branches relative to the total tree height.

Mass Wasting: The downslope movement of soil, rock, and debris under the force of gravity.

Mature forest: The growth phase of a forest typically comprised of older trees and increasingly complex forest structure.

MBF: Abbreviation for *thousand board feet.*

Merchantable: The part of a tree that can be manufactured into a salable wood product.

Natural Regeneration: The natural process of seeding and tree establishment.

Old growth: A tree or forested area that has never been cut, harvested, cleared, or converted from its natural state.

Overstocked: A stand condition where high tree densities lead to increasing competition between individual trees.

Overstory: The horizontal layer of tree crowns that comprise the uppermost portion of a forest's canopy. Typically composed of dominant and codominant trees.

Perennial stream: A stream that contains flowing water throughout the year.

Pioneer species: Species of fungus, insects, plants, and animals that are the first to colonize a recently disturbed site.

Pruning: Removing the lower branches of trees.

Resilience: The ability of a forest ecosystem to adapt to and recover from a disturbance.

Riparian: The zone of land and ecosystem between surface water such as lakes, streams, and wetlands, and upland terrestrial ecosystems.

Second growth: The second generation of forest to grow on a site following the disturbance or removal of the first generation of forest.

Shade tolerance: Trees and shrubs adapted to growing in low light conditions, such as the understory of a forest.

Shrub: A low-growing perennial plant with a woody stem and low branching habit.

Site class: A quantification of soil productivity typically expressed on a scale of 1-5 where site class 1 soils are the most productive and site class 5 soils are the least productive.

Slash: Small diameter woody material resulting from forest thinning.

Slash reduction: The burning, crushing, or scattering of woody material produced during thinning. This practice is typically used to prepare a site for tree planting or to reduce wildfire risk.

Snag: A standing dead tree.

Soil compaction: The process by which soil particles are squeezed or compressed, reducing air and water spaces.

Stem Exclusion: Stage of forest successional development when densely stocked forests begin to thin themselves through competition-induced mortality and many of the suppressed trees die off, filling the forest with small-diameter snags and downed logs on the forest floor.

Structural complexity: A diverse arrangement of trees of different sizes and species occupying multiple canopy positions as well as a diverse collection of understory vegetation, standing snags, and downed wood.

Wetlands: An area of land where water accumulates creating hydric soils and hydric plant communities.

Appendix VI. Summary of Public Engagement for the Lake Whatcom Forest Management Plan

Overview

Development of the Lake Whatcom Forest Management Plan began in April 2025, building on decades of community interest and involvement in protecting the watershed of this vital drinking water source. From the outset, public engagement has played a central role in shaping the Plan. The decision to create a dedicated Forest Management Plan for the Lake Whatcom watershed was driven by long-standing support for lake protection from community members, staff, and elected officials.

Land preservation – and more recently, forest management – have consistently been identified as priorities in the five-year work plans of the Lake Whatcom Management Program. These plans are guided by monitoring, data and research, which is driven by community input and aligned with the priorities of local elected leaders. Creating the Forest Management Plan was identified as a goal in the 2025-2029 work plan.

Public input was collected through two phases – in the early stages of Plan development and on the draft Plan.

Phase 1 Community Engagement: Defining Objectives (April-July 2025)

The first phase of community engagement took place between April and July 2025 and helped inform the Plan's goals and recommendations. During this time, community feedback was received through:

- Engage Bellingham (online platform for collecting input)
- Community meeting at Silver Beach Elementary School (May 2025)
- Two community forest tours (June and July 2025)
- Staff meetings with Tribal partners, Lake Whatcom stakeholders, and recreation stakeholders

On Engage Bellingham, participants could submit general comments on the Plan or provide feedback specific to County-managed park properties or City-managed protected properties.

Public Comment Summary

During this phase, 56 comments were submitted via Engage Bellingham and the community meeting. While comments from the forest tours and stakeholder meetings were not formally recorded, similar themes emerged across all engagement activities.

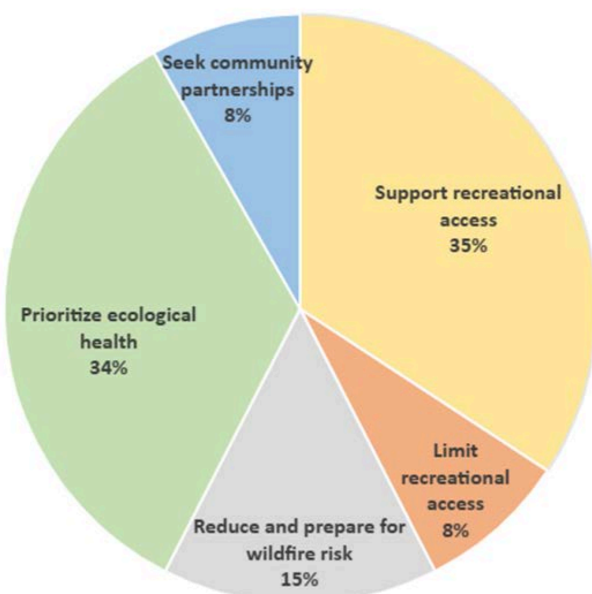
Community input, along with feedback from partners and stakeholders, shaped the Plan's goals and recommendations.

Key Themes from Public Comments

This section highlights the themes that were most prevalent throughout the 56 comments. There were five overarching themes mentioned most frequently:

1. Prioritize ecological health (25 comments)
    a. Emphasis on limiting development, protecting water quality, and long-term forest resilience.
2. Support recreational access (25 comments)
    a. Calls for continued or expanded access to trails and natural areas, with an emphasis on balancing recreation with forest health.
3. Reduce and prepare for wildfire risk (11 comments)
    a. Interest in improved wildfire access and planning in the watershed.
4. Seek community partnerships (6 comments)
    a. Suggestions to collaborate with local organizations.
5. Limit recreational access (6 comments)
    a. Concerns about overuse, added infrastructure, and lake impacts.

Public Comments by Overarching Theme



Public Comments by Overarching Theme

Theme	General Comments (Engage Bellingham)	County Managed Lands (Engage Bellingham)	City Managed Lands (Engage Bellingham)	In-Person Community Meeting	Total
Prioritize ecological health	13	3	4	5	25
Support recreational access	13	9	3	0	25
Reduce and prepare for wildfire risk	5	2	2	2	11
Limit recreational access	0	1	5	0	6
Seek community partnerships	1	3	0	2	6

Under each overarching theme, there were also many sub-themes mentioned.

Prioritize Ecological Health Sub-Themes

Theme	General Comments (Engage Bellingham)	County Managed Lands (Engage Bellingham)	City Managed Lands (Engage Bellingham)	In-Person Community Meeting	Total
Limit development in the watershed	5	0	2	0	7
Protect water quality	2	0	1	1	4
Decrease extractive use of land (logging, etc.)	3	0	0	1	4
Reduce climate change risks	2	1	0	0	3

Theme	General Comments (Engage Bellingham)	County Managed Lands (Engage Bellingham)	City Managed Lands (Engage Bellingham)	In-Person Community Meeting	Total
Expand public ownership of land in watershed	1	0	2	0	3
Use thinning as a tool to improve forest health	0	0	0	2	2
Remove invasive plants	1	1	0	0	2
Integrate indigenous knowledge into plan	1	0	0	0	1
Purchase Sudden Valley forests for protection	0	0	1	0	1
Decrease impacts from existing development	1	0	0	0	1
Prioritize wild land	0	0	1	0	1
Minimize soil disturbance	0	0	0	1	1
Minimize management activities	1	0	0	0	1
Minimize thinning	0	0	0	1	1
Improve management of existing public land	0	0	1	0	1
Monitor progress over time	0	0	0	1	1

Support Recreational Access Sub-Themes

Theme	General Comments (Engage Bellingham)	County Managed Lands (Engage Bellingham)	City Managed Lands (Engage Bellingham)	In-Person Community Meeting	Total
Balance recreation and environment	5	5	4	0	14
Increase non-motorized access	7	4	2	0	13
Increase mountain bike trails	3	3	2	0	8
Protect recreational access	1	2	1	0	4
Improve trail maintenance and building process to protect forest health	0	3	1	0	4
Increase trails (general)	1	1	1	0	3
Improve trail connectivity	2	1	0	0	3
Increase motorized access	2	0	0	0	2
Consider a paid pass for accessing watershed recreation	1	1	0	0	2
More government financial support for recreation	1	0	0	0	1
Revive the Mount Baker Ultra Marathon	0	1	0	0	1

Reduce and Prepare for Wildfire Risk Sub-Themes

Theme	General Comments (Engage Bellingham)	County Managed Lands (Engage Bellingham)	City Managed Lands (Engage Bellingham)	In-Person Community Meeting	Total
Improve wildfire access	1	1	1	1	4
Reduce public access in remote areas	0	1	1	0	2
Add emergency services	1	0	0	0	1
Prioritize education and outreach about fireproofing	1	0	0	0	1
Add fire breaks when building trails	1	0	0	0	1

Seek Community Partnerships Sub-Themes

Theme	General Comments (Engage Bellingham)	County Managed Lands (Engage Bellingham)	City Managed Lands (Engage Bellingham)	In-Person Community Meeting	Total
More partnerships with recreation groups	2	3	0	0	5
Increase community involvement in recreation projects	2	2	0	0	4
Include Sudden Valley in forest management	0	0	0	2	2
Try a Natural Capital Project approach	1	0	0	0	1

Limit Recreational Access Sub-Themes

Theme	General Comments (Engage Bellingham)	County Managed Lands (Engage Bellingham)	City Managed Lands (Engage Bellingham)	In-Person Community Meeting	Total
Prohibit motorboats on Lake Whatcom	1	1	1	0	3
Do not use City-owned protected properties for recreation	0	0	3	0	3
Reduce costs associated with infrastructure required for recreation access	0	0	2	0	2
Reduce motorized access	0	2	0	0	2
No new roads	0	0	2	0	2
Require safety inspections for boats	0	0	1	0	1

Northwest Natural Resource Group (NNRG) used the themes collected through the first phase of community engagement, along with data from their summer 2025 field assessments, to help determine the objectives in the draft Lake Whatcom Forest Management Plan.

Phase 2 Community Engagement: Draft Plan (November 2025)

The draft Plan was published in November 2025 on the Engage Bellingham website. Community members were invited to complete a survey designed to assess whether the Plan's objectives align with community values. The survey was available to all and provided enough context for participants to take the survey without reading the full Plan.

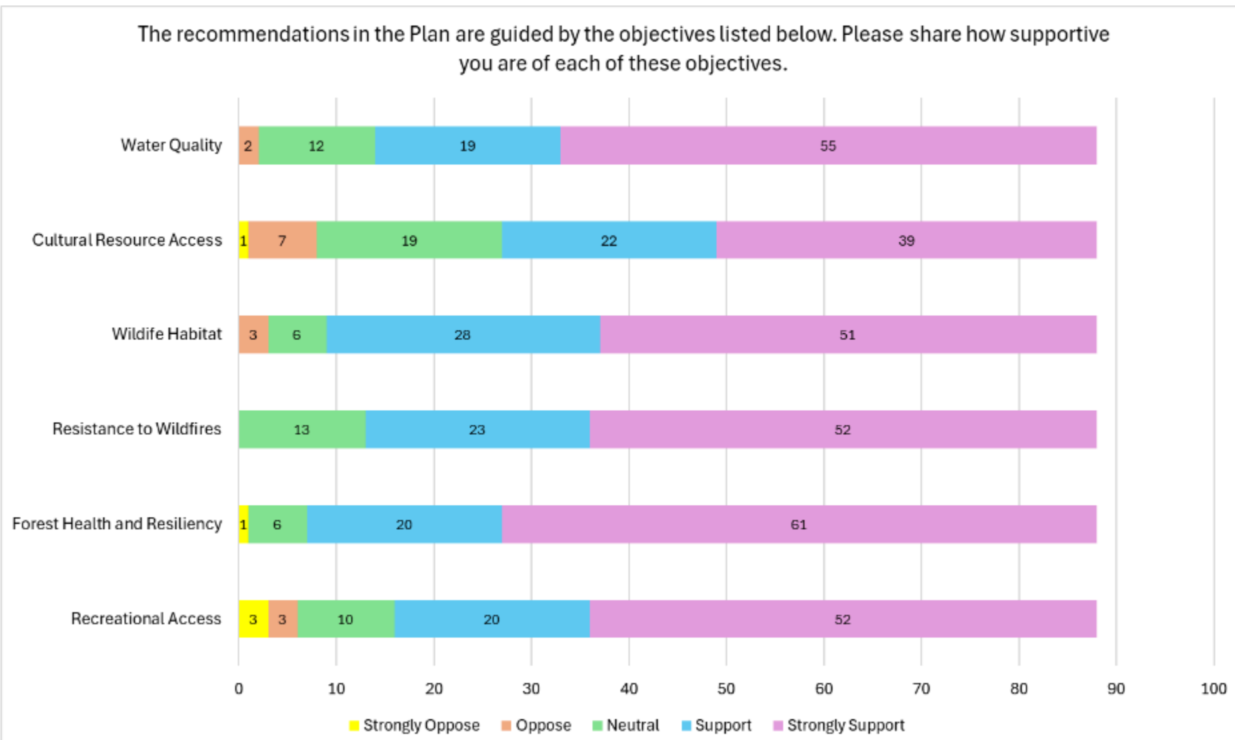
The 11-question survey asked about:

- Clarity of the Plan's content
- Support for the Plan's objectives

- Agreement with the Plan's vision and key elements
- Concerns about forest conditions in the watershed
- How participants interact with the watershed
- Additional feedback or suggestions

Survey Participation and Outcomes

A total of 88 people completed the survey. Through ranking questions, the majority of respondents expressed support for the Plan's direction. On average, 84% of respondents expressed support or strong support across the six plan objectives, while 13% were neutral and only 3% expressed opposition. The figure below shows the level of support expressed for each of the Plan's objectives.



Written comments provided through the survey also led to several revisions in the final Plan around the following topics:

- Landslides: Clarified terminology to distinguish between general references that the Plan uses and definitions used by the Washington Geological Survey.
- Adaptive management: Strengthened language about adaptive management in the Management Planning Process and Management Sequence sections.

- Thinning: Added text to the Thinning Considerations section to clarify that professional foresters will mark timber prior to any thinning operations to ensure alignment with management goals.
- Glossary: Added new technical terms to the glossary at the end of the Plan.
- Species selection: Revised the Planting Considerations section to emphasize species diversity and referenced a species tolerance table throughout the Plan.
- Recreation: Added clarifying language around the Plan's scope as it relates to recreation – managing recreational access and developing trails or other amenities is not within the scope of this planning effort. Also added language clarifying the impacts that poorly designed or maintained recreational trails can have on water quality.

Feedback on the draft Plan was also collected from City and County staff and representatives from the Lake Whatcom Policy Group, Whatcom County Parks Advisory Commission, and other stakeholder groups.

Comments Outside of the Plan's Scope

Throughout the community engagement process, valuable comments were shared that address concerns outside of the scope of this planning effort. For example, many comments about recreation access and trail expansion were shared. While the Plan considers how recreation and forest health can coexist, its primary focus is long-term stewardship – not the development of new trails or recreation infrastructure. Therefore, the recreation-related comments received through this process have been documented by staff to inform future recreation or property management planning by the County or City. There were also comments provided that address broader Lake Whatcom protection topics, such as pesticide use on private property or boating on the lake, which will help inform future Lake Whatcom Management Program five-year work plans, as appropriate.