Technical Report

Best Available Science Research
La Center Critical Areas Ordinance Update

Submitted to

City of La Center
La Center, Washington

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Submitted by

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TECHNICAL REPORT

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1.0 INTRODUCTION

Under the Washington State Growth Management Act (GMA), the City of La Center (City) is required to update its critical areas regulations periodically on the schedule set out in the Revised Code of Washington (RCW) Section 36.70A.130. The City of La Center was required to update its critical areas regulations by 30 June 2016. The City is currently out of compliance with this obligation and is seeking to complete its update by early 2019.

The City's critical areas ordinance (CAO) was first adopted in 2001 in response to the 1991 adoption of GMA and was most recently updated in 2012. Evolving best available science (BAS) for critical areas means the City's CAO may not reflect the latest scientific findings. In addition, the CAO does not comply with the updated wetland rating guidance from the Washington State Department of Ecology (Ecology) published in 2014 for wetlands in Western Washington.

BergerABAM's review of BAS included critical area resource documents and guidance that provide BAS-based approaches to protecting the functions and values of critical areas. The BAS review included peer-reviewed literature, gray literature, expert opinion, and the anecdotal experience of professionals that is relevant to the City as well as documents prepared for other jurisdictions, guidance prepared by state and federal agencies, and research from across the country regarding the effectiveness of existing standards and the state of the science. This document presents the findings of the review and those of the sources cited in the report. Appendix A lists the literature, data, and reports used to review the state of BAS for each regulated critical area.

2.0 BEST AVAILABLE SCIENCE RESEARCH

A foundational element of all CAO updates is documenting the BAS that supports the new and/or revised regulations. Washington Administrative Code (WAC) 365-195-900 through 925 provides assessment criteria to assist jurisdictions in determining what information constitutes the "best available science." Of primary importance is that the information presented in a given source was produced through a "valid scientific process." Characteristics of a valid scientific process are outlined in WAC 365-195-905 and are described as follows:

1. Peer review. The information has been critically reviewed by other persons who are qualified scientific experts in that scientific discipline. The criticism of the peer reviewers has been addressed by the proponents of the information. Publication in a refereed scientific journal usually indicates that the information has been appropriately peer-reviewed.

2. Methods. The methods that were used to obtain the information are clearly stated and can be replicated. The methods are standardized in the pertinent scientific discipline or, if not, the methods have been appropriately peer-reviewed to assure their reliability and validity.
3. Logical conclusions and reasonable inferences. The conclusions presented are based on reasonable assumptions supported by other studies and consistent with the general theory underlying the assumptions. The conclusions are logically and reasonably derived from the assumptions and supported by the data presented. Any gaps in information and inconsistencies with other pertinent scientific information are adequately explained.
4. Quantitative analysis. The data have been analyzed using appropriate statistical or quantitative methods.
5. Context. The information is placed in proper context. The assumptions, analytical techniques, data, and conclusions are appropriately framed with respect to the prevailing body of pertinent scientific knowledge.
6. References. The assumptions, analytical techniques, and conclusions are well referenced with citations to relevant, credible literature and other pertinent existing information.

The BAS research presented below includes scientific information that is readily available, is of high quality, and/or has been independently peer-reviewed.

3.0 WETLANDS

The City currently relies on wetland mapping from the National Wetlands Inventory Wetlands Mapper as well as Clark County Maps Online (Maps Online), which also identifies hydric soils in the City. Wetlands in the City may be located adjacent to surface waterbodies, including the East Fork Lewis River and Brezee Creek or are upland and hydrologically connected to nearby waterbodies. Wetlands are highly productive and valuable ecosystems that provide high quality habitat to various terrestrial and aquatic flora and fauna, protect water quality by filtering contaminants and promoting infiltration, provide aquifer recharge, and slow the velocity of and retain flood waters protecting downstream communities from the impacts of flooding. Current BAS for wetlands includes guidance for the identification, classification, and categorization of wetlands, information regarding useful and effective protective buffers, and guidance for mitigating impacts to wetlands, including mitigation sequencing and compensatory mitigation, all of these are factors in protecting and maintaining wetland functions and values. This section of the report discusses the functions and values provided by wetlands and information regarding their identification, classification/characterization, and protection and management.

3.1 Functions and Values

Wetland functions are the interactions between the structural components of the wetland, and the physical, chemical and biological processes within the wetland and surrounding landscape (Sheldon et al. 2005). Because wetlands provide functions at many scales, from the microscopic to watershed level, functions are generally grouped into one of three categories: biochemical, hydrologic, and habitat functions. Not all wetlands provide the same level of functions, and most functions are dependent on a number of factors that include the presence and kind of vegetation, soil type, water regime and residence time of water, and position within the landscape. Additionally, the value of an individual wetland may differ from another because of external factors such as the presence of nearby contaminant sources (e.g., agricultural practices), runoff from adjacent impervious surfaces, proximity to resident and anadromous fish-bearing streams, precipitation patterns, likelihood of flooding, and/or changes in regional climate conditions. The following sections provide a broad overview of the functions provided by wetlands, and examples of the value of these functions to society. The discussion is not exhaustive, but is meant to show representative examples of the findings of existing science regarding the functions provided by wetlands.

Biochemical functions include nutrient cycling, removal and retention of metal and toxic organic compounds, and sediment stabilization, among others. Water quality can be impaired by the presence of contaminants including sediments, phosphorous, metals and organic compounds, and/or pathogens. As discussed in Ecology's *Wetlands in Washington State Volume 1 – A Synthesis of the Science* (Sheldon et al. 2005), wetlands improve water quality by promoting sedimentation, absorbing and precipitating contaminants, biodegrading contaminants by supporting microbes that break them down, removing nitrogen through nitrification and denitrification processes, and helping retain and remove pathogens by detaining water and aiding microorganisms that feed on bacteria. These natural processes provide water quality protection that reduces society's dependency on water quality treatment facilities, protect local resources such as fish stocks that may be impaired by contaminated water, and help promote the health and safety of communities by limiting the presence of pathogens, metals, and toxic organic compounds in the drinking water that is provided by ground and surface water resources (Sheldon et al. 2005).

The hydrologic functions provided by wetlands include flood attenuation, groundwater recharge, decreased downstream erosion, and reduction in peak flows, among others. The hydrologic functions of wetlands are related to their ability to retain more surface water than terrestrial habitats; the many wetlands across a watershed retain and gradually release runoff and surface water that would otherwise flow directly into surface waters (Adamus et al. 1991, *in* Sheldon et al. 2005). While these functions are associated with water storage, an individual wetland's ability to store surface or subsurface water is additionally influenced by a number of factors, including the wetland's location within the landscape, soils and vegetation, and the type or class of the wetland (Sheldon et al. 2005). These functions can contribute to the long-term health, safety and financial benefits to downstream communities; for example, wetlands in floodplains dissipate the erosive forces of flood waters, and can store large volumes of surface water; these functions act to protect downstream communities from flooding events, and channel migration, and minimize damage to structures and other assets such as cropland.

Wetlands provide habitats for various species, including species that are dependent on wetland habitat for their entire life cycle, species that rely on wetlands for a single life stage, and species that use wetlands on occasion, such as for drinking water, or as a stopover point during migration (Johnson and O'Neil 2001). Wetlands support anadromous and resident fish, reptiles and amphibians, waterfowl and migratory birds, and terrestrial species, as well as a variety of aquatic invertebrates and microorganisms. The use of a wetland by any specific animal or group of animals depends on factors that include hydrologic regime, structure and complexity of vegetation, proximity to other habitat, climate/seasonality, and topography, among others (Adamus et al. 1991, Mitsch and Gosselink 2000). Many of the species that rely on wetlands for all or part of their life cycle have unique societal and cultural values. For example, wetlands provide juvenile rearing habitat for salmon, and they provide habitat for waterfowl which are valued for recreation (e.g., birding and hunting). Wetlands supply habitat for protected species such as migratory birds, WDFW priority species, and state and federally listed threatened and endangered species.

Disturbances to wetlands and the functions they provide can occur at several geographic scales, and can be created by and depend on a variety of land uses, the land use intensity/severity, and the scale at which the disturbance occurs (Sheldon et al. 2005). Disturbances include vegetation removal and increased impervious surfaces, agricultural practices, logging and development, and other activities that alter natural drainage patterns, fill wetlands, and increase inputs of pollutants. Each of these disturbances may affect the functions and values of wetlands by increasing water volume and flow rates after storm events, increasing sediment and other pollutants in runoff, contributing to habitat fragmentation, increasing erosion, and/or reducing biodiversity (Sheldon et al. 2005).

Protecting wetland resources entails the regulation of direct and indirect impacts to wetlands and should be guided by BAS. Direct wetland impacts are activities that include filling, draining, or adversely impacting the vegetation within a wetland. Indirect impacts result from changes to the surrounding landscape that negatively influence the physical, chemical, or biological characteristics of a wetland, such as its hydroperiod, microclimate or habitat connectivity, for example (McMillan 2000).

3.2 Identification and Classification

Section 365-190-090 of the WAC and RCW 36.70A.030 define wetlands as 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 non-wetland 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 1 July 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 non-wetland areas to mitigate the conversion of wetlands.

To address regional wetland characteristics and improve the accuracy of wetland delineations, the U.S. Army Corps of Engineers (USACE) issued regional supplements to its wetland delineation manual (1987) on which the state manual is based. Therefore, current wetland methodology is based on the USACE manual and the *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Western Mountains, Valleys, and Coast Region* (Version 2.0) (regional supplement) (USACE September 2010). The USACE manual provides the methodology for identifying jurisdictional wetlands based on an examination of vegetation, soils, and hydrology.

WAC 365-190-090 also indicates that when designating wetlands, counties and cities should use a rating system that evaluates the existing wetland functions and values to determine what functions must be protected, and, when developing wetland rating systems, jurisdictions should consider using the wetland rating system developed jointly by Ecology and the USACE. Ecology's *Wetland Rating System for Western Washington* (Hruby 2014), which is the most commonly used and regionally accepted wetland classification system, categorizes wetlands based on their specific attributes including rarity, sensitivity, and the functions they provide. To identify and classify wetlands, the system incorporates other classification systems including the hydrogeomorphic classification and classification of plant communities (Cowardin et al. 1979), as well as classification based on special characteristics. As described in the Ecology guidance, the rating system was designed to "differentiate between wetlands based on their sensitivity to disturbance, their significance, their rarity, our ability to replace them, and the functions they provide" (Hruby 2014). The intent of the system is to provide a basis for developing standards to protect and manage wetlands.

3.3 Best Available Science for Wetlands

Buffers are generally recognized as part of protecting the functions and values of wetlands. Buffers are vegetated areas adjacent to an aquatic resource (a wetland for purposes of this discussion) that can, through various processes, reduce the impacts of adjacent land uses (Sheldon et al. 2005). Functions provided by buffers include removing sediments, excess nutrients, and toxics; influencing the microclimate; maintaining habitat connectivity; and minimizing adjacent disturbances. The effectiveness of buffers to protect wetland functions and values is generally related to the type of wetland function to be protected, the activities that are being buffered, and the characteristics of both the wetland and its associated buffer. For example, differing widths for effective buffers for water quality protection, and habitat for a specific species have been documented. Additionally, different buffer widths to protect a similar function may be necessary depending on the stressors associated with the different wetlands that provide the function. Generally, the characteristics that most influence buffer functions include vegetation, slope of the buffer, the soils, and the width of the buffer; of these, just vegetation and buffer width can be manipulated or controlled easily.

It is generally accepted that the width of a buffer should be related to the wetland functions that need protecting, the intensity of the adjacent land use, and the condition of the adjacent buffer. While the BAS states unanimously that buffers are effective in protecting wetlands functions and values, there is significant debate about how much buffer is necessary to protect particular functions. In order to protect the ecological functions and values of wetlands, it is necessary for regulators to consider a number of ecological principles, and their implications for development and the use of natural resources. These principals include factors such as temporal and spatial functions of ecological processes and implications of development, direct and cumulative impacts, and the type, intensity, and duration of impacts to natural resources.

As stated in Ecology's *Wetlands in Washington State Volume 2 – Protecting and Managing Wetlands* (Granger et al. 2005),

> *[a]uthors who synthesized the literature on the effectiveness of buffer widths suggest buffers between 25 and 75 feet for wetlands with minimal wildlife habitat functions and adjacent low-intensity land uses; 50 to 150 feet for wetlands with moderate habitat functions or adjacent high-intensity land uses; and 150 to 300 feet for wetlands with high habitat functions. Effective buffer widths for protecting water quality ranged from 25 to 50 feet for 60 percent removal of pollutants, to 150 to 200 feet for 80 percent removal of pollutants.*

Ecology suggests assessing the potential risk to wetlands as a result of development and the amount of risk that is acceptable; this risk assessment can offer a local jurisdiction insight on appropriate protective measures for implementation. This means that regulations implementing larger, rather than smaller, buffers around all wetlands would be characterized as lower risk for preserving functions and values, whereas a jurisdiction that implements narrower buffers would have a higher risk of impacting functions and values, and the narrower buffers would be unlikely to provide all of the functions necessary to protect wetlands.

4.0 CRITICAL AQUIFER RECHARGE AREAS

4.1 Functions and Values

GMA requires the protection of groundwater because it supplies our drinking water and, without replenishment, the amount of water in aquifers can be diminished or even depleted (Ecology 2005). An aquifer is saturated subsurface material that yields a sufficient supply of water to a source. Critical aquifer recharge areas (CARA) are "areas with a critical recharging effect on aquifers used for potable water where an aquifer that is a source of drinking water is vulnerable to contamination that would affect the potability of the water" (WAC Chapter 365-190-030). By protecting CARAs, a community can focus its efforts and resources on protecting its most critical supplies of groundwater.

Regulating CARAs protects public drinking water from contamination by hazardous materials and waterborne illnesses, helps ensure the future availability of groundwater, and is less expensive than post-contamination cleanup of groundwater. Studies have shown that funding initiatives to protect groundwater is more cost-effective than cleaning up groundwater after contamination occurs. Contaminated public drinking water can cause illness, bring about the ingestion of chemicals or other harmful substances, and incur costs as new wells must be developed or contaminated soils and/or groundwater must be cleaned (Ecology 2005). In addition, "some aquifers may also have critical recharging effects on streams, lakes, and wetlands that provide critical fish and wildlife habitat. Protecting adequate recharge of these aquifers may provide additional benefits in maintaining fish and wildlife habitat conservation areas" (WAC 365-190-100).

4.2 Identification and Classification

Clark County [Maps Online] identifies CARA I in La Center; however, CARA II areas are not defined in the City's codified regulations. WAC 365-190-100 classifies CARAs as sole source aquifers, special protection areas, and wellheads. The La Center CAO defines CARAs as areas with a critical recharging effect on aquifers used for potable water are areas where an aquifer that is a source of drinking water is vulnerable to contamination that would affect the potability of the water. BAS for CARAs involves knowledge and data about the occurrence and movement of groundwater (Morgan 2005). The first step in identifying CARAs is ascertaining where groundwater is susceptible to contamination, including the locations of aquifers, water wells, streams, springs, and lakes. In addition to locating these items, their characteristics should be noted, including soil cover, porosity, and hydraulic conductivity, i.e., the interaction between aquifers, within the same aquifer, or between surface and groundwater resources. Hydraulic connectivity describes the ability of the water to flow and depends on the nature of the materials through which the water is flowing.

Once located and characterized, the susceptible groundwater areas should be evaluated based on their resource value and where contamination would have the highest negative impact. Finally, the susceptibility data is overlain with the resource value, to identify priority areas (King County 2004).

Information sources for evaluating and designating CARAs include well logs, soil surveys and maps, topographic maps, and geologic studies and maps. These sources should be evaluated by a qualified hydrogeologist, geologist, or engineer who is licensed in Washington and has experience in preparing hydrogeologic assessments (Washington State Department of Community, Trade and Economic Development 2018).

4.3 Best Available Science for CARAs

BAS for protecting CARAs recommends addressing both recharge and discharge areas. Aquifer recharge occurs where stormwater, irrigation water, and other water infiltrates into the ground. Using resources and land in various ways can impact aquifer recharge areas; some examples of risks include the contamination of CARAs by hazardous materials or reducing recharging effects by increasing impervious surfaces. Discharge areas are locations where groundwater flows from the surface such as a spring, wetland, or well.

BAS recommends protecting public groundwater by limiting potential contamination risks within CARAs, and promoting land use and development standards that maintain groundwater withdrawals and recharge. In order to support the adequate recharge of its aquifers, a municipality can limit impervious surfaces, encourage low impact development, and use other stormwater best management practices (BMPs) such as raingardens. A commonly used resource for identifying BMPs that will protect groundwater recharge and water quality is the *2012 Stormwater Management Manual for Western Washington*, as amended in December 2014 (Ecology 2014).

Some land use activities have been identified as high-risk for groundwater contamination, and jurisdictions should consider prohibiting these uses within priority CARAs, or requiring strict pollution prevention requirements. BAS also recommends the identification and monitoring of existing high-risk uses within CARAs. Examples of high-risk uses in CARAs include landfills, wood treatment facilities, chrome platers, tank farms, and facilities that treat, store, or dispose of hazardous waste (Ecology 2005).

Other uses may present a moderate or low risk of contamination within a CARA, and can be permitted as conditional uses, provided that they meet BMPs and other requirements to ensure protection of the CARA.

5.0 GEOLOGICALLY HAZARDOUS AREAS

5.1 Functions and Values

The GMA recognizes four main types of geologic hazards: landslide hazard areas, seismic hazard areas, erosion hazard areas, and areas subject to other geologic events such as coal mine hazards and volcanic hazards. According to the U.S. Department of Agriculture-Natural Resources Conservation Service (USDA-NRCS) Web Soil Survey and Maps Online, the City's landscape has various environments susceptible to geologic hazards such as landslide hazards and erosion hazards along East Fork Lewis River and its tributaries. All of the types of geologic events listed above are risks to human health and safety and can damage property. Managing geologically hazardous areas is necessary to ensure the safety and wellbeing of city residents, and to prevent avoidable damage and/or loss of public and private property. In addition, according to the

Washington Department of Commerce, "geologically hazardous areas also have an important function in maintaining habitat integrity. Mass wasting events, such as landslides and debris flows, contribute needed sediment and wood for building complex instream habitats, estuarine marshes, and beaches important for fisheries, wildlife, and recreation." The BAS summarized below discusses the BAS for designating and mapping geologically hazardous critical areas in the interests of human health and structural safety and the contributions of these areas to the natural environment.

5.2 Identification and Classification

The Washington State Department of Natural Resources (DNR) website "Geologic Hazards and the Environment" provides information and maps of seismic hazards, landslides, and volcanic hazards and is an important BAS mapping source. DNR's Geologic Information Portal is a BAS information source for mapping landslide, seismic, and volcanic hazards. Erosion hazards are mapped by corresponding soil type through the USDA-NRCS Web Soil Survey of Clark County. Geologic hazards are also commonly identified through site-specific geologic or geotechnical engineering studies where agency-produced hazard mapping is insufficient.

The City's existing CAO classifies steep slopes exceeding 25 percent as unbuildable, geologically hazardous areas. Rather than classify certain slope categories as unbuildable, WAC 365-190-120 classifies slopes exceeding 15 percent as landslides under certain conditions and all slopes exceeding 40 percent with 10 feet or more of vertical relief as landslides with the exception of bedrock slopes.

5.3 Best Available Science for Landslide Hazards

According to DNR, "Washington is one of the most landslide-prone states in the country, with hundreds to thousands of events each year." Landslides are mass wasting events with soil and rock moving downslope and are more frequent after precipitation events when soil loses its strength. Gravity, water, and friction all play a role in landslides. There are many different types of landslides, but slides generally fall into two categories: shallow and deep-seated (DNR 2018). Literature tends to focus on how to categorize and map these hazards. DNR's Geologic Information Portal, an online database, provides information about the mapping by the agency's Division of Geology and Earth Resources of geologic hazards in Washington, and, in the absence of site-specific studies, the mapping is considered BAS for the designation of landslides in the City.

Site-specific geotechnical studies with a delineation of landslide hazards and recommended mitigation measures for building in and near these areas are considered BAS based on the criteria in WAC 365-195-905. The literature contains mitigation measures and best practices for site development near landslide hazards. According to the U.S. Geological Survey (USGS), "the simplest means of dealing with landslide hazards is to avoid construction on steep slopes and existing landslides; however, this is not always practical" (Highland and Brobrowsky 2008). The USGS recommends other mitigation, including slope stabilization by channeling drainage away from the landslide, draining groundwater away from the landslide, minimizing surface irrigation, using retaining walls, retaining/planting vegetation, and seeking professional advice (Highland and Brobrowsky 2008). Burns and Mickelson (2012) recommend a buffer from the top of shallow landslide-prone slopes equal to twice the vertical height of the slope for high or moderate susceptibility landslide areas.

5.4 Best Available Science for Erosion Hazards

Erosion is the wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep. The 2018 USDA-NRCS web soil survey of Clark County classifies the erosion potential of soil types as slight, moderate, severe, and very severe. According to "Understanding Soil Risks and Hazards, Using Soil to Survey to Identify Areas with Risks and Hazards to Human Life and Property,"

> *…construction activities can have serious detrimental effects on the soil on construction sites. Topsoil removal, grading, and filling drastically reduce soil quality on these sites, resulting in long-term adverse impacts on plant growth and runoff. Removal of topsoil inhibits biological activity and reduces the supply of organic matter and plant nutrients ... Erosion from construction sites has offsite environmental and economic impacts.* (USDA-NRCS 2004)

The 2018 soil survey is considered BAS for erosion hazards in the City and the County generally. In the City's developed urban area, most soil types are rated as having a slight to moderate risk of erosion, but areas immediately northwest and southeast along McCormick Creek, Jenny Creek, and Brezee Creek are classified as having a "severe" or "very severe" risk of erosion. Soils rated by USDA-NRCS as "severe" or "very severe" are those with an erodibility index of 0.75 or greater and, in most jurisdictions across the state, are classified as regulated critical areas. BMPs for development or alteration in erosion hazard areas tend to focus not on prohibiting development, but on requiring erosion controls during construction, eliminating clearing activities during the wet season, and directing drainage around these areas so as not to exacerbate pre-existing erosion potential. Ecology's *Stormwater Management Manual for Western Washington* (Ecology 2014) is considered a resource document for erosion control methods. In "Understanding Soil Risks and Hazards," which is considered to be BAS, USDA-NRCS recommends the following erosion control techniques during construction:

- Divide the project into smaller phases, clearing smaller areas of vegetation.
- Schedule excavation during low-rainfall periods when possible.
- Fit development to the terrain.
- Excavate immediately before construction instead of exposing the soil for months or years.
- Cover disturbed soils with vegetation or mulch as soon as possible and thus reduce hazard of erosion.
- Divert water from disturbed areas.

- Control concentrated flow and runoff, thus reducing the volume and velocity of water from work sites and preventing the formation of rills and gullies.
- Minimize the length and gradient of slopes (e.g., use bench terraces).
- Prevent the movement of sediment to off-site areas.
- Inspect and maintain all structural control measures.
- Install windbreaks to control wind erosion.
- Avoid soil compaction by restricting the use of trucks and heavy equipment to limited areas.
- Break up or till compacted soils prior to vegetating or placing sod.
- Avoid dumping excess concrete or washing trucks on site.
- Revegetate exposed surfaces to provide immediate permanent or intermittent cover.

5.5 Best Available Science for Seismic Hazards

Earthquakes can be incredibly expensive and destructive events that can level buildings and damage public infrastructure. According to DNR, "Washington has the second highest risk of large and damaging earthquakes in the nation as a result of its geologic setting." WAC 365-190-120 defines seismic hazards as geologically hazardous areas and requires that jurisdictions adopt critical area ordinances regulating development in them. This same WAC section defines seismic hazard areas as "areas subject to a severe risk of damage as a result of earthquake induced ground shaking, slope failure, settlement or subsidence, soil liquefaction, surface faulting or tsunamis. According to USGS, "ground shaking or ground motion is the movement of the earth's surface from earthquakes and is produced by waves that are generated by sudden slip of a fault and travel through the earth and along its surface." The USGS defines liquefaction as "the phenomenon that occurs when loose, water-logged sediments at or near the ground surface lose their strength in response to strong ground shaking from an earthquake."

DNR's Washington Geological Survey and its Geologic Information Portal have online map information for active faults, seismic scenarios, and liquefaction susceptibility that are considered to be BAS for seismic hazards. DNR's data shows that there is an inferred seismogenic fault trace approximately 15 miles south/southeast of the City and another fault about 6 miles east. The southwest part of the City has a very low to low probability of soil liquefaction during an earthquake, while the northeast has a low probability. Areas along the East Fork Lewis River, however, have a moderate to high susceptibility. The City would experience shaking of strong to very strong intensity during an earthquake originating from the Cascadia subduction zone. DNR also maintains National Earthquake Hazard Reduction Program (NEHRP) maps (available through Maps Online) for seismic site classes ranging from B (soft rock) to E (soft clay soil). Class B is lowest risk and Class E is highest risk of damage from an earthquake. The NEHRP classes change as one moves across the City, with classes rated predominantly C and D in the north/northeast and south/southwest. Areas adjacent to the East Fork Lewis River are rated E.

The following documents represent BAS for earthquake design:

- NEHRP Recommended Seismic Provisions for New Buildings and Other Structures. 2015 Edition
- 2015 Minimum Design Loads for Buildings and Other Structures, American Society of Civil Engineers (ASCE) 7 (2016 ASCE-7 Standard)(ASCE, 2016)
- 2015 International Building Code (International Code Council 2015)

5.6 Best Available Science and Volcanic Hazards

DNR identifies five active volcanoes in the state: Mount Baker, Glacier Peak, Mount Rainier, Mount St. Helens, and Mount Adams. High-speed ash, rock, lava, and landslides can destroy houses and infrastructure within 10 miles of an eruption. Lahars (flows of ash, debris, and ice) can affect areas more than 50 miles away. Eruption columns and clouds, lava flows and domes, pyroclastic flows, lahars, volcanic landslides, and volcanic gas are all hazard risks associated with volcanic eruptions. DNR and USGS maintain volcanic hazard maps for Washington which are considered BAS for the City. According to DNR's Geologic Information Portal, the City is not located within any volcanic hazard areas and, therefore, this report does not include further discussion of the science for this issue.

6.0 FREQUENTLY FLOODED AREAS

6.1 Functions and Values

Good management of frequently flooded areas can protect downstream areas and reduce the risk of flooding to public safety and property. In addition, floodplains also provide valuable in-stream and off-channel habitat to a variety of species, and are important for water quality protection. Floodplains enhance biological productivity and help maintain biodiversity and the ecological value of ecosystems (Federal Emergency Management Agency [FEMA] 2007).

6.2 Identification and Classification

Frequently flooded areas are defined as areas that will be inundated by a flood event having a 1-percent chance of being equaled or exceeded in any given year. The 1-percent annual chance flood is also referred to as the base flood or 100-year flood. In Washington, jurisdictions are required to regulate the 100-year floodplain as a critical area, at a minimum, but may also optionally regulate other areas including channel migration zones, areas inundated by the flood of record, areas subject to groundwater flooding, or streams where the path of flood waters can be unpredictable (Ecology 2018).

As part of its continuing effort to improve floodplain management practices, FEMA encourages communities to steer development away from floodplains documented in flood insurance rate map (FIRM) panels. FIRM panels are official maps of communities in which FEMA has delineated special flood hazard areas and the risk premium zones applicable to the community. FIRM panels are generally considered BAS for designating frequently flooded areas. The flood insurance map (No. 53011C0206D) for the City was updated in September 2012. La Center is a 44 CFR 60.3(d) community, meaning the base flood elevations are determined for all A/AE zones, and a floodway is designated. A flood insurance study (FIS) for all of Clark County was conducted in September 2012 and revised in January 2018 (No. 53011CV001B). Therefore, BAS for the City's frequently flooded areas consists of FIRM panels, the FIS, and any available or obtainable site-specific assessments. The FIRM panel for the City shows frequently flooded areas (Zone A) along the shorelines of the East Fork Lewis River and a short section of Brezee Creek.

6.3 Best Available Science for Frequently Flooded Areas

Development within the floodplain has been popular throughout history, not only because people want to live near water, but also because waterways are an efficient way to move products, making them a valuable economic resource. However, development within a floodplain can result in a problematic cycle: development first alters the natural flow and drainage patterns of the floodplain, and then subsequent flooding in the altered floodplain damages development (FEMA 2007).

Developing or updating frequently flooded areas ordinances can be an opportunity to promote flood safety and protect ecological habitat through locally appropriate standards (Ecology 2018). The fundamental floodplain management program that most others are built on is FEMA's National Flood Insurance Program (NFIP). FEMA manages NFIP in order to assist owners of properties subject to flood damage. The minimum requirements of the NFIP protect the health, safety, and welfare of the community by protecting buildings from the 100-year flood, which FEMA refers to as special flood hazard areas (SFHA).

FEMA encourages communities to use the FEMA elevation certificate as an official record showing that new buildings and substantial improvements in all identified SFHAs have been properly elevated. This elevation information is also needed to show compliance with the floodplain management ordinance, and can be used by the property owner to obtain flood insurance.

Limiting development within floodplains reduces the need for "structural solutions," which are both expensive and disruptive to the local environment (Association of State Floodplain Managers, Inc. [ASFPM] 1993). BAS recommends limiting all development within floodplains (including grading and fill) and prohibiting new residential development. Repairs, reconstruction, or improvements to an existing structure within the floodplain may be allowed, but consideration should be given to the design and structural integrity of these improvements.

The BAS for development within floodplains is generally agreed upon as being the applicable flood resistant provisions of the 2018, 2015, 2012, and 2009 International Codes (I-Codes); the referenced standard ASCE 24, Flood Resistant Design and Construction; and NFIP requirements. FEMA has compiled the applicable I-Code provisions into a single document, "Flood Resistant Provisions of the 2015 International

Codes" (FEMA 2018). General recommendations for development within a floodplain include:

- For buildings located within more than one SFHA, the provisions associated with the most restrictive SFHA should apply.
- It should be demonstrated through hydrologic and hydraulic analyses performed by an accredited professional that the grading and/or fill will not result in any increase in flood levels.
- Grading and fill should not be approved unless fill is placed, compacted, and sloped to minimize shifting, slumping, and erosion during the rise and fall of flood water.
- Exterior walls extending below the base flood elevation should be constructed with flood-damage-resistant materials.
- The finished ground level of an under-floor space (e.g., a crawl space) should be equal to or higher than the outside finished ground level on one side or more.
- Anchoring to prevent flotation.
- Using flood-resistant construction materials and methods.
- Preventing infiltration of flood waters in utility systems.
- Elevating residential and nonresidential construction above the base flood elevation.

7.0 FISH AND WILDLIFE HABITAT CONSERVATION AREAS

7.1 Functions and Values

Fish and wildlife habitat conservation areas are the various highly productive and diverse ecosystems that provide resources and functions necessary for fish and wildlife and the surrounding human populations. These critical area functions include the protection of sensitive species, stabilizing streambanks, maintaining invertebrate communities, providing corridors for movement between habitats, and supplying habitat for foraging, nesting, overwintering, rearing, escape, and cover. These areas also benefit local communities by providing water quality improvements and protection from flooding, and financial opportunities related to recreation, tourism, and education, among others.

The following list identifies the fish and wildlife habitat conservation areas per WAC 365-190-130. The WAC distinguishes these areas for their intrinsic value and because they contribute to the state's biodiversity. In addition to the listed areas, WAC directs counties and cities to give special consideration to conservation or protection measures necessary to preserve or enhance anadromous fisheries (WAC 365-190-080).

- Areas where endangered, threatened, and sensitive species have a primary association, including federal and state listed species and state priority habitat areas associated with state priority species.
- Habitats and species of local importance, as determined locally.
- Commercial and recreational shellfish areas.

- Kelp and eelgrass beds, and herring, smelt, and other forage fish spawning areas.
- Naturally occurring ponds under 20 acres and their submerged aquatic beds that provide fish or wildlife habitat.
- Waters of the state.
- Lakes, ponds, streams, and rivers planted with game fish by a governmental or tribal entity.
- State natural area preserves, natural resource conservation areas, and state wildlife areas.

Some of the listed areas (naturally occurring ponds under 20 acres, shellfish areas, kelp and eelgrass beds, and herring, smelt, and other forage fish spawning areas) are not represented in the City (or in the general vicinity) and their identification and classification, as well as BAS for protecting them, are not discussed further in this report.

BAS indicates that the identification and characterization of fish and wildlife habitat conservation areas, and providing protective measures such as buffers for them, is critical to maintaining the functions and values they provide. This report relies primarily on a series of approximately 15 reports published by the Washington Department of Fish and Wildlife (WDFW) under the title "Priority Habitats and Species – Management Recommendations." These reports focus on particular habitats (e.g., riparian) or species (e.g., mammals) and consolidate scientific literature and information on their importance and BMPs for their protection in Washington.

7.1.1 Terrestrial Habitats

Terrestrial habitats provide valuable habitat area for various species, including federal and state listed species. WDFW's mapping tool for priority habitats and species (PHS), PHS on the Web, identifies several areas of Oregon white oak (*Quercus garryana*) in the City. This species is Washington's only native oak, and their woodlands provide a mix of feeding, resting, and breeding habitat for several wildlife species. Tree snags and dead branches host insect populations and provide nesting areas and perches for birds and mammals. The trees are also sources of food in the form of acorns as well as leaves, fungi, and insects. Oak/conifer associations provide contiguous aerial pathways for small terrestrial mammals, such as squirrels (Larsen and Morgan 1998).

7.1.2 Riparian and In-Stream Habitats

In total, riparian areas represent a relatively small proportion of fish and wildlife habitat conservation areas, but they support more diverse and abundant fish and wildlife than any other habitat. Riparian areas are situated adjacent to aquatic habitat and are transitional areas which contain elements of mutually influential aquatic and upland ecosystems. Functions provided by riparian areas include improving water quality, stabilizing streambanks, maintaining moist and mild microclimates and cool stream temperatures, providing nutrient cycling/inputs, and controlling flooding. Riparian areas also offer multilayered habitat structure and complexity that provide habitat for breeding, rearing, forage, cover, escape, and migration, and habitat connectivity between aquatic and terrestrial habitats.

Functioning riparian habitat is essential for a number of threatened, endangered, sensitive, and priority species, including salmon and steelhead, reptiles and amphibians, cavity nesting birds, and migratory birds, among others (Knutson and Naef 1997). Protecting these areas can be controversial as their protection can restrict the development potential of private and public property; on the other hand, limiting development in riparian areas can benefit humans by protecting water quality in streams and rivers used as drinking water and can promote healthy fish populations that are a source of food for people.

WDFW's "Management Recommendations" indicates that the protection of riparian habitat may yield the greatest gains for fish and wildlife (and by extension humans) while involving the least amount of area, when compared to other habitats, because riparian habitat:

- covers a relatively small area yet supports a higher diversity and abundance of fish and wildlife than any other habitat;
- provides important fish and wildlife breeding habitat, seasonal ranges, and movement corridors;
- is highly vulnerable to alteration; and
- has important social values, including water purification, flood control, recreation, and aesthetics.

Approximately 85 percent of Washington's wildlife species have been known to use riparian habitat (Thomas 1979, Brown, 1985). Many of these species are dependent on riparian areas for at least one stage in their life cycles, while others may use riparian areas only occasionally or to move between habitats (O'Connell et al. 1993). Reptiles, amphibians, cavity nesting ducks and other waterfowl, beaver, otter, and great blue heron are examples of species that rely almost exclusively on riparian area habitats and their proximity to water, and mild microclimates for breeding, nesting, rearing, forage, and cover. Other species (e.g., migratory birds) rely on these highly productive habitats as stopover locations during seasonal migration, or as breeding and rearing habitat before or after migration, and thus may be present only during specific seasons (Andelman and Stock 1994).

Riparian areas are linked by definition to instream fish habitat and support its functions for fish. Seventy-seven species of fish inhabit freshwater in Washington for all or a portion of their lives (Wydoski and Whitney 1979). These species include ESA-listed salmon and various other native aquatic species. Riparian areas support a number of physical, chemical, and biological processes for instream habitats, including maintaining appropriate water temperatures; stabilizing stream channels and banks; providing inputs of large woody debris (LWD); regulating stream velocity; storing, conserving and purifying water; providing nutrient inputs and cycling; and providing and maintaining migratory habitat (Cummins 1974, Harmon et al. 1986, Beschta 1978, Sullivan et al. 1987, Debano and Schmidt 1990, Meehan and Bjornn 1991, Swanston 1991). LWD inputs from riparian areas provide complex stream structure, including pools and riffles, and cover for hiding and escape. Riparian areas such as side channels, backwater wetlands, and floodplains also provide invaluable rearing, hiding, cover, and escape habitat for juvenile salmon.

Riparian areas are not just valuable as fish and wildlife habitat; they provide important water quality, flood control, recreation, and aesthetics functions for people as well. Functioning riparian areas can filter 40 to 90 percent of organic debris and environmental pollutants from surface water before the pollutants enter stream channels (Lowrance et al. 1984, Rhodes et al. 1985). The natural water quality functions provided by riparian areas can reduce contamination and ease our reliance on water quality treatment facilities. When flood waters move through riparian areas, vegetation slows stream water velocity, and the slowed flood waters deposit sediment loads and infiltrate soils. Because functioning riparian areas retain flood waters and reduce their velocity and erosive forces, these areas protect downstream communities from flooding and streambank erosion, and minimize flood damage to structures and other assets such as cropland (Griggs 1984, Roseboom and Russell 1985, Booth 1991).

In addition to their functions for people (protecting water quality and preventing floods), riparian areas also provide financial benefits by supporting recreational opportunities such as hunting and fishing (Theurer et al. 1985). Other recreational activities supported by functioning riparian habitat include hiking, bird watching, camping, and tourism (Knutson and Naef 1997).

7.2 Identification and Classification

Of the fish and wildlife habitat conservation areas identified in WAC 365-190-130, the following are applicable to the City and must be considered for classification and designation:

- **Areas endangered, threatened, and sensitive species have a primary association, including federal and state species, and state priority habitat areas associated with state priority species.** Determinations of state and federally listed species are made (by mandate of the WAC and the Endangered Species Act [ESA], respectively) solely on the basis of the best scientific and commercial data available. Thus, the protection of these species, by nature of their designation, is rooted in BAS. Federally listed threatened, endangered, sensitive, and candidate species are determined by the U.S. Fish and Wildlife Service (USFWS) and National Oceanic and Atmospheric Administration NOAA Fisheries Service (NOAA Fisheries). State listed threatened, endangered, and sensitive species are determined by WDFW. In 2018, WDFW revised its 2008 Priority Habitats and Species List. The list is a catalogue of habitats and species considered by the state to be priorities for conservation and management. Furthermore, both the USFWS and NOAA Fisheries have developed rigorous species assessments in order to collect data about a given species. The data includes, but is not limited to, information about the life history, biology, population structure and abundance, and threats and vulnerability to the species. In addition to aiding in the determination of species listings, the information collected in these assessments is used to support and advise on policy and management recommendations. As their designations and protection are rooted in BAS, individual species are not discussed in detail in this report.

WDFW's PHS on the Web database identifies species found in the state that are listed by the federal and state governments. Per the database, several listed species are associated with the East Fork Lewis River, and state priority habitats, including oak woodlands, are located within the City's boundaries. WDFW also maps a "biodiversity corridor," the East Fork Lewis River riparian corridor, within the City. The corridor lies along the East Fork Lewis River and Brezee Creek.

- **Habitats and species of local importance, as determined locally**. This category would include heritage tree sites, which the City currently identifies and protects under the LCMC 18.350.110. In determining habitats and species of local importance, jurisdictions should consider areas important for local and ecoregional biodiversity. The PHS data from WDFW should be considered as it provides BAS for threatened, endangered, and other vulnerable species and habitats. While these lists represent state priorities, they also provide valuable BAS relevant to the City's determinations of what is of local importance. WDFW also can assist in the identification of priority habitat areas on a smaller landscape scale. In addition, DNR can provide the City with a list of high quality ecological communities and systems and rare plants through the Natural Heritage Program.
- **Waters of the state**. Waters in the state are typically broken down into the categories (or "types") listed below. Water type maps are available through DNR's forest practices application mapping tool; however, jurisdictions should not rely on these maps alone when regulating land uses or establishing stream buffers, but should develop a process to verify actual stream conditions (WAC 365-190-130).
  - Type S waters are all waters, within their bankfull width, as inventoried as "shorelines of the state" under RCW Chapter 90.58 and the rules promulgated pursuant to Chapter 90.58, including periodically inundated areas of their associated wetlands. Type S shorelines are regulated under the City's shoreline master program (SMP) adopted in 2018. The East Fork Lewis River is the only Type S water within the City.
  - Type F waters are segments of natural waters that are not classified as Type S Waters and have a high fish, wildlife, or human use. These are segments of natural waters and the periodically inundated areas of their associated wetlands. Brezee Creek, Bolen Creek, and McCormick Creek are examples of Type F waters within the City.

- Type Np waters are all segments of natural waters within defined channels that are perennial non-fish-habitat streams. Perennial streams are waters that do not go dry at any time of a year of normal rainfall. However, for the purpose of water typing, Type Np Waters include the intermittently dry portions of the perennial channel below the uppermost point of perennial flow. There are unnamed tributaries to Breeze and McCormick creeks and the East Fork Lewis River that are Type Np waters. Field verification of all intermittent or non-fish-bearing streams should occur during the wet season (October to March) or as determined locally (WAC 365-190-130).
- Type Ns waters are all segments of natural waters within defined channels that are not Type S, F, or Np waters. These are seasonal, non-fish habitat streams in which surface flow is not present for at least some portion of a year of normal rainfall and are not located downstream from any stream reach that is a Type Np water. Ns waters must be physically connected by an aboveground channel system to a Type S, F, or Np water. There are unnamed tributaries to Breezee and McCormick creeks and the East Fork Lewis River that are Type Ns waters. Field verification of all intermittent or non-fish-bearing streams should occur during the wet season (October to March) or as determined locally (WAC 365-190-130).

- **Lakes, ponds, streams, and rivers planted with game fish by a governmental or tribal entity**. The presence of game fish may change as governments or tribal entities change their stocking and fisheries plans. The current status of a waterway's game fish should be verified through WDFW.
- **State natural area preserves, natural resource conservation areas, and state wildlife areas.** These areas are designated by the state and managed by DNR (natural area preserves, natural resource conservation areas), and WDFW (wildlife areas). While these areas are not currently present within the City limits, they are a designated fish and wildlife habitat conservation area, and it is possible that one could be established in the future as the result of a federal, state, or tribal entity action.

The WAC identifies the fish and wildlife habitat conservation areas described above for their intrinsic value and because they contribute to the state's biodiversity. Each of these areas is important to various ecosystems. In addition to the areas identified in the list, counties and cities must also give special consideration to the conservation or protection measures necessary to preserve or enhance anadromous fisheries (WAC 365-190-080). BAS regarding the protection of riparian and terrestrial habitats is discussed in the following section.

According to WDFW's "Management Recommendations," priority Oregon white oak woodlands are stands of pure oak or oak/conifer associations where canopy coverage of the oak component of the stand is ≥ 25 percent; or where total canopy coverage of the stand is < 25 percent but oak accounts for at least 50 percent of the canopy coverage present. In urban or urbanizing areas, single oaks, or stands of oaks 1 acre (< 0.4 hectare), may be considered priority habitat (Larsen and Morgan 1998).

7.3 Best Available Science for Fish and Wildlife Habitat Conservation Areas

The following sections discuss BAS for the protection of terrestrial habitats and riparian/in-stream (aquatic) habitats. While riparian habitat is technically a type of terrestrial habitat, it serves as a transition between upland and aquatic areas, and BAS for protection of riparian and aquatic go hand in hand; therefore, riparian and aquatic habitat are discussed together.

7.3.1 Terrestrial Habitats

BAS for protecting terrestrial habitats relies primarily on land use planning to protect and restore existing habitat areas. In 2009, WDFW published "Landscape Planning for Washington's Wildlife: Managing for Biodiversity in Developing Areas" (Azerrad 2009), a guidance document for landscape planning in urbanizing areas. This document identifies aspects of residential land development and uses that affect wildlife (e.g., clearing land for homes, replacing native vegetation with non-native species and lawns), and impact and mitigation considerations at the site scale and at the watershed scale. The document should be referenced as a guiding document for use in the development of critical area reports and identifying appropriate protection and mitigation efforts.

"Landscape Planning for Washington's Wildlife" defines habitat connectivity as "the degree to which habitat patches in the landscape are connected and can facilitate movement of animals." Within urban areas, such as La Center, terrestrial habitats are often scattered or fragmented by development. Fragmentation of habitat reduces the ability of species to migrate from natural areas outside of the City.

Two examples of existing terrestrial habitat corridors in the City are the East Fork Lewis River Riparian Corridor (designated by WDFW) and the East Fork Lewis River Greenway. Both provide habitat connectivity through the City, and BAS recommends focusing on protecting large, connected patches of open space within these corridors to facilitate their use by priority species (Azerrad 2009). Although not designated by WDFW, Bolen Creek is a potential terrestrial/riparian habitat corridor that traverses the City. The City continues to protect tracts of land along the creek as part of the community trail system, and this in turn creates a wildlife corridor providing habitat connectivity along Bolen Creek. WDFW recommends watershed-level planning efforts to prioritize conservation efforts within biodiversity corridors.

In addition to protecting habitat connectivity on a larger scale, existing areas of priority habitats should be protected where they currently exist, such as the Oregon white oak stands identifies by WDFW. The BAS for Oregon white oak consists primarily of maintaining and protecting existing stands of trees, and encouraging the planting of new oak trees where feasible. WDFW's management recommendations for the Oregon white oak (Larsen and Morgan 1998) consist of the following:

- Designate large, contiguous oak and oak/conifer stands as critical areas. Oak habitat presently in good condition should receive the highest priority for protection.
- Large oaks (> 20-inch [50 cm] diameter at breast height [dbh]), medium oaks (> 12-inch [30 cm] dbh), older oaks, and oaks with well formed, dominant crowns, should be retained wherever oak enhancement activities occur. Very large oaks are rare and should be retained at the cost of efficient oak regeneration directly under their canopies.
- Mixed oak/conifer associations should be retained where contiguous aerial pathways between oaks and conifers exist.
- Remaining oak stands > 1 acre (0.4 hectare) west of the Cascades and > 5 acres (2.0 hectares) east of the Cascades should be maintained or enhanced, regardless of age-class or composition of the stand. Specifically, maintain 25 to 50 percent canopy cover of Oregon white oaks in oak woodland stands.
- In oak savannas (i.e., stands with < 25 percent total canopy cover), maintain the oak component at ≥50 percent of the canopy cover present. In urban and urbanizing areas, single trees or small patches of oaks should be maintained if they are deemed important to species highly associated with Oregon white oak.
- Oregon white oak woodlands should not be clearcut, removed, replaced, or patch-cut unless these activities are inherent to the functional maintenance or enhancement of oak habitat.

One way for jurisdictions to protect existing native vegetation and the species that rely on it, is to manage and control invasive species on a local level. Resources for the identification of these species and site-specific control recommendations may be found through Clark County Vegetation Management, WSU Clark County Extension, and the National Invasive Species Information Center.

7.3.2 Riparian and In-Stream Habitats

The Aquatic Habitat Guidelines are technical guidance documents and white papers from WDFW. While originally created to protect and restore salmonid habitat, the scope of the program was broadened to include the protection and restoration of freshwater and riparian habitats through management of activities affecting aquatic and riparian ecosystems. Recent updates include:

- Land Use Planning for Salmon, Steelhead and Trout: A land use planner's guide to salmonid habitat protection and recovery (Knight 2009)
- Stream Habitat Restoration Guidelines (Cramer 2012)
- Water Crossing Design Guidelines (Barnard 2013)

The aquatic habitat guideline documents may be referenced as guiding documents for use in the development of critical areas reports and identifying appropriate protection and mitigation efforts.

Protecting riparian habitat areas meets several of the goals and policy recommendations of WAC 365-190-130. Although there is widespread agreement within the scientific community that restricting the use of riparian habitats is necessary to maintain their functions and values, there is less agreement regarding the width of riparian areas that is necessary to preserve their functions or what kind of activities are compatible with riparian habitat (Knutson and Naef 1997).

Generally, recommendations include limiting or restricting activities that may affect riparian areas negatively; examples include tree and vegetation removal, road building, agriculture and grazing, and clearing and earth moving for development (Knutson and Naef 1997). There is limited specific information regarding the level of development or activity a riparian area can withstand, and while they provide similar functions, all riparian areas are different, and support different communities of species; therefore, WDFW recommends a conservative approach to riparian habitat protection.

To protect the functions and values of riparian areas, WDFW recommends designating riparian areas that are wide enough to allow proper functioning of riparian and aquatic ecosystems, including protection of instream habitat through temperature and sediment control, preservation of fish and wildlife habitat, and connectivity between aquatic, riparian, and upland habitats. The goal of this recommendation is to protect the full range of riparian functions, not just instream habitat by buffering adjacent, more upland uses. Existing recommendations for riparian habitat protection generally apply to individual functions and thus vary widely. WDFW-published literature showed that widths recommended for riparian areas that address the full range of ecological functions necessary to support fish and wildlife ranged from just 10 feet, to more than 650 feet.

To provide a basis for planning and evaluating specific site conditions, WDFW developed recommendations for standardized widths of riparian habitat areas to protect the full array of riparian habitat functions. These recommended widths were developed by evaluating existing studies that examined individual functions within riparian areas and the widths necessary to support them, and then evaluating the average range of riparian habitat area widths by grouped functions. These recommendations are shown in the table below; it should be noted that these standard riparian habitat widths were developed using a stream type classification that is no longer used by WDFW, the DNR, or the WAC. The new system of stream typing is shown in parentheses. Where the 100-year floodplain exceeds these widths, WDFW notes that the riparian habitat area should extend to the outer edge of the 100-year floodplain, as this area has elements of both aquatic and upland ecosystems which influence each other, and therefore meets the definition of riparian habitat.

Table 1. WDFW-Recommended Widths of Riparian Habitat Areas

Stream Type	WDFW-Recommended Riparian Habitat Area Widths (Feet)
Shorelines of the State, Shorelines of Statewide Significance (Type S)	250
Other perennial or fish bearing streams 5-20 ft (1.5-6.1 m) wide (Type F)	200
Other perennial or fish bearing streams <5 ft (1.5m) wide (Type F)	150
Intermittent streams and washes with low mass wasting* potential (Type Np and Type Ns)	150
Intermittent streams and washes with high mass wasting* potential (Type Np and Type Ns)	225

* Mass wasting is a general term for a variety of processes by which large masses of rock or earth material are moved downslope by gravity, either slowly or quickly.

It should be noted that WDFW is in the process of releasing a new volume of management recommendations for riparian ecosystems (Windrope et al. 2018). The public comment period on the draft document ended 17 August 2018, and a public review draft dated May 2018 is currently available, but the report has not yet been finalized or adopted by WDFW. Based on a conversation with BergerABAM, WDFW indicates the document is likely to be finalized in June, 2019. Once published, the final report will be considered the BAS for management of riparian habitat, including potential changes to recommended riparian habitat buffers. Since La Center is expected to adopt an updated CAO by March or April, 2019, the new management recommendations would not be effective and would not be considered BAS until after the code update is complete. A summary of the draft management recommendations follows.

According to the draft management recommendations (May 2018), the riparian management zone (RMZ) in areas of the state that currently or historically supported forests is defined as the distance of one site-potential tree height (SPTH), where the SPTH is the average maximum height attained by dominant trees at 200 years of age, measured from the edge of the active channel or channel migration zone (CMZ), whichever is wider. The RMZ describes the area that has the potential to provide full riparian function, regardless of its current conditions. Measuring the RMZ width at the outer edge of the CMZ ensures that when the stream migrates, it will still be adjacent to the zone of influence that can provide riparian function (Windrope et al. 2018). Appendix A2 of the draft management recommendation provides SPTH histograms by county for the state of Washington. According to Figure A2-4, the average SPTH for Clark County is 235 feet.

Pending management recommendations for riparian ecosystems include delineating the RMZ as described above, considering current conditions when reviewing regulations with the ultimate goal of maintaining remaining functions through regulations, improving functions through voluntary restoration, and maintaining and enhancing connectivity laterally along the stream. Areas closer to the stream provide the greatest conservation benefit and should be prioritized for preservation, replanting, or restoration. Using low impact development techniques to better manage stormwater, and adopting a stormwater design manual equivalent to Ecology's most current version of *Stormwater Management Manual for Western Washington* are also recommended (Windrope et al. 2018).

Protecting functions within the RMZ is a scientifically supported approach if the goal is to protect and maintain high or full functions of the riparian ecosystem for aquatic habitat and species, including salmon. Protecting all riparian ecosystem functions within the RMZ is recommended. Areas closer to the stream have potential to provide a higher level of function than those further from the stream on a per area basis, generally meaning that the same disturbance to an outer portion of the RMZ reduces riparian function less than disturbance to the inner portion of the RMZ. The currently suggested widths for riparian habitat areas are based on a synthesis of existing science. WDFW indicates that local habitat conditions and factors, as well as resident species, should be considered when evaluating the standard widths of riparian habitat areas. WDFW also suggests requiring wider riparian areas where priority species occur (especially those that require greater or specific habitat areas), where there is high potential for tree blowdown, and where unstable slopes adjoin streams.

The East Fork Lewis River supports several threatened and endangered fish species, including steelhead (*Oncorhynchus mykiss*), Chinook (*Oncorhynchus tshawytscha*), and coho (*Oncorhynchus kisutch*). The river and several of its tributaries (including Jenny Creek and Brezee Creek) are listed on the state's polluted waters list for high water temperatures and fecal coliform bacteria. Improving these deficiencies is important because high levels of bacteria increase risks for humans and other species, and high temperatures create poor conditions for fish and other wildlife that rely on the river and tributaries for habitat and migration.

Because of its listing on the polluted waters list, Ecology is in the process of developing a water cleanup plan (alternatively known as a Total Maximum Daily Load or TMDL) for the East Fork Lewis River. In order to initiate this planning process, Ecology completed a source assessment report for the river in May 2018 (McCarthy 2018). The report analyzed water quality data, developed an inventory of the watershed, provided general implementation recommendations to improve water quality, and identified critical areas to address temperature and bacteria issues.

In conjunction with the source assessment report, the East Fork Lewis River Partnership was established comprising local, state, tribal, and federal governments; non-profits; private industry; and landowners. The partnership is holding a series of meetings, and will develop the water cleanup plan for the river by summer 2019. The plan will include a project list to address bacteria and temperature. While the cleanup plan will provide specific recommendations that should be used as BAS for protecting the river and its tributaries, the source assessment report includes general implementation recommendations that can be used until the publication of the cleanup plan. The recommendations in the source assessment report include but are not limited to:

- Implement BMPs to reduce fecal coliform loading from agricultural land into waters.
- Continue management of stormwater through appropriate BMPs to reduce water quality impacts at Brezee Creek stormwater outfalls, particularly during the wet season.
- Conduct investigative stream walks along tributaries to identify and sample unknown or unmapped outfalls (e.g., pipes and culverts), including stormwater outfalls.
- Continue to increase native vegetation plantings on streambanks to increase riparian shade. Focus these restoration activities in areas with large shade deficits in the middle watershed, as determined through the shade analysis.
- Protect and restore natural floodplains, riparian habitats, and microclimate enhancements that increase the number of cold water refuges available and improve the overall habitat quality for salmonids and other fish species.

WAC 365-190-130 notes that cities may review species recovery plans in order to help identify local habitats with primary association for a priority species. The Lower Columbia Fish Recovery Board serves as the state’s Regional Salmon Recovery Board for Clark County. The Board was created under RCW 77.85, which recognizes the Board as a regional organization. Recovery reports published by the Board that are pertinent to La Center include the East Fork Lewis River Basin Habitat Assessment (Johnston 2005) and the Lower East Fork Lewis River Habitat Restoration Plan (East Fork Lewis Working Group 2009). These reports include site assessment (and some field verification) on a more local scale.

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Appendix A
Best Available Science Sources

BEST AVAILABLE SCIENCE SOURCES

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