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Critical Areas Ordinance Update

Best Available Science Review

MEDINA

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Prepared for:

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The information contained in this report is based on the application of technical guidelines currently accepted as the best available science. All discussions, conclusions and recommendations reflect the best professional judgment of the author(s) and are based upon information available at the time the study was conducted. All work was completed within the constraints of budget, scope, and timing. The findings of this report are subject to verification and agreement by the appropriate local, state, and federal regulatory authorities. No other warranty, expressed or implied, is made.

Acronyms and Abbreviations

BAS	Best Available Science
BMP	Best Management Practices
CAO	Critical Areas Ordinance
CARA	Critical Aquifer Recharge Area
CMZ	Channel Migration Zone
DNR	Washington State Department of Natural Resources
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
FEMA	Federal Emergency Management Agency
FFA	Frequently Flooded Area
FIRM	Flood Insurance Rate Map
FWHCA	Fish and Wildlife Habitat Conservation Area
GIS	Geographic Information System
GMA	Growth Management Act
HUC	Hydrologic Unit Code
LID	Low Impact Development
OHWM	Ordinary High Water Mark
NFIP	National Flood Insurance Program
NMFS	National Marine Fisheries Service
PHS	Priority Habitats and Species
RMZ	Riparian Management Zone
RCW	Revised Code of Washington
SPTH	Site Potential Tree Height
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service
WAC	Washington Administrative Code
WDFW	Washington Department of Fish and Wildlife
WHPA	Wellhead Protection Areas

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1. INTRODUCTION

1.1 Purpose

This best available science (BAS) review was prepared to support the City of Medina's update to its Critical Areas Ordinance (CAO). As required under the Washington State Growth Management Act (GMA), cities and counties must periodically update their comprehensive plans and development regulations. Medina's comprehensive plan recently underwent an update in 2024 which sets the framework for planned CAO updates in Medina. This BAS establishes the scientific foundation for the CAO update and the forthcoming gap analysis, serving as a resource to identify where revisions are needed to be consistent with the scientific literature.

The term "best available science" refers to the current and best available information that follows a valid scientific process as specified in WAC 365-195-900 through WAC 365-195-925. A valid scientific process is characterized by peer review, standardized methods, logical conclusions and reasonable inferences, quantitative analysis, proper context, and references. Accepted sources of scientific information include research, monitoring, inventory, modeling, assessment, and synthesis (WAC 365-195-905). Only resources that meet these requirements are included as reference in this review.

Under the GMA, Medina is required to include the best available science and give special consideration to conservation or protection measures necessary to preserve or enhance anadromous fisheries when developing policies and development regulations to protect the functions and values of critical areas (WAC 365-195-900). Regulated critical areas include wetlands, areas with a critical recharging effect on aquifers used for potable water, fish and wildlife habitat conservation areas, frequently flooded areas, and geologically hazardous areas (RCW 36.70A.030).

While this BAS review is a resource for critical area management, it is not intended to provide definitive answers for all policy and regulatory decisions. Effective policy making should integrate BAS with societal values, planning objectives, and other considerations. Additionally, ecological systems are complex and the scientific body of knowledge is constantly evolving. Where scientific uncertainty exists, this review presents a range of potential ideas, findings, and interpretations. In accordance with WAC 365-195-920, decision-makers may opt for a precautionary, or no-risk approach, when scientific information is incomplete or inconclusive.

1.2 Previous BAS Reviews in Medina

Medina's last comprehensive update to its CAO occurred in 2015. In 2014, The Watershed Company[1] prepared the *Best Available Science & Critical Areas Ordinance Review – City of Medina CAO Update* (hereafter referred to as the "2014 BAS Review"). Prior to that, The Watershed Company completed a separate BAS review in 2005 to support the City's critical area regulations at that time. Much of the foundational science underlying critical area regulations has remained consistent over this period and continues to be relevant. This BAS review does not duplicate information that has been comprehensively addressed in earlier reports. Instead, it presents information from new BAS resources and selectively references earlier findings that are applicable to current regulatory considerations.

2. CLIMATE CHANGE

As of July 2023, with passage of Washington House Bill 1181: Climate Change in Local Comprehensive Planning, the GMA requires jurisdictions to incorporate and evaluate the effects of climate change in long-range planning. Climate change is anticipated to have a profound influence on natural systems. By addressing these anticipated impacts on critical areas, decision-makers can integrate climate resilience into policies and regulations. This section provides a high-level overview of predicted climate change effects in the Puget Sound region of Washington State that have the potential to influence the functions of critical areas. Further details on climate change impacts are discussed within each subsection as they pertain to specific critical area types.

Air Temperature

- Long-term atmospheric warming, along with lengthening of the frost-free season, and increased frequency of nighttime heat waves have been observed (Mauger et al. 2015).
- An increase in the frequency of extreme heat events, with the number of "hot days" each year from only 1 to 11-127 by 2100 (Ecology 2024). A hot day is defined as a day with a daily high temperature in the top 1% of past high temperatures for June through August.
- Global atmospheric temperature has currently risen by of about 1°C. Temperature increases may exceed 1.5°C (2.7°F) by 2030 (Snover 2019).

Precipitation Patterns

- Increases in both the frequency and intensity of heavy rainfall events have been documented in western Washington (Mauger et al. 2015)

[1] In 2023, The Watershed Company merged with Davido Consulting Group to form Facet. All intellectual property and trademark rights formerly held by The Watershed Company remain the sole property of Facet as its successor in interest.

- Alterations of summer precipitation frequency, intensity, and duration, along with lower snowpack levels are expected to make droughts more common (Ecology 2024; Mauger et al. 2015).
- Snowpack decline is anticipated to result in reduced stream flows (Ecology 2024).
- An increase in the frequency and intensity of floods (Ecology 2024).
- Reduction in groundwater availability is anticipated due to changes in precipitation patterns and intensity and timing of snowmelt combined with increased summer demand from people and ecosystems (Ecology 2024).

Wildfire and Smoke

- Projected hotter, drier summers and declining snowpack are expected to create conditions that increase the likelihood of wildfires west of the Cascades (Mauger et al. 2015).
- Although the overall risk of wildfires in Medina is lower compared to other regions of Washington, smoke from wildfires occurring elsewhere frequently migrates into the Puget Sound basin. Projections for future changes in frequency or intensity of wildfire smoke are not available and the impact of wildfire smoke on natural systems is not fully understood (Ecology 2024; Voisin et al. 2023).

Flora, Fauna, and Pathogens

- Climate change is anticipated to alter phenological patterns, geographic species and habitat distribution, demography, and ecosystem composition and resilience (Mauger et al. 2015).
- Significant changes in prevalence and distribution of pests and pathogens is predicted, with species- and host-specific responses (Mauger et al. 2015).
- Range expansion is anticipated for adaptable invasive species that can exploit shifting habitats and climate-related ecological disturbances, effectuating further ecological impacts (Poland 2021; Shirk et al. 2021).

3. WETLANDS

3.1 Definitions

Wetland definitions adopted by local jurisdictions, as well as state and federal agencies, determine which wetlands are subject to regulation. The definitions used by Washington State and the City of Medina are provided below to highlight key similarities and differences in regulatory approaches. Washington State defines wetlands in WAC 365-190-030(24) as:

> *"Wetland" or "wetlands" means areas that are inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas. Wetlands do not include those artificial wetlands intentionally created from nonwetland sites, grass-lined swales, canals, detention facilities, wastewater treatment facilities, farm ponds, and landscape amenities, or those wetlands created*

after July 1, 1990, that were unintentionally created as a result of the construction of a road, street, or highway. However, wetlands may include those artificial wetlands intentionally created from nonwetland areas to mitigate conversion of wetlands, if permitted by the county or city.

Medina's definition, located in the Medina Municipal Code (MMC) Chapter 16.12, is comparable to the Washington State definition except that it expands on the list of exclusions to irrigation and drainage ditches, and contains minor differences in terminology and punctuation.

"Wetlands means those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs and similar areas. Wetlands do not include those artificial wetlands intentionally created from nonwetland sites, including, but not limited to, irrigation and drainage ditches, grass-lined swales, canals, detention facilities, wastewater treatment facilities, farm ponds, and landscape amenities, or those wetlands created after July 1, 1990, that were unintentionally created as a result of the construction of a road, street, or highway. Wetlands may include those artificial wetlands intentionally created from nonwetland areas to mitigate the conversion of wetlands. For identifying and delineating a regulated wetland, local government shall use the approved federal wetland delineation manual and applicable regional supplements."

The definitions are largely similar, with minor wording differences and a few distinctions. The City of Medina's definition explicitly requires the use of the approved federal wetland delineation manual and applicable regional supplements when identifying regulated wetlands. Additionally, Medina's version includes broader exclusionary language, such as "including, but not limited to, "when identifying features that are not considered wetlands.

3.2 Wetlands in Medina

Medina is situated within a Lake Washington frontage subbasin that is hydrologically isolated from larger surrounding watersheds by Clyde Hill to the east. A small ridge along the city's western edge further defines the topography, creating a lowland trough between the two hills. Nearly all of Medina's inventoried terrestrial wetlands are located on two properties within this low-lying area: Overlake Golf and Country Club and Medina Park. Lacustrine wetlands are also abundant along Lake Washington shorelines, however, these have been substantially reduced and degraded due to residential development activities, including bulkhead installation, grading, and vegetation modification.

Figure 1. Critical Areas Map reproduced from LDC (2024).

3.3 Functions and Values

Wetlands are highly productive ecosystems that perform essential physical, chemical, and biological functions and processes. Extensive research has documented the wide range of ecological services they provide, along with their associated cultural, social, and economic benefits. The quality of these functions varies depending on many factors such as hydrogeomorphology, landscape setting, vegetation structure, hydroperiods, and presence or absence of priority habitats and species. The primary ecological functions of wetlands can be grouped into the following categories and underlaying processes (Sheldon et al. 2005):

Improving water quality

- Retention and detention of surface water runoff
- Sediment removal
- Filtering, removal, and transformation of pollutants and pathogens
- Uptake of nutrients including phosphorous and nitrogen

Maintaining the water regime in a watershed (*i.e.*, hydrologic functions)

- Peak flow and velocity reduction
- Bank stabilization and erosion control
- Desynchronizing surface water flows and reducing flooding
- Groundwater recharge
- Maintaining base stream flows in the dry season

Providing habitat

- Wetlands provide general and specialized habitat for a wide range of species include water-dependent and water associated organisms. Although habitat quality is species and context specific, the following processes and characteristics that are associated with well-functioning habitat:
    - Structural complexity
    - Heterogeneity at multiple spatial scales
    - Floristic diversity and composition
    - Presence of unique micro habitats
    - Presence of species-specific niche habitat requirements
    - Food availability
    - Adequate refuge
    - Surface water source
    - Diversity of hydrologic regimes
    - Connectivity to other ecosystems
    - Patch size
    - Climate and weather
    - Topography and geology
    - Nutrient availability

- Biological productivity and supporting of food webs

3.4 Key Protection Strategies

3.4.1 Wetland Identification and Classification

Online resources such as the King County iMap and the National Wetland Inventory provide modeled estimates of wetland locations. These have been incorporated into Medina's Critical Areas Map (Figure 1). While these online databases are useful planning tools, site-level planning and development require individual studies by a qualified professional. Wetlands are more abundant than shown in inventory databases and may change over time.

The nationwide standard for wetland delineations is the U.S. Army Corps of Engineers (USACE) *Wetlands Delineation Manual* (Environmental Laboratory 1987). In Medina, the *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Western Mountains, Valleys, and Coast Region Version 2.0* also applies (USACE 2010).

The Washington State Department of Ecology (Ecology) has developed and periodically updated a statewide wetland rating system, with separate versions for eastern and western Washington. The most recent version is the Washington State Wetland Rating System for Western Washington, Version 2 (Hruby and Yahnke 2023). Version 2 is generally consistent with the prior iteration, except for certain clarifications and annotations.

Ecology's wetland rating system is a rapid assessment tool used to evaluate wetland functions related to water quality, hydrology, and habitat, considering site potential, landscape context, and societal value (Hruby and Yahnke 2023). Based on this system wetlands are classified into one of four categories. The classification helps guide regulatory and land-use decisions, supporting the protection and management of wetlands. It also informs appropriate buffer distances, ensuring the preservation of key ecological functions and values

3.4.2 Management Resources and Standards

3.4.2.1 Wetland Buffers

The preservation of wetlands and wetland buffers are a primary mechanism for protecting wetlands in Washington. Buffers protect wetlands by minimizing the impacts of nearby human activities and also offer their own ecological benefits, especially by enhancing water quality and supporting wildlife habitat (Sheldon et al. 2005). Buffers are effective at reducing the impacts of adjacent land uses on wetlands, though their effectiveness can vary depending on physical characteristics such as slope, soil type, vegetation, and width (Hruby 2013; Sheldon et al. 2005). The following summarizes the key conclusions from Hruby's 2013 report, *Update on Wetland Buffers: The State of the Science*:

- Wetland buffer effectiveness at protecting water quality varies in conjunction with several factors, including width, vegetation type, geochemical and physical soil properties, source and concentration of pollutants, and path of surface water through the buffer.
- Wider buffers are generally functioning higher than narrower buffers.
- Depending on site-specific environmental factors, different buffer widths may be needed to achieve the same level of protection.
- To protect wetland-dependent wildlife, a broader landscape-based approach that considers habitat corridors and connections is necessary.
- Many animals, particularly native amphibians, require undisturbed upland habitats for their survival.

Ecology's has published *Wetland Guidance for CAO Updates*, which provides a guide and framework for local jurisdictions to update the CAOs and wetland regulations (Ecology 2022). Three wetland buffer options are presented that jurisdictions can consider, all based on a moderate-risk approach to protecting wetland functions (Ecology 2022). The following summary of these buffer options assumes that wetland buffers are well-vegetated with native species.

- **Option 1**. Buffer width is based on wetland category and habitat score, if minimization measures are applied, and a habitat corridor is provided. If a habitat corridor is not provided or minimization measures are not implemented, then buffer width requirements increase. Modified buffers should be not less than 75 percent of the otherwise required buffer. Option 1 provides the most flexibility.

- **Option 2**. Buffer width is based on wetland category and modified by the intensity of the impacts from proposed land use. Option 2 decreases regulatory flexibility and eliminates buffer averaging and reduction provisions through the application of corridors and minimization measures.

- **Option 3**. Buffer width is based on wetland category only. Option 3 is the least flexible and simplest to administer.

Ecology's guidance also provides recommendations for when functionally disconnected buffers may be appropriate to exclude from regulated buffer area (Ecology 2022).

3.4.2.2 Wetland Mitigation

<u>Mitigation Sequencing</u>

Mitigation sequencing is the structured process of avoiding, minimizing, and mitigating all impacts to a particular resource. Medina has incorporated mitigation sequencing into existing critical areas regulations in MMC 16.50.060.C. This is consistent with federal directives to achieve no net loss of wetland functions and values. Mitigation sequencing is also required by the Wetlands Compensatory Mitigation Rule issued by the U.S. Environmental Protection Agency in 2008 and WAC 197.11.768. Per current Ecology guidance for CAO updates, mitigation sequencing must be applied in the following order (Ecology 2022):

> *Avoiding the impact altogether by not taking a certain action or parts of an action;*
>
> *Minimizing impacts by limiting the degree or magnitude of the action and its implementation, by using appropriate technology, or by taking affirmative steps to avoid or reduce impacts;*
>
> *Rectifying the impact by repairing, rehabilitating, or restoring the affected environment;*
>
> *Reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action;*
>
> *Compensating for the impact by replacing, enhancing, or providing substitute resources or environments; and/or*
>
> *Monitoring the impact and taking appropriate corrective measures.*

Compensatory Mitigation

Compensatory mitigation may be enacted through a programmatic approach or a permittee-responsible mitigation (PRM) plan. Programmatic approaches utilize third-party sponsors to obtain mitigation credits, such as a mitigation bank or in-lieu fee (ILF) program. Mitigation banks are certified by the state to ensure that lost ecological functions are adequately replaced. ILF programs collect fees and allocate those funds to restoration projects within a designated service area. Both the U.S. Army Corps of Engineers (USACE) and the Washington State Department of Ecology review and approve ILF programs.

Alternatively, PRM is a mitigation project directly managed by the applicant. These projects are typically developed and implemented concurrently with wetland impacts, though they may also be completed in advance. PRM applicants are responsible for carrying out project installation, site maintenance, monitoring, and any necessary adaptive management to meet the goals and performance standards of the approved mitigation plan

State and federal agencies have determined an order of mitigation preference according to the 2008 Federal Mitigation Rule (33 CFR Part 332.3[b] and 40 CFR Part 230.93[b]). This establishes the following hierarchy:

1. Mitigation bank credits
2. In-lieu fee (ILF) program credits
3. Permittee-responsible mitigation (PRM) under a watershed approach
4. PRM that is on site and in kind
5. PRM that is off site and/or out of kind

Ecology's recommended mitigation ratios for projects in Western Washington vary based on the wetland category and the type of mitigation action proposed (Granger et al. 2005). For direct impacts to wetlands, these ratios are increased to compensate for temporal loss of function and probability of failure (Ecology 2022). When applying advanced mitigation, the Ecology-recommended ratios account for the wetland category and proposed mitigation actions (Ecology, USACE, and EPA 2021).

To support ecological priorities within Washington State's watersheds, Ecology has developed additional guidance and tools for applicants. These include recommendations for applying a watershed-based approach to mitigation site selection and the use of the credit-debit method (Hruby 2012; Hruby, Harper, and Stanley 2009). The credit-debit method provides a standardized system for quantifying the number of mitigation credits required for a given project. This method can be applied to various forms of compensatory mitigation, including on-site (in-situ) mitigation, mitigation banking, and in-lieu fee programs. Unlike fixed mitigation ratios, the credit-debit method accounts for site-specific ecological conditions, which may result in a requirement for more or fewer credits than traditional ratio-based approaches (Hruby 2012).

Compensatory wetland mitigation methods in order of preference are (Ecology, USACE, and EPA 2021):

1. Restoration: Re-establishment,
2. Restoration: Rehabilitation-hydrologic processes restored,
3. Creation (establishment),
4. Preservation, and
5. Enhancement

Mitigation actions that rely solely on preservation or enhancement are the least preferred because they result in a net loss of wetland area. Ecology and federal agencies recommend that preservation or enhancement be used in combination with other forms of mitigation that achieve no net loss of wetland area and function, such as wetland creation (Ecology, USACE, and EPA 2021).

Ecology recommends applying at least a 1:1 ratio for impacts to wetland buffers (Ecology, USACE, and EPA 2021). However, higher ratios may be needed to replace all lost critical area functions. In addition, Ecology recommends evaluating indirect wetland impacts to determine the need and extent of compensatory mitigation requirements (Ecology, USACE, and EPA 2021).

Monitoring

Evaluations of wetland mitigation outcomes found that most wetland mitigation efforts do not fully replace impacted functions and often fall short of the no net loss goal (Ecology 2008; Johnson et al. 2002). Once a mitigation site is established, monitoring, ongoing maintenance, and clearly defined performance standards are essential to ensure regulatory compliance and the long-term success of restored wetland functions. Compensatory mitigation sites typically require performance standard monitoring for a period of 5-10 years to ensure that the planned functions are realized. However, few studies have examined long-term compliance, and one assessment reported a decline in site compliance between 8 and 20 years after installation (Van den Bosch and Matthews 2017). The National Research Council (2001) has identified factors that improve the likelihood of successful mitigation, including comprehensive functional assessments, adequate performance standards, detailed mitigation plans, larger financial assurances reflecting current market values, high replacement ratios, and appropriate technical expertise.

3.5 Climate Change Impacts and Mitigation

Climate change is predicted to significantly affect wetland ecosystems by altering hydrologic regimes, reducing biodiversity, disrupting carbon storage processes, modifying plant and animal community composition, and increasing disease prevalence (Aukema et al. 2017; Burkett and Kusler 2000). Anticipated hydrologic impacts include sea level rise and associated salinity shifts in coastal ecosystems (Burkett and Kusler 2000), increased surface ponding during wet seasons, and reduced water availability during dry periods (Halabisky 2017; Mauger, Casola, Morgan, Strauch, Jones, Curry, Busch Isaksen, et al. 2015). These changes can lead to the loss of wetland area and shifts in vegetation communities. Altered seasonal hydrologic cycles may also impair the ability of wetland soil bacteria and plants to retain, process, and sequester pollutants (EPA 2015). While wetlands are inherently dynamic systems, their capacity to adapt to rapid environmental change is limited. Wetlands particularly vulnerable to the effects of climate change are those in coastal areas and those sustained by surface water and stormwater inputs.

Wetlands also provide functions that help mitigate climate change impacts. As significant carbon sinks, wetlands contribute to climate regulation by storing organic carbon, reducing decomposition rates, and sequestering greenhouse gas emissions (Gallagher et al. 2022). In addition, wetlands and wetland buffers help maintain shaded and cool microclimates that provides thermal refuge for wildlife and serve as movement corridors at both local and landscape scales (Association of State Wetland Managers 2015). Wetlands also play a role in attenuating flood waters, a function that is expected to become increasingly important as the frequency and intensity of flood events rise due to climate change.

Although wetlands are expected to be significantly affected by climate change, they also play a crucial role in mitigating its extent and impacts. The interaction between wetlands and climate change presents a two-fold risk: the loss of wetland area may lead to the release of stored carbon, while degradation of wetland conditions may impair key ecological functions. These outcomes represent positive feedback mechanisms, whereby climate-driven wetland loss contributes to increased greenhouse gas emissions and diminished ecosystem services. As a result, the functional value of wetlands becomes especially critical when viewed through the lens of climate resilience and climate change mitigation.

3.5.1 Strategies to Manage Climate Change Impacts on Wetlands

Washington State's current wetland protection standards follow a moderate-risk approach, is a moderate likelihood that wetland functions may be impacted even when standard protections are applied (Ecology 2022). The additional strategies listed below may be considered by the City for managing their wetland resources:

- Create and maintain a wetland database.
- Identify wetlands which may be at risk from the effects of climate change (e.g., where surface water is a primary source of hydrology).
- Incorporate climate resiliency into mitigation sequencing.
  - Consider loss of wetland functions in the landscape within the context of climate change during mitigation sequencing.
  - Plan for climate change impacts when developing mitigation/restoration plans. For example, consider a broader range of hydrologic conditions and avoid/limit use of plant species predicted to be vulnerable to climate change stresses and pests.
  - Consider assisted migration for seed selection of native plants from locations that are better adapted to future climate conditions.
- Require applicants to document compliance with all applicable local, state, and federal permit requirements.

4. CRITICAL AQUIFER RECHARGE AREAS

Critical Aquifer Recharge Areas (CARAs) are a type of critical area designated to protect sources of potable water by maintaining the quality and quantity of groundwater recharge. These areas are especially important where aquifers serve as primary sources of drinking water and are susceptible to contamination or reduced recharge due to land use activities. According to WAC 365-190-030(3), CARAs are defined as:

> *Critical aquifer recharge areas are areas with a critical recharging effect on aquifers used for potable water, including areas where an aquifer that is a source of drinking water is vulnerable to contamination that would affect the potability of the water, or is susceptible to reduced recharge.*

While many jurisdictions adopt local definitions and regulatory frameworks for CARAs to align with state guidance, the City of Medina does not currently regulate CARAs, nor does it provide a specific definition in the Medina Municipal Code (MMC).

An inventory of CARAs has been conducted by King County in 2003 which determined Medina does not contain any areas of high susceptibility to groundwater contamination, nor does it contain any designated sole source aquifers or well head protection areas (Figure 2). According to King County's groundwater source database, Medina currently has only one identified Group D well, classified as a domestic water source; however, this well is not located within a designated CARA. Based on the absence of mapped CARAs and associated groundwater vulnerabilities, this report does not provide further evaluation or regulatory recommendations for this critical area type, as it is not currently applicable within Medina's jurisdiction.

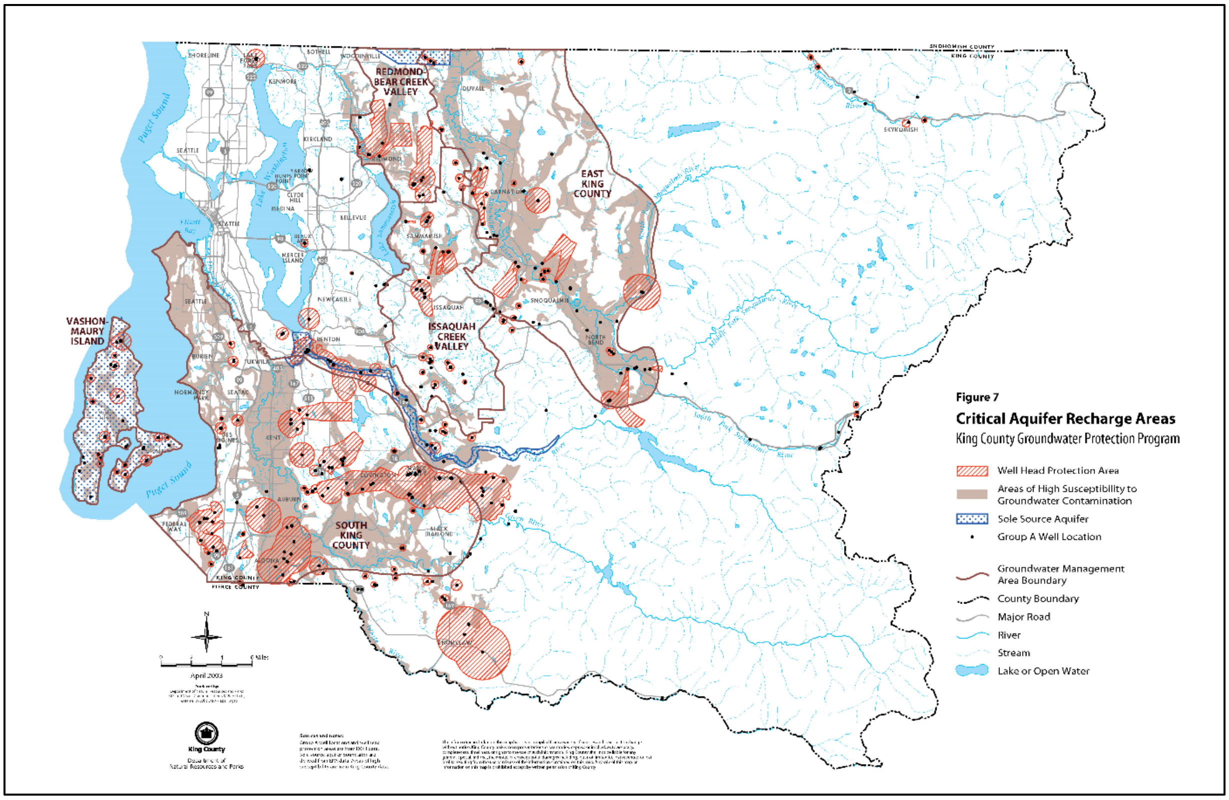

Figure 2. Map of CARAs in King County, reproduced from King County (2003).

5. FREQUENTLY FLOODED AREAS

Frequently Flooded Areas (FFAs) are lands with a high risk of periodic inundation, such as those within the 100-year floodplain which pose a hazard to public safety, property, and environmental resources. According to WAC 365-190-030(8), FFAs are defined as:

> *Frequently flooded areas are lands in the flood plain subject to at least a one percent or greater chance of flooding in any given year, or within areas subject to flooding due to high groundwater. These areas include, but are not limited to, streams, rivers, lakes, coastal areas, wetlands, and areas where high groundwater forms ponds on the ground surface.*

Flood hazard mapping and analyses conducted by the Federal Emergency Management Agency (FEMA) have determined that no 100-year floodplain hazard areas are present within Medina.

Additionally, Medina is not known to experience flooding related to high groundwater, coastal surge, or localized ponding that would warrant classification as FFAs under state definitions.

Since no mapped FFAs or associated flood risks have been identified in Medina, this report does not include further evaluation or management recommendations for this critical area type. Should future floodplain mapping or climate change projections identify new risks, the City may need to re-evaluate the applicability of FFA-related development standards.

6. GEOLOGICALLY HAZARDOUS AREAS

6.1 Definitions

Geologically hazardous areas are a category of critical areas designated to protect people, property, and the environment from risks associated with unstable soils and geologic activity. These areas are typically identified through geotechnical analysis and are subject to specific development regulations to reduce hazards. Washington State defines geologically hazardous areas as (WAC 365-190-030):

> *Areas that because of their susceptibility to erosion, sliding, earthquake, or other geological events, are not suited to the siting of commercial, residential, or industrial development consistent with public health or safety concerns"*

According to WAC 365-190-120, the four primary types of geologically hazardous areas include erosion hazard areas, landslide hazard areas, seismic hazard areas, and areas subject to other geological events, such as coal mine hazards and volcanic hazards.

The City of Medina has adopted a similar definition and aligned its regulations with state guidance. Medina defines geologically hazardous areas as (MMC 16.12):

> *Geologically hazardous areas means areas that may not be suited to development consistent with public health, safety or environmental standards, because of their susceptibility to erosion, sliding, earthquake, or other geologic events as designated by WAC 365-190-120. In the City of Medina, types of geologically hazardous areas include erosion, landslide, and seismic hazards.*

Within Medina's jurisdiction, the types of geologically hazardous areas currently recognized include erosion, landslide, and seismic hazard areas. These areas are evaluated during planning and development review processes to minimize risks to public safety and infrastructure.

6.1.1 Erosion Hazard Areas

Erosion hazard areas are lands where soil erosion is likely to occur due to the presence of steep slopes, unconsolidated soils, or highly erodible soil types, posing a risk to slope stability, water quality, and infrastructure. Washington State defines erosion hazard areas according to WAC 365-190-030(5) as follows:

"Erosion hazard areas" are those areas containing soils which, according to the United States Department of Agriculture Natural Resources Conservation Service Soil Survey Program, may experience significant erosion. Erosion hazard areas also include coastal erosion-prone areas and channel migration zones.

Further guidance under WAC 365-190-120(5) continues that "erosion hazard areas include areas likely to become unstable, such as bluffs, steep slopes, and areas with unconsolidated soils."

Medina adopts an approach which further classifies erosion hazard areas as a regulatory framework. According to Medina Municipal Code (MMC) 16.12.060, the city defines erosion hazard areas as:

Erosion hazard areas means at least those areas identified by the U.S. Department of Agriculture's Natural Resources Conservation Service as having a "moderate to severe," "severe," or "very severe" rill and inter-rill erosion hazard.

6.1.2 Landslide Hazard Areas

Landslide hazard areas are a type of geologically hazardous area characterized by an increased risk of mass movement. These areas can pose significant risks to public safety and infrastructure, particularly in steep slopes, unstable soils, or lands influenced by high levels of surface or ground water. Washington State defines landslide hazard areas under WAC 365-190-030(10) as: "areas at risk of mass movement due to a combination of geologic, topographic, and hydrologic factors."

Further criteria for identifying landslide hazard areas are detailed in WAC 365-190-120(6), which states:

They include any areas susceptible to landslide because of any combination of bedrock, soil, slope (gradient), slope aspect, structure, hydrology, or other factors, and include, at a minimum, the following:

- *(a) Areas of historic failures, such as:*
  - *(i) Those areas delineated by the United States Department of Agriculture Natural Resources Conservation Service as having a significant limitation for building site development;*
  - *(ii) Those coastal areas mapped as class u (unstable), uos (unstable old slides), and urs (unstable recent slides) in the department of ecology Washington coastal atlas; or*
  - *(iii) Areas designated as quaternary slumps, earthflows, mudflows, lahars, or landslides on maps published by the United States Geological Survey or Washington department of natural resources.*
- *(b) Areas with all three of the following characteristics:*
  - *(i) Slopes steeper than 15 percent;*
  - *(ii) Hillsides intersecting geologic contacts with a relatively permeable sediment overlying a relatively impermeable sediment or bedrock; and*
  - *(iii) Springs or groundwater seepage.*
- *(c) Areas that have shown movement during the holocene epoch (from 10,000 years ago to the present) or which are underlain or covered by mass wastage debris of this epoch;*

(d) Slopes that are parallel or subparallel to planes of weakness (such as bedding planes, joint systems, and fault planes) in subsurface materials;
(e) Slopes having gradients steeper than 80 percent subject to rockfall during seismic shaking;
(f) Areas potentially unstable as a result of rapid stream incision, stream bank erosion, and undercutting by wave action, including stream channel migration zones;
(g) Areas that show evidence of, or are at risk from snow avalanches;
(h) Areas located in a canyon or on an active alluvial fan, presently or potentially subject to inundation by debris flows or catastrophic flooding; and
(i) Any area with a slope of 40 percent or steeper and with a vertical relief of 10 or more feet except areas composed of bedrock. A slope is delineated by establishing its toe and top and measured by averaging the inclination over at least 10 feet of vertical relief.

The City of Medina has adopted a local definition consistent with the state guidance, adapted to a local regulatory framework and site-specific characteristics. According to the Medina Municipal Code (MMC 16.12), landslide hazard areas are defined as:

> *Landslide hazard areas means areas that are potentially subject to risk of mass movement due to a combination of geologic, topographic, and hydrologic factors. These areas are typically susceptible to landslides because of a combination of factors including bedrock, soil, slope (gradient), slope aspect, geologic structure, ground water, hydrology, or other factors.*

Medina further specifies landslide hazard areas through the following criteria outlined in MMC 16.50.90.B.2:

- *a. Areas of historic failures, such as:*
  - *i. Those areas delineated by the U.S. Department of Agriculture's Natural Resources Conservation Service as having a "severe" limitation for building site development;*
  - *ii. Areas designated as quaternary slumps, earth-flows, mudflows, lahars, or landslides on maps published by the U.S. Geological Survey or Department of Natural Resources;*
- *b. Areas with all three of the following characteristics:*
  - *i. Slopes steeper than 15 percent; and*
  - *ii. Hillsides intersecting geologic contacts with a relatively permeable sediment overlying a relatively impermeable sediment or bedrock; and*
  - *iii. Springs or ground water seepage;*
- *c. Slopes that are parallel or sub-parallel to planes of weakness (such as bedding planes, joint systems, and fault planes) in subsurface materials;*
- *d. Areas potentially unstable because of rapid stream incision, stream bank erosion, and undercutting by wave action;*
- *e. Areas located in a canyon or on an active alluvial fan, presently or potentially subject to inundation by debris flows or catastrophic flooding; and*
- *f. Steep slopes, which are any area with a slope of 40 percent or steeper and with a vertical relief of ten or more feet except areas composed of consolidated rock. A slope is delineated by*

establishing its toe and top and measured by averaging the inclination over at least ten feet of vertical relief.

While both the state and local consider similar risk factors, Medina's code clarifies regulatory thresholds for development suitability and adopts classification methods. These provisions improve appropriate siting and mitigation for development in areas that have elevated risk levels.

6.1.3 Seismic Hazard Areas

Seismic hazard areas are a geologically hazardous area with a high risk for potential for earthquake-related damage due to local geologic and soil conditions. These areas require evaluation in land use planning and development to mitigate risks to life, property, and infrastructure. Washington State defines seismic hazard areas under WAC 365-190-030(18) as: "areas subject to severe risk of damage as a result of earthquake induced ground shaking, slope failure, settlement, soil liquefaction, debris flows, lahars, or tsunamis." Additional detail is provided in WAC 365-190-120, which expands the definition to include areas subject to severe risk of damage as a result of subsidence and surface faulting.

The City of Medina adopts a similar definition in MMC 16.12, which states: "*Seismic hazard areas means areas that are subject to severe risk of damage as a result of earthquake-induced ground shaking, slope failure, settlement, soil liquefaction, lateral spreading, or surface faulting.*"

6.2 Hazard Characterization

6.2.1 Erosion Hazard Areas

Erosion hazard areas present risks to infrastructure, the environment, and public safety. For example, erosion may undermine the foundation of buildings or other structures and increase the risk of landslides which threaten property and human life. There is also a direct link between erosion and impacts to other aquatic critical areas including streams, ponds, and wetlands (Dubois et al. 2018).

Erosion and landslides are natural processes that contribute sediment, rocks, and large woody debris to streams and other waterbodies. The introduction of periodic pulses or chronic turbidity and suspended solids associated with erosion has been demonstrated to harm certain types of aquatic life, particularly salmonids (Bash et al. 2001). This can occur from activities such as clearing vegetation and the creation of new impervious surfaces, which can introduce sediments and pollutants to natural waterways (Booth 1991).

The stability of erosion hazard areas is influenced by the vegetation composition, structure, and cover. Vegetation reduces erosion through rainwater interception and by anchoring soils within root networks (Booth et al. 2004; R. J. Naiman and Decamps 1997). In cleared areas, rainfall tends to concentrate in small channels, and sediment can be mobilized as the water gains depth, volume, and increased flow. Small channels or rills can eventually develop into gullies in these types of exposed soils.

As shown in Figure 1, there are erosion hazard areas along the Medina's western and southeastern shorelines. These areas are defined by relatively steep hillsides that descend toward the shoreline, increasing their susceptibility to erosion.

6.2.2 Landslide Hazard Areas

Landslides are inherently difficult to predict, as their occurrence is influenced by a combination of bluff geology, sediment composition, topography, and hydrology. Steeper slopes are generally more susceptible to failure due to increased gravitational stress (Shipman 2004). Certain land use activities such as vegetation removal and the introduction of impervious surfaces can elevate landslide risk by altering natural slope stability. Vegetation plays a critical role in slope stabilization through root systems that anchor soil and evapotranspiration, which reduces groundwater levels and intercepts rainfall before it infiltrates (Schmidt et al. 2001; Watson and Burnett 2017). These hydrologic and mechanical functions of vegetation help mitigate the likelihood of shallow, rapid landslides (Schmidt et al. 2001).

As shown in Figure 3, there are no areas within Medina currently designated as landslide hazard areas by King County or the Washington Department of Natural Resources. However, landslides can still occur outside formally mapped critical areas. Notably, the Washington Geologic Information Portal identifies several landslides in Medina that date back to the Pleistocene Epoch, indicating a geologic history of slope movement in the area.

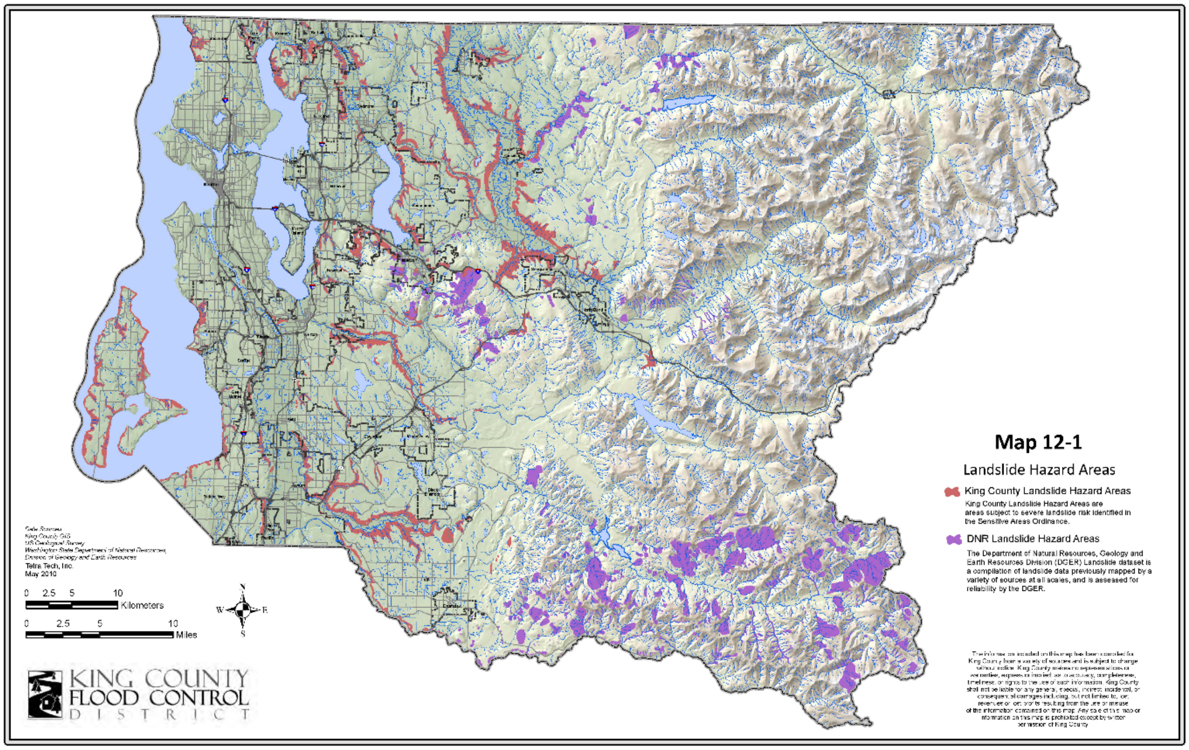

Figure 3. King County landslide hazard areas, reproduced from King County Flood Control District (2010a).

6.2.3 Seismic Hazard Areas

Seismic hazard areas are areas subject to damage resulting from earthquake-induced landslides, seismic ground shaking, dynamic settlement, fault rupture, soil liquefaction, or flooding caused by tsunamis and seiches. Medina is located in an area of high seismic activity, as are all areas of Western Washington. There are between 1,000-2,000 earthquakes which occur annually between Washington and Oregon, although most are small and fewer than 25% are perceptible (Cooper 2006; McCrumb et al. 1989). The probability of occurrence and risk of earthquakes depends on location, and seismic hazard areas have been mapped to identify areas with the greatest risk.

Secondary hazards associated with seismic events can include soil liquefaction, rockfall, landslides, dam and levee failure, and tsunamis or seiches. Figure 4 illustrates modeled liquefaction hazard areas within King County, while Figure 5 displays soil site classes based on the National Earthquake Hazards Reduction Program (NEHRP), which influence ground shaking intensity. Although Medina does not currently contain any formally designated seismic hazard critical areas, nearly all of King County, including Medina, faces some degree of seismic risk. According to the Washington Department of Natural Resources Geologic Information Portal, projected shaking intensities from the Cascadia Subduction Zone, Seattle Fault, and Tacoma Fault seismic scenarios could reach levels classified as 'very high' or 'severe.'

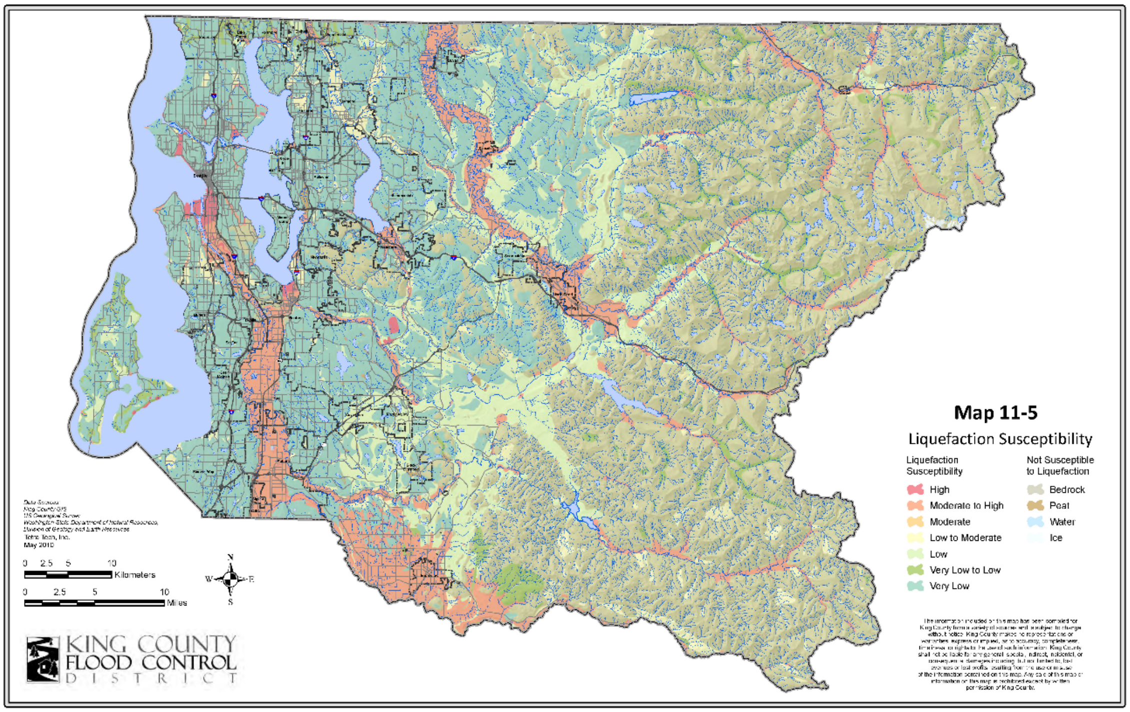

Figure 4. King County NEHRP soil site class, reproduced from King County Flood Control District (2010b).

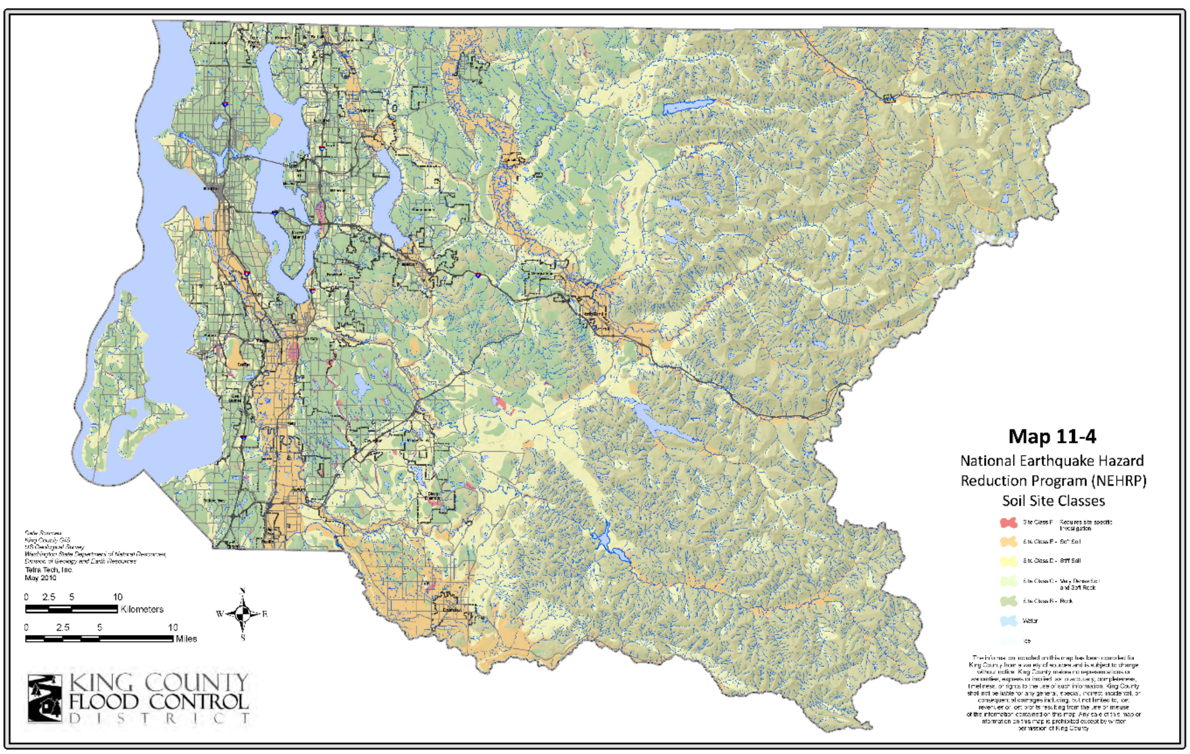

Figure 5. King County NEHRP soil site class, reproduced from King County Flood Control District (2010c).

6.3 Key Protection Strategies

Regulating activities in geologically hazardous areas serves to protect public safety and reduces the risk of property damage, injury, or loss of life. The type of land use and development in these areas influences the level of risk and may, in some cases, increase the likelihood or severity of geologic events in these areas. Since a single event can affect properties well beyond its point of origin, there is public interest in managing these hazards. Identifying the location of geologically hazardous areas is essential to ensure that development is planned and managed with appropriate safeguards for stability and safety.

6.3.1 Management Resources and Standards

The primary goal of protection measures for geologic hazards is to protect people and property. Risk management begins during the planning and development stages, where potential impacts can be reduced by limiting occupancy and restricting development within geologically hazardous areas. Additional risk reduction can also be managed by requiring engineered solutions that enhance structural resilience. To inform risk management decisions, classification systems are used to assess site-specific geologic risks and guide the development of appropriate restrictions and design requirements.

One common risk management approach is the establishment of buffers around geologic hazard areas to prevent encroachment and limit development within high-risk areas. In erosion and landslide hazard areas, specific design and construction standards are necessary to maintain slope stability and ensure that new development is resilient to potential hazards. Any proposed development in the geologic hazard area or its associated buffer should be evaluated on a site-specific basis by a licensed geotechnical engineer or engineering geologist. Methods used in site studies should adhere to best professional standards and include subsurface exploration and testing of soils at a frequency appropriate to site conditions and project scope.

While the preferred approach is to avoid disturbance within geologic hazard areas, WAC 365-190-080(4) recognizes that "some geological hazards can be mitigated by engineering, design, or modified construction or mining practices so that risks to health and safety are acceptable."

Following the 2014 Oso landslide, the SR-530 Landslide Commission identified additional strategies for improving protection from geologic hazards. Key recommendations from the commission include integrating and funding Washington's emergency management system, supporting a statewide landslide hazard and risk mapping program, establishing a geologic hazards resilience institute, conducting landslide investigations, and advancing public awareness of geologic hazards (SR530 Landslide Commission 2014). To improve landslide hazard mapping and risk assessment, the Commission emphasized collaboration among agencies and landowners, risk prioritization, and the use of LiDAR and GIS tools.

The Commission also recommended updates to critical area regulations to improve the identification and manage development in geologic hazard areas. Specifically, they advise cities and counties adopt identifying 'critical area buffer widths based on site specific geotechnical studies' as a development regulation (SR530 Landslide Commission 2014).

Seismic hazards can be managed by applying earthquake-resistant building standards to high-risk areas. The Washington State Building Code (WAC 51-50) incorporates provisions from the 2018 International Existing Building Code along with state-specific amendments, including several related to seismic safety standards.

6.4 Climate Change Effects

Geologically hazardous areas, particularly erosion hazard areas and landslide hazard areas, are expected to be increasingly affected by climate change. Climate change models predict warmer, drier summers, and increased precipitation in other seasons while resulting in a similar annual total but with more seasonal variability (Dalton et al. 2013). Extreme precipitation events are also expected to become more frequent and intense (Mauger, Morgan, and Won 2021). Heavy and prolonged rainfall are known to contribute to landslides, making these events more likely as climate patterns shift and extreme weather becomes more common (Chleborad 2006; DNR 2020). Climate change is also expected to increase the frequency and severity of wildfires, which further increase the risk of erosion and landslides (Mauger et al. 2015).

Changing climate is also anticipated to affect vegetative community composition through changes in plant hardiness zones and species ranges; this may increase mortality of native plants that become outside their climatic tolerance (Lenoir and Svenning 2015). These disruptions may be compounded by the spread of invasive species, which can displace native species, modify species assemblages, and alter root system structures. Although plant provenance is not the only indicator of a plants capability to stabilize slopes, opportunistic invasive plants often have shallow root systems and short lifespans that are less effective at anchoring soils than native counterparts. For example, Himalayan blackberry is a widespread invasive plant with a shallow root system and can lead to excess soil erosion by preventing the establishment of deeper-rooted native counterparts (Gaire et al. 2015). Moreover, higher plant diversity typically improves soil stability by combining multiple forms of root architecture, a benefit that is diminished when invasive plant species are introduced to ecosystems (Ghestem et al. 2014).

To address these challenges, the City should consider the following climate-adaptive strategies for managing geologically hazardous areas:

- Encourage or require climate-informed design for development and infrastructure in or near geologic hazard areas (DNR 2020).
- Require appropriate surface and ground water management practices for development near coastal bluffs.
- Encourage utilization of soft shore protection strategies.

- Identify and prioritize geologic hazards within the City, then update mapping as needed using current practices such as LiDAR and GIS database tools.
- Keep in communication with the governor's office to ensure the Medina is included in statewide collaborative efforts to manage geologic hazard areas.
- Manage vegetation for climate resilience and slope stability.

7. FISH AND WILDLIFE HABITAT CONSERVATION AREAS

7.1 Definition

Fish and Wildlife Habitat Conservation Areas (FWHCAs) are a category of critical area designated to protect habitats for the long-term viability of native fish and wildlife populations. According to WAC 365-190-030(6), FWHCAs are defined as:

> *(a) "Fish and wildlife habitat conservation areas" are areas that serve a critical role in sustaining needed habitats and species for the functional integrity of the ecosystem, and which, if altered, may reduce the likelihood that the species will persist over the long term. These areas may include, but are not limited to, rare or vulnerable ecological systems, communities, and habitat or habitat elements including seasonal ranges, breeding habitat, winter range, and movement corridors; and areas with high relative population density or species richness. Counties and cities may also designate locally important habitats and species.*
>
> *(b) "Habitats of local importance" designated as fish and wildlife habitat conservation areas include those areas found to be locally important by counties and cities.*
>
> *(c) "Fish and wildlife habitat conservation areas" does not include such artificial features or constructs as irrigation delivery systems, irrigation infrastructure, irrigation canals, or drainage ditches that lie within the boundaries of, and are maintained by, a port district or an irrigation district or company.*

WAC 365-190-130 further outlines the specific types of areas that must be considered for classification and designation as FWHCAs:

> *(a) Areas where endangered, threatened, and sensitive species have a primary association;*
>
> *(b) Habitats and species of local importance, as determined locally;*
>
> *(c) Commercial and recreational shellfish areas;*
>
> *(d) Kelp and eelgrass beds; herring, smelt, and other forage fish spawning areas;*
>
> *(e) Naturally occurring ponds under 20 acres and their submerged aquatic beds that provide fish or wildlife habitat;*
>
> *(f) Waters of the state;*
>
> *(g) Lakes, ponds, streams, and rivers planted with game fish by a governmental or tribal entity; and*

(h) State natural area preserves, natural resource conservation areas, and state wildlife areas.

Medina incorporates the state's general framework but applies its own criteria and definitions in MMC 16.12.070 and MMC 16.50.100, as follows:

Fish and wildlife habitat conservation areas are areas that serve a critical role in sustaining needed habitats and species for the functional integrity of the ecosystem, and which, if altered, may reduce the likelihood that the species will persist over the long term. These areas may include, but are not limited to, rare or vulnerable ecological systems, communities, and habitat or habitat elements including seasonal ranges, breeding habitat, winter range, and movement corridors; and areas with high relative population density or species richness. In the City of Medina, fish and wildlife habitat conservation areas include:

1. *Areas with which state or federally designated endangered, threatened, and sensitive species have a primary association.*
    a. *Federally designated endangered and threatened species are those fish and wildlife species identified by the U.S. Fish and Wildlife Service and the National Marine Fisheries Service that are in danger of extinction or are threatened to become endangered. The U.S. Fish and Wildlife Service and the National Marine Fisheries Service should be consulted as necessary for current listing status.*
    b. *State designated endangered, threatened, and sensitive species are those fish and wildlife species native to the State of Washington, identified by the State Department of Fish and Wildlife, that are in danger of extinction, threatened to become endangered, vulnerable, or declining and are likely to become endangered or threatened in a significant portion of their range within the state without cooperative management or removal of threats. State designated endangered, threatened, and sensitive species are periodically recorded in WAC 232-12-014 (state endangered species), and WAC 232-12-011 (state threatened and sensitive species). The State Department of Fish and Wildlife maintains the most current listing and should be consulted as necessary for current listing status.*
2. *State priority habitats and species. Priority habitats and species are considered to be priorities for conservation and management. Priority species require protective measures for their perpetuation due to their population status; sensitivity to habitat alteration; and/or recreational, commercial, or tribal importance. Priority habitats are those habitat types or elements with unique or significant value to a diverse assemblage of species. A priority habitat may consist of a unique vegetation type or dominant plant species, a described successional stage, or a specific structural element. Priority habitats and species are identified by the State Department of Fish and Wildlife.*
3. *Habitats and species of local importance. Habitats and species of local importance are those identified by the city as approved by the Medina city council, including those that possess unusual or unique habitat warranting protection.*
4. *Naturally occurring ponds under 20 acres. Naturally occurring ponds are those ponds under 20 acres and their submerged aquatic beds that provide fish or wildlife habitat, including*

those artificial ponds intentionally created from dry areas in order to mitigate impacts to ponds. Naturally occurring ponds do not include ponds deliberately designed and created from dry sites, such as canals, detention facilities, wastewater treatment facilities, farm ponds, temporary construction ponds, and landscape amenities, unless such artificial ponds were intentionally created for mitigation.

5. *Waters of the state. In the city, waters of the state include lakes, ponds, streams, inland waters, underground waters, and all other surface waters and watercourses within the jurisdiction of the State of Washington.*
6. *State natural area preserves and natural resource conservation areas. Natural area preserves and natural resource conservation areas are defined, established, and managed by the State Department of Natural Resources.*
7. *Land found by the Medina city council to be essential for preserving connections between habitat blocks and open spaces.*

Medina's definitions align closely with the intent of state requirements and expand on it with criteria that reflect local priorities and regulatory clarity. Notably, Medina excludes shellfish beds, kelp and eelgrass beds, and herring, smelt, and other forage fish spawning areas because these natural resources do not occur in the city.

7.2 FWHCAs in Medina

7.2.1 Waterbodies

According to the 2014 BAS Report there are six inventoried streams in the City which include Medina Creek (also known as "Fairweather Creek"), and five other unnamed creeks (The Watershed Company 2014). The unnamed creeks are referred to as the Fairweather Bay tributary, Medina Park tributary to Lake Washington, Meydenbauer Bay tributary, Overlake Drive stream, and Evergreen Point Road stream. The city is bordered by Lake Washington, on the north, west, and south, with shoreline along each of these edges. Several ponds have also been inventoried within the Overlake Gold and Country Club and Medina Park.

7.2.2 Wildlife and Habitats

Medina is a heavily developed city with limited areas of high-quality wildlife habitat. The Washington Department of Fish and Wildlife's (WDFW) Priority Habitats and Species (PHS) program has identified and mapped a biodiversity area and wildlife corridor within the Fairweather Nature Preserve. The only priority species mapped as having habitat within the city is the great blue heron (*Ardea herodias*), with a designated breeding area located in Medina Park. Additionally, wetlands and aquatic habitats have been inventoried by the PHS program within the Overlake Golf and Country Club and Medina Park.

Table 1 provides a comprehensive list of PHS species and habitats identified by WDFW as potentially occurring in King County. While many of these species are unlikely to be found in a highly urbanized environment such as Medina, rare or sensitive species may still occur infrequently. As WDFW notes, the presence and distribution of habitats and species can shift over time as populations expand, contract, or respond to environmental changes.

Table 1. List of WDFW-designated priority habitats and species which occur in King County. Species and habitats associated with marine environments have been excluded from this table.

	Species and Habitats	State Status	Federal Status
Habitats	Biodiversity Areas and Corridors		
	Herbaceous Balds		
	Old-Growth/Mature Forest		
	Oregon White Oak Woodlands		
	West Side Prairie		
	Riparian		
	Freshwater Wetlands and Fresh Deepwater		
	Instream		
	Caves		
	Cliffs		
	Snags and Logs		
	Talus		
Fishes	Pacific Lamprey		
	River Lamprey	Candidate	
	White Sturgeon		
	Olympic Mudminnow	Sensitive	
	Bull Trout/ Dolly Varden	Candidate	Threatened
	Chinook Salmon		Threatened
	Chum Salmon		Threatened
	Coastal Res./ Searun Cutthroat		
	Coho Salmon		Threatened–Lower Columbia
	Kokanee		
	Pink Salmon		
	Pygmy Whitefish	Sensitive	
	Rainbow Trout/ Steelhead/ Inland Redband Trout	Candidate	Threatened
	Sockeye Salmon		Threatened–Ozette Lake
Amphibians	Larch Mountain Salamander	Sensitive	
	Oregon Spotted Frog	Endangered	Threatened
	Western Toad	Candidate	
Reptiles	Northwestern Pond Turtle	Endangered	Proposed Threatened
Birds	Common Loon	Sensitive	
	Marbled Murrelet	Endangered	Threatened
	Western Grebe	Candidate	
	W WA nonbreeding concentrations of: Loons, Grebes, Cormorants, Fulmar, Shearwaters, Storm-petrels, Alcids		
	W WA breeding concentrations of: Cormorants, Storm-petrels, Terns, Alcids		
	Great Blue Heron		

	Species and Habitats	State Status	Federal Status
	Western High Arctic Brandt		
	Cavity-nesting ducks: Wood Duck, Barrow's Goldeneye, Common Goldeneye, Bufflehead, Hooded Merganser		
	Western Washington nonbreeding concentrations of: Barrow's Goldeneye, Common Goldeneye, Bufflehead		
	Harlequin Duck		
	Trumpeter Swan		
	Tundra Swan		
	Waterfowl Concentrations		
	Golden Eagle	Candidate	
	Northern Goshawk	Candidate	
	Sooty Grouse		
	W WA nonbreeding concentrations of: Charadriidae, Scolopacidae, Phalaropodidae		
	Band-tailed Pigeon		
	Yellow-billed Cuckoo	Endangered	Threatened
	Northern Spotted Owl	Endangered	Threatened
	Vaux's Swift		
	Black-backed Woodpecker	Candidate	
	Oregon Vesper Sparrow	Endangered	
Mammals	Roosting Concentrations of: Big-brown Bat, Myotis bats, Pallid Bat		
	Townsend's Big-eared Bat	Candidate	
	Cascade Red Fox	Endangered	
	Fisher	Endangered	
	Marten		
	Wolverine	Candidate	Threatened
	Columbian Black-tailed Deer		
	Mountain Goat		
	Elk		
Invertebrates	Blue-gray Taildropper	Candidate	
	Pacific Clubtail	Candidate	
	Beller's Ground Beetle	Candidate	
	Hatch's Click Beetle	Candidate	
	Western Bumble Bee	Candidate	Candidate
	Johnson's Hairstreak	Candidate	
	Valley Silverspot	Candidate	

7.3 Functions and Values

FWHCAs support a wide range of biological, chemical, and physical conditions and processes that are essential to sustaining wildlife. Since wildlife includes all species, from the largest megafauna to microorganisms, functions reflect a complex web of interrelated ecological processes. At their core, FWHCAs provide suitable habitat necessary for species survival. Beyond ecological value, ecosystems, plants, and wildlife also provide sources of food and materials for consumptive and productive uses. Additionally, they are valued for a range of cultural, social, and economic benefits (Chardonnet et al. 2002).

7.3.1 Streams, Lakes and Ponds, and Riparian Areas

Streams, lakes, ponds, and associated riparian areas provide essential habitat for a wide range of wildlife species and support ecosystem functions. Commonly recognized functions and processes that influence the habitat conditions within aquatic FWHCA types are outlined below.

Water Quality

- Many aquatic organisms including fish and amphibians require cool, clean water to meet their physiological and reproductive needs.
- Riparian vegetation regulates stream temperature and maintains stable microclimate conditions, including air temperature, wind speed, light exposure, and humidity. Riparian vegetation influence these functions through a variety of mechanisms including shade, orientation, relative humidity, ambient air temperature, wind, channel dimensions, groundwater, hyporheic exchange, and overhead cover (Quinn et al. 2020).
- Salmonids are among the most frequently studied species due to their cultural and economic importance, as well as their relative sensitivity to high temperatures and narrow thermal tolerance (Quinn et al. 2020). Amphibians also have narrow thermal tolerances and are sensitive to changes in microclimate conditions (Bury 2008).

Hydrology

- Streams, lakes, ponds, and their associated riparian areas often have complex and dynamic connections to other surface waters and groundwater within a watershed. These hydrologic linkages influence water availability, quality, and timing throughout the system.
- Hydrologic forces such as streamflow and floods transport water, nutrients, sediment, organic material, and organisms downstream, which shape channel morphology and support ecological processes.
- Many fish and wildlife species are adapted to, and in some cases dependent on, the natural variability of seasonal flows and flood regimes. This variability supports critical life cycle functions such as spawning, migration, foraging, and the creation of off-channel habitats.
- Riparian vegetation reduces the volume and velocity of surface water runoff through processes such as rainfall capture, infiltration, and evapotranspiration (Wynn and Mostaghimi 2007).
- Floodplain features, including wetlands and sinuous stream channels, attenuate peak flows during storm events, which helps to reduce downstream flood risk, recharge groundwater, and support habitat complexity.

Physical Habitat Characteristics

- Large woody debris (LWD) plays a significant role in the geomorphic formation of stream channels and in the creation of diverse channel habitat morphologies (Quinn et al. 2020)

- Streams migrate naturally, often resulting in complex natural geomorphology, floodplains, and heterogeneous ecosystems.
- Bank stability is affected by factors such as bank material, hydraulic forces, and vegetation (Ott 2000).
- Beaver dams incorporate both small and large wood, and serve to slow water, retain sediment, and create pools and off-channel ponds used by rearing coho salmon and cutthroat trout (Pollock et al. 2004; R. Naiman et al. 1988)
- Riparian microclimate affects many ecological processes and functions, including plant growth, decomposition, nutrient cycling, succession, productivity, migration and dispersal of flying insects, soil microbe activity, and fish and amphibian habitat (Brosofske et al. 1997).

7.3.2 Impacts of Urbanization

Urban development significantly affects natural surface waters, riparian areas, and associated fish and wildlife that depend on them. The following section outlines the primary mechanisms by which urbanization impacts the functions and processes discussed above.

Changing Landcover and Impervious Surfaces

- Removal of riparian vegetation leads to higher instream water temperature (Beschta 1987; Murray et al. 2000; Moore and Wondzell 2005a; Gomi et al. 2006).
- Watersheds with widespread loss of forest land are more susceptible to channel instability (Booth et al. 2004). The resulting increase in erosion and bank instability, combined with a reduced of forest cover and root systems, often leads to the simplification of stream morphology, and produces incised, wider, and straighter stream channels (Konrad and Booth 2005).
- Increased impervious surface land cover is positively correlated with higher peak flow volumes and greater daily streamflow variability, and negatively correlated with groundwater recharge and summer low flow volumes (Burges et al. 1998; Cuo et al. 2009; Konrad and Booth 2005)
- Flows become more synchronized and become more variable and volatile in landscapes with high impervious surface cover (Sheldon et al. 2005).
- Simplified or less dynamic stream morphology linked to areas of high impervious surface is known to accelerate water transport and reduce temporary instream flood storage capacity (Kaufmann and Faustini 2012).
- Hydrological functions are also impacted through soil compaction, draining, and ditching across a landscape (Moore and Wondzell 2005b; Booth et al. 2004).

Habitat Removal, Degradation, and Fragmentation

- Habitat loss, degradation, and fragmentation have profound impacts on wildlife and their ecosystems (Gaston 2010; Wiegand et al. 2005; Young et al. 2016).
- Anthropogenic inputs and disturbance from high-intensity land uses (e.g., noise, light, physical intrusions by people and pets, pollution, garbage, etc.) degrade retained habitats in urban settings.

- Fragmentation from roads, fences, buildings, and various land uses restrict interpatch movements and migrations in urban landscapes (Wiegand et al. 2005).
- Urban areas contribute a disproportionately high load of sediment and pollutants to receiving waters (Soranno et al. 1996). Heavy metals, bacterial pathogens, as well as PCBs, hydrocarbons, and endocrine-disrupting chemicals are aquatic contaminants that are commonly associated with urban and agricultural land uses.
- Some contaminants have significant effects on aquatic organisms. For example, coho salmon pre-spawn mortality is caused by a breakdown product of tire wear, 6PPD-quinone (Tian et al. 2021). Coho pre-spawn mortality is also positively correlated with the relative proportion of roads, impervious surfaces, and commercial land cover within a basin (Feist et al. 2011).
- Fine sediment adversely affects stream habitat by reducing spawning habitat quality for fish, smothering benthic organisms, and impairing overall aquatic ecosystem function (Jensen et al. 2009; Galbraith et al. 2006; Knutson et al. 2004)
- Cumulative impacts from both direct and indirect habitat alterations, such as changes in hydrologic, compromised water quality, and fragmentation, can significantly reduce the habitat functions and values of wetlands and riparian areas (Azous and Horner 2010; Sheldon et al. 2005).

7.4 Key Protection Strategies

7.4.1 Identification and Classification

Numerous online resources are available that can be used to aid in determining likely presence or absence of the various types of FWHCAs. Several notable online mapping tools are listed below; however, this list is not comprehensive. Since not all FWHCAs are mapped, and mapping may not reflect current on-the-ground conditions, any findings should be verified in the field by a qualified biologist.

- WDFW Priority Habitats and Species Database (PHS on the Web)
- National Oceanic and Atmospheric Administration Fisheries Range Maps
- U.S. Fish and Wildlife Service (USFWS) Information for Planning and Consultation online tool
- Washington State Department of Natural Resources (DNR) Natural Heritage Program Data Explorer
- Streams are mapped by Medina and other King County and Washington State agency resources.

7.4.1.1 Waters of the State

Waters of the state include lakes, rivers, ponds, streams, inland waters, underground waters, salt waters, wetlands[2] and all other surface waters and watercourses, as defined by RWC 90.48.020 and WAC 173-

[2] Wetlands, while considered a type of water of the state, are typically regulated in a separate section of a local jurisdiction’s critical areas regulations.

201A-020. For jurisdictional purposes, the ordinary high water mark (OHWM) is typically used to determine the boundary of these waters. In tidal waters, however, the USACE applies the high tide line to determine jurisdiction, while Ecology uses the OHWM if present or the line of mean higher high tide if the OHWM cannot be found. While the definition and guidance for determining OHWM differ slightly between the USACE and Ecology, they are largely consistent in practice. The OHWM should be determined in the field by a qualified biologist using one of the following manuals:

- *National Ordinary High Water Mark Field Delineation Manual for Rivers and Streams* (David et al. 2025)
- *Determining the Ordinary High Water Mark for Shoreline Management Act Compliance in Washington State* (Anderson et al. 2016)

The Washinton Department of Natural Resources (DNR) has developed a water typing system for streams and other waters based on various characteristics that has become the standard framework for applying city-scale regulations (WAC 222-16-030). As summarized in Table 2, these characteristics include flow volume, fish use and accessibility, seasonality, among others. Instead, Medina currently regulates streams with an older classification system adapted from the DNR Interim Water Typing System in WAC 222-16-031. However, Medina has condensed the five categories of the Interim System into three: Type 1, Type 2, and Type 3 that relatively match the current DNR System.

In a recent shift in state policy and guidance, WDFW, is recommending a change in stream protection methods by managing streams and their upland riparian areas together as a Riparian Management Zone (RMZ) using site potential tree height (SPTH) as a tool to determine buffer width (Rentz et al. 2020). This updated RMZ guidance is discussed further in Section 7.4.2.2.

Table 2. Water type classifications using DNR's water typing system according to WAC 222-16-030.

Type	Description
Type S Shoreline	Streams and waterbodies that are designated "shorelines of the state" as defined in chapter 90.58.030 RCW.
Type F Fish	Streams and waterbodies that are known to be used by fish, or meet the physical criteria to be potentially used by fish. Fish streams may or may not have flowing water all year; they may be perennial or seasonal.
Type Np Non-Fish	Streams that have flow year round and may have spatially intermittent dry reaches downstream of perennial flow. Type Np streams do not meet the physical criteria of a Type F stream. This also includes streams that have been proven not to contain fish using methods described in Forest Practices Board Manual Section 13.
Type Ns Non-Fish Seasonal	Streams that do not have surface flow during at least some portion of the year, and do not meet the physical criteria of a Type F stream.

7.4.2 Management Resources and Standards

7.4.2.1 Buffers based on Water Typing

Most jurisdictions in Washington State have historically managed stream and riparian habitats by establishing fixed-width buffers, having a width determined by a stream's water type classification. This approach arose in the forestry industry as a response to stream ecosystem degradation from industrial forestry expansion in the mid-20th century (Richardson et al. 2012). Fixed-width buffers have the advantage of being straightforward to define, implement, and regulate; however, they do not account for site-specific conditions which may influence a buffer's effectiveness. When fixed-width buffers are used, they should be sufficiently wide to ensure protection across a range of variable conditions.

7.4.2.2 Riparian Management Zones

In 2020, WDFW developed BAS guidance for the riparian protection, marking a shift from the traditional concept of "stream buffers" to "riparian management zones" (RMZs). A RMZ is defined as "…a scientifically based description of the area adjacent to rivers and streams that has the potential to provide full function based on the SPTH [site potential tree height] conceptual framework" (Quinn et al. 2020; Rentz et al. 2020). Further, RMZs are recommended to be regulated as a fish and wildlife habitat conservation areas themselves to protect their fundamental value, rather than simply buffers for waterbodies (Rentz et al. 2020).

WDFW's current recommendations for establishing RMZ widths are based primarily on the site potential tree height (SPTH) framework. The $SPTH_{200}$ is defined as "…the average maximum height of the tallest dominant trees (200 years or more) for a given site class" (Rentz et al. 2020). To support implementation, WDFW has developed a web-based mapping tool which shows modeled SPTH values across much of Washinton State. The mean $SPTH_{200}$ in forested western Washington ecoregions range from 100 to 240 feet (Rentz et al. 2020). Although certain riparian forests may have lower $SPTH_{200}$ values, a minimum 100-foot RMZ width is recommended to preserve water quality buffer function. While modeled SPTH values may be used as an indicator of RMZ width, WDFW recommends site-specific SPTH field assessments to determine RMZ width. Such field assessments may also be needed to address data gaps or to refine modeled estimates ((WDFW 2025).

WDFW recommends using the SPTH value to determine the RMZ width, measured from the edge of OHWM or channel migration zone (if present), whichever is broader. In cases where SPTH values are less than 100 feet, a minimum RMZ width of 100 feet is recommended to ensure sufficient water quality protection, as well as to support habitat functions including shade and wood recruitment. A 100-foot-wide RMZ is estimated to remove 95% of pollutants and approximately 85% of surface nitrogen (Rentz et al. 2020).

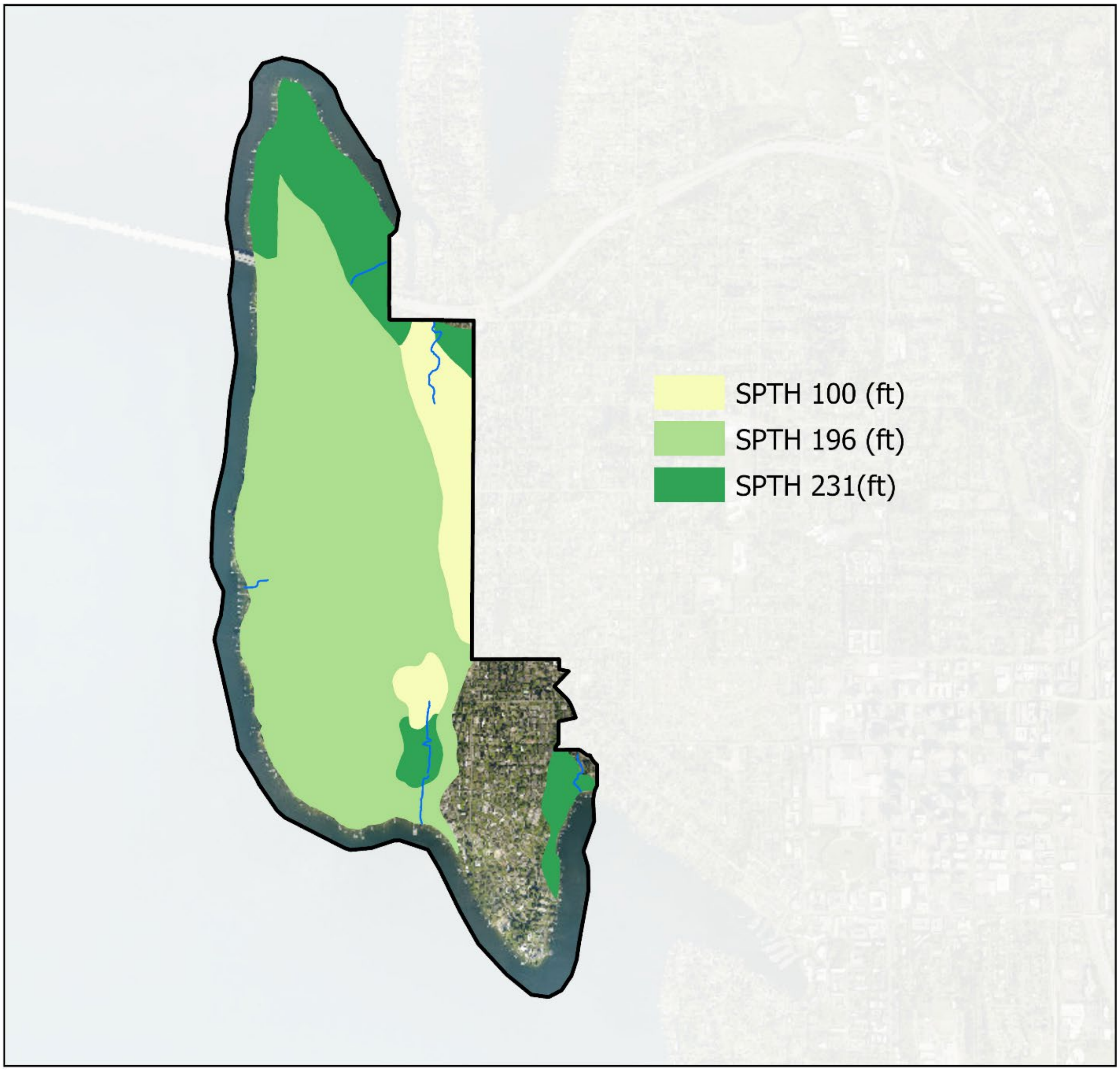

Figure 6. $SPTH_{200}$ distribution in Medina, the uncolored area indicates no data. Map produced from data obtained from WDFW and NRCS (2024).

A visual comparison of the current riparian buffers and potential SPTH-based RMZs is shown in Figure 7. The current extent of riparian buffers is projected using stream type information provided in available BAS resources, but it is considered approximate since the dataset is not comprehensive or exhaustive. Areas with no recommended SPTH values also show no buffer data.

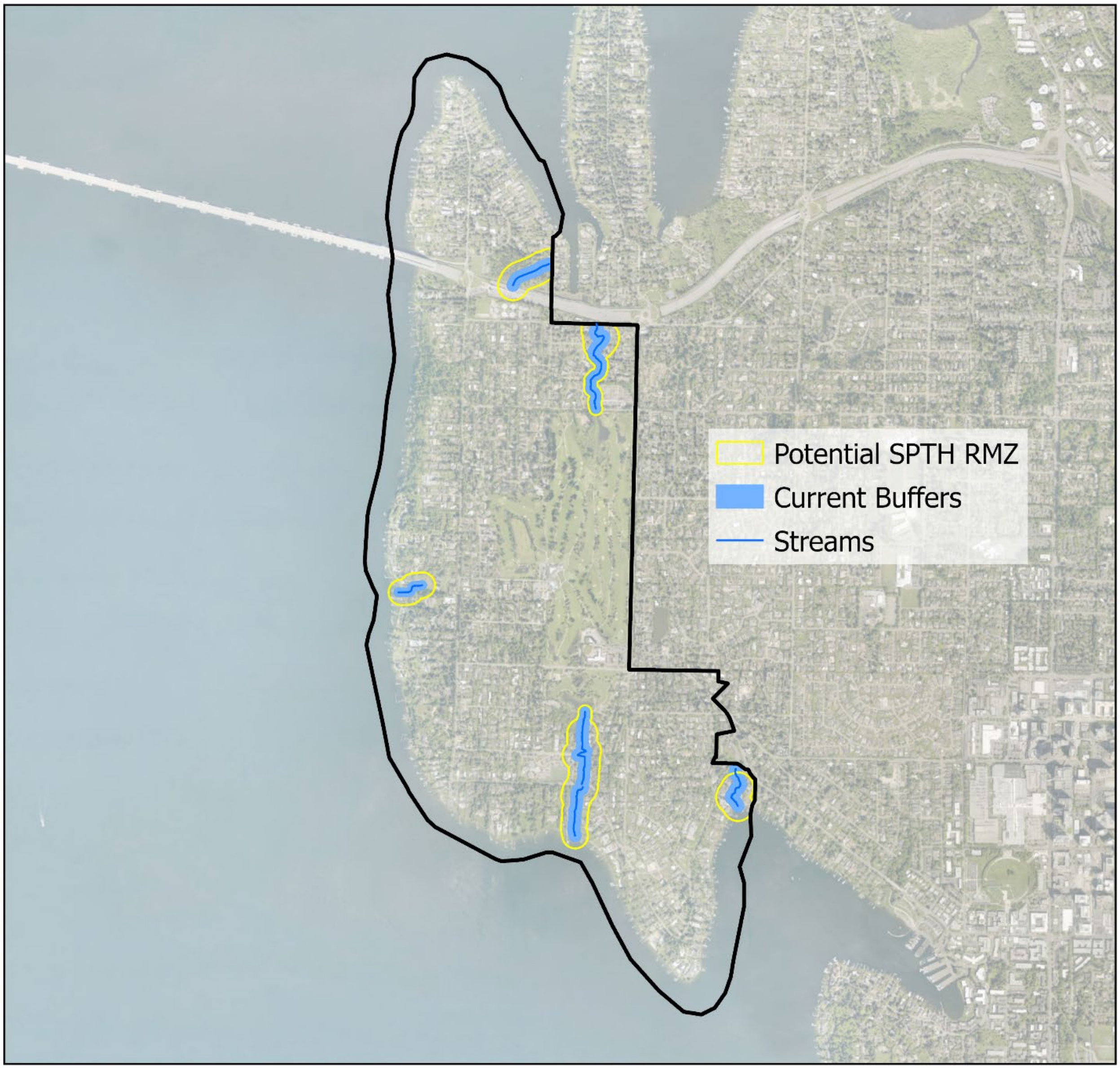

Figure 7. Visualization of potential $SPTH_{200}$-based riparian management zones (RMZs) compared to existing buffers.

Recognizing that establishing fully functional RMZs using the WDFW recommended methods may not be feasible in all developed areas, WDFW emphasizes effective watershed management, preservation, and the protection and restoration of ecosystem functions as much as possible within existing constraints. To support this goal, WDFW recommends delineating stream ordinary high water marks and associated riparian management zones, documenting current conditions to target riparian areas for restoration, and maintain or improve functions through regulatory and voluntary measures. In addition, Additional recommendations include prioritizing opportunities to maintain and restore in-stream and riparian connectivity, effective stormwater management, and requiring stormwater retrofits for redevelopment projects (Rentz et al. 2020).

In addition to the recommendations of WDFW, BAS-based literature identifies a range of management strategies and buffer considerations to help maintain habitat functions for fish and wildlife in urban environments. Effective methods to reduce impacts from urbanization and manage associated runoff should include the following:

- Retaining forests and other native vegetation and minimizing clearing in watershed;
- Maintaining vegetated riparian buffers;
- Limiting or consolidating development and reducing impervious surface coverage;
- Locating roads and other pollutant sources away from watercourses;
- Minimizing road networks and encouraging shared access roads and driveways;
- Implementing low impact development (LID);
- Installing municipal-scale stormwater treatment infrastructure;
- Promoting public education on watershed health and management.

As noted above, effective stormwater management is essential for watershed protection. Stormwater infrastructure, such as biofiltration swales, created wetlands, and infiltration systems, can intercept and treat runoff before reaching stream channels. However, stormwater that is conveyed in pipes or ditches directly to stream channels bypasses the buffer and water treatment functions. To preserve the biofiltration processes that a buffer naturally provides, stormwater discharges may be dispersed in outer buffer areas.

7.4.2.3 Species of Concern

Effective BAS-based strategies can be applied to protect state and federally listed endangered or threatened species and state designated priority habitats and species (PHS). Species-specific management recommendations by WDFW, USFWS, and NMFS have been made available to guide city-level or site-level management. While extensive information exists for high profile species, many regulated species have limited available data and lack detailed management recommendations from state or federal agencies. Where species or habitat-specific management recommendations are available from WDFW guidance documents, those should be followed or adapted to local regulatory frameworks. General recommendations for management strategies to protect terrestrial habitat are listed below.

<u>**General Terrestrial Habitat Management Recommendations**</u>

- High-quality habitats should be retained. Habitat loss is leading cause of biodiversity decline and extinction (Beninde et al. 2015).
- Minimize habitat fragmentation, particularly in large intact habitat areas by designing development to avoid breaking up ecosystems. Where large forests remain, manage for forest-interior species and avoid introducing fragmentation (Donnelly and Marzluff 2004; Diffendorfer et al. 1995; Mason et al. 2007; Pardini et al. 2005; WDFW 2009)
- Manage agricultural development to limit fragmentation and edge effects. Native vegetative and areas with structural complexity should be preserved (Southerland 1993).

- Protect priority habitats and focus on the preservation of habitats having a primary association with an ESA-list species or species of local importance. Follow WDFW management recommendations, and other BAS-based approaches to species protection and management.
- Control invasive species on a site-specific basis, with particular attention on high-risk areas which may be vulnerable due to disturbance, such as edges habitats, roadways, and riparian zones contiguous with developed areas (McKinney 2002; Olden et al. 2004; Pimentel et al. 2005).
- Protect and enhance key habitat structures such as snags and downed wood (Blewett and Marzluff 2005).
- Encourage native vegetative in landscaping and discourage lawns (Nelson and Nelson 2001).
- Site habitats away from roads to minimize edge effects and the threats of traffic on wildlife (Fahrig et al. 1995; Lehtinen et al. 1999).
- Promote adequate buffers to support entire wildlife communities (Ficetola et al. 2009; Semlitsch and Bodie 2003; Crawford and Semlitsch 2007).
- Support habitat connectivity by preserving or creating vegetated corridors between fragmented habitats (Gilbert-Norton et al. 2010).
- Identify and protect important habitat patches and corridors (Gillies and St. Clair 2008; Gilbert-Norton et al. 2010). In developed areas, habitat patches of at least moderate size 35 ha (86 ac) should be preserved because larger patches typically support greater biodiversity (Kissling and Garton 2008).
- Promote restoration of FWHCAs, buffers, and other management zones through land use regulations and public education. Encourage stewardship at a site-scale, and throughout the broader landscape.

7.5 Climate Change Effects

7.5.1 Strategies to Manage Climate Change Impacts on FWHCAs

Climate change is predicted to result in significant and irreversible impacts to fish, wildlife, and their habitats. Anticipated effects include habitat loss and degradation through temperature increases, sea level rise, ocean acidification, extreme weather events, altered precipitation patterns, biological invasions, food web disruptions, and disease (Lyons et al. 2022; Nagelkerken et al. 2023). The specific impacts on fish and wildlife vary by species and may include range shifts, phenological shifts, altered morphology and behavior, biodiversity loss, and increased risk of extinction (Sattar et al. 2021). Collectively, these factors are projected to contribute to biodiversity decline and higher rates of extinction (Sattar et al. 2021).

Changes in temperature and seasonal precipitation patterns are projected to significantly impact Pacific Northwest ecosystems. In riparian zones and other native habitats, warmer and drier summers are expected to result in reduced vegetation cover and shifts in plant community composition. These may trigger a cascade of ecological effects such as decreased shading, elevated stream temperature, reduced detrital inputs, diminishing instream habitat structure, and compromised stream bank stability.

Additionally, shifts in seasonal hydrology, such higher intensity and increasingly frequent storm events, are anticipated to increase the transport sediment and pollutants into streams. These conditions are expected to reduce groundwater recharge and lower capacity supports base stream flows in summer. Instream habitats are also particularly vulnerable to excess sediment discharge and deposition. Collectively, these factors threaten vulnerable salmonid populations, including Chinook salmon, a critical pray species for endangered Southern Resident Orca whales (Crozier et al. 2008).

The following policy approaches are adapted from other regional guidance in coordination with the University of Washington Climate Impacts Group, and represent potential strategies that Medina could use to mitigate climate-related impacts on FWHCAs (Redmond et al. 2022).

- Promote retention of trees and urban forests and enforce tree replacement and reforestation requirements.
- Encourage and incentivize enhancement and restoration of native forest patches throughout the City, particularly where connectivity to one or more FWHCAs is identified. This should be paired with monitoring, maintenance, dry season irrigation, and adaptive management.
- Consider climate resilient planting, including the consideration of assisted migration to source native plants genotypes that are adapted to future climate conditions.
- Manage stormwater infrastructure and promote LID to reduce the downstream impacts of stormwater runoff.
- Maintain and improve regulations which protect regulated wildlife species and associated habitats, and regularly update species maps to identify the lands most in need of protection.
- Prioritize the protection and restoration of streams and riparian corridors to mitigate the effects of climate change on native fish species, such as chinook salmon.
- Identify and protect cold water refugia in waterbodies to buffer impacted species from climate stressors.
- Conduct vulnerability assessments and develop climate action plans to identify priorities, allocate resources, and track priorities.

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