

**This document provides a summary of Best Available Science documents reviewed to date to update the critical areas ordinance (CAO).**

### I. AQUIFER RECHARGE AREAS

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Guidance pertaining to the delineation of critical aquifer recharge areas has been prepared by the state.

The most recent scientific studies pertaining to the hydrogeology of the Island's aquifer system to include extents, recharge areas, and system susceptibility have been prepared by licensed consultants and the U.S. Geological Survey.

Other sources of information include the Kitsap Public Health District's Group A & B water system inventories, Ecology's contaminated sites inventories, City of Bainbridge Island land use and zoning maps, and City of Bainbridge Island Groundwater Management Program aquifer system safe yield and seawater intrusion early warning level assessments.

#### General Guidance Document

**Critical Aquifer Recharge Areas Guidance Document (Washington State Department of Ecology Publication #05-10-028, Olympia, WA, January 2005).** This guidance document helps local jurisdictions and the public understand what is required for the protection of local groundwater resources under the Growth Management Act. It includes guidance for planning, ordinances, and for including the Best Available Science as these relate to Critical Aquifer Recharge Areas.

#### Delineation and Categorization

**Conceptual Model and Numerical Simulation of the Groundwater-Flow System of Bainbridge Island, Washington (U.S. Geological Survey Science Investigations Report 2011-5021, Reston, VA, 2011).** This document describes the hydrogeology of the Bainbridge Island aquifer system to include aquifer extents, recharge rates, groundwater elevation, and groundwater flow direction. This document also describes the development and use of the Island's numerical groundwater model and projected aquifer system responses to potential growth and land use modifications.

**Ground Water Numerical Model Initial Scenario Selection Report (Prepared by City of Bainbridge Island Department of Public Works-Water Resources and Department of Planning & Community Development, Bainbridge Island, WA, September 2009).** Describes the methodology and supporting population and land use data behind the development of the initial scenarios run by the U.S. Geological Survey as part of the development and initial use of Bainbridge Island's numerical groundwater model. Specifically, this report defines land use intensity categorization (by % impervious cover).

**Hydrogeologic Framework, Groundwater Movement, and Water Budget of the Kitsap Peninsula, West-Central Washington (U.S. Geological Survey Science Investigations Report 2014-5106, Reston, VA, 2011).** This document presents information used to characterize the groundwater-flow system on the Kitsap Peninsula including Bainbridge Island, and includes descriptions of the geology and hydrogeologic framework, groundwater recharge and discharge, groundwater level and flow directions,

seasonal groundwater-level fluctuations, and interaction between aquifer and the surface-water system and a water budget. This study provided updated aquifer recharge rates for Bainbridge Island.

**Bainbridge Island Groundwater Model: Review Findings and Recommendations (Task 2) and Critical Aquifer Recharge Area Assessment (Task 3 Scenario) (Aspect Consulting, LLC, Bainbridge Island, WA, December 2015).** This technical memorandum describes a technical review and recalibration and validation of the Island's numerical groundwater model, provides both implemented and yet-to-be recommendations to update and improve the Island's groundwater model and describes the findings of the critical aquifer recharge area assessment. This study identified both shallow and deep aquifer recharge areas.

**Bainbridge Island Groundwater Model: Aquifer System Carrying Capacity Assessment (Task 3 Scenario) (Aspect Consulting, LLC, Bainbridge Island, WA, March 2016).** This technical memorandum describes the findings from the aquifer system carrying capacity assessment using the updated Bainbridge Island numerical groundwater model to include projected growth and climate change impacts to recharge, groundwater levels, drainage to surface waters, and seawater intrusion.

**Task 1 – Hydrogeological Assessment of Groundwater Quantity, Quality and Production (Aspect Consulting, LLC, Bainbridge Island, WA, December 2015).** This technical memorandum describes the current quality and quantity conditions of Island's groundwater resources.

#### Sole Source Aquifer Designation

**Support Document for Sole Source Aquifer Designation of the Bainbridge Island Aquifer System (DRAFT) (U.S. EPA - Region 10, Seattle, WA, March 2012).** This document summarizes readily available information and describes the technical and legal basis for the Bainbridge Island aquifer system Sole Source Aquifer designation.

#### Low Impact Development and Native Vegetation Retention (partial list)

AHBL 2012. Integrating LID into Local Codes: A Guidebook for Local Governments. Prepared by AHBL for the Puget Sound Partnership. Tacoma, Washington.

Alberti, M., D. B. Booth, K. Hill, B. Coburn, C. Avolio, S. Coe, and D. Spirandelli. 2007. *The impact of urban patterns on aquatic ecosystems: an empirical analysis in Puget lowland sub-basins: landscape urban planning. Landscape and Urban Planning* 80: 345-361.

Berland, A., et al. 2017 *The role of trees in urban stormwater management. Landscape and Urban Planning* 164: 167-177.

Booth, D. B. 1991. *Urbanization and the natural drainage system--impacts, solutions, and prognoses. Northwest Environmental Journal* 7: 93-118

Booth, D.B. 2000. *Forest cover, impervious-surface area, and the mitigation of urbanization impacts in King County, Washington.* King County Water and Land Resources Division, Seattle, Washington.

Booth, D.B. and L.E. Reinelt 1993. *Consequences of urbanization on aquatic systems – measured effects, degradation thresholds, and corrective strategies*. King County Surface Water Management Division, Seattle, Washington.

Booth, D. B., and C. R. Jackson. 1997. *Urbanization of aquatic systems--thresholds and the limits of mitigation*. *Journal of the American Water Resources Association* 33: 1077-1090.

Brabec, E., et al. 2002. *Impervious surfaces and water quality: A review of current literature and its implications for watershed planning*. *Journal of Planning Literature* 16(4): 499-514

Cappiella, K., Wright, T., Schueler, T. 2006. *Urban Watershed Forestry Manual. Part 2: Conserving and Planting Trees at Development Sites*. Center for Watershed Protection, Ellicott City, MD.

Cappiella, Schueler, T., Wright, T. 2005. *Part 1: Principles of Urban Watershed Forestry*. USDA, Forest Service, Northeastern Area, State and Private Forestry.

Center for Watershed Protection 2016. *Review of the Available Literature and Data on the Runoff and Pollutant Removal Capabilities of Urban Trees*. A Synthesis Report submitted by the Center for Watershed Protection to the US Forest Service.

Center for Watershed Protection 1998. *Better Site Design: A Handbook for Changing Development Rules in Your Community*. Prepared for the Site Planning Roundtable. Elliot City, Maryland.

May, Christopher n.d. *Watershed processes and aquatic resources: a literature review*. Urban Watersheds, Drainage and Wastewater, Seattle Public Utilities, Seattle, Washington.

May, C & R. Horner, R & Karr, James & W Mar, B & B. Welch, E. 1997. *Effects of Urbanization on Small Streams in the Puget Sound Lowland Ecoregion*. Watershed Protection Techniques.

McBride, M., and D. B. Booth. 2005. *Urban impacts on physical stream conditions: effects of spatial scale, connectivity, and longitudinal trends*. *Journal of the American Water Resources Association* 41: 565-580

Puget Sound Partnership and Washington State University Extension 2012. *Low Impact Development Technical Guidance for Puget Sound*. Publication No. PSP 2012-3.

## II. FISH AND WILDLIFE HABITAT CONSERVATION AREAS (FWHCA)

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Most documents related to FWHCAs have been prepared by Washington Department of Fish and Wildlife (WDFW). Other sources, largely Bainbridge-based, as well as legislative changes were also reviewed.

### WDFW Documents and Programs

**Priority Habitats and Species Program (PHS).** WDFW updated its PHS list in 2008. The new list should be referenced where appropriate and used to clarify Class I and Class II FWHCA. In addition, designating

biodiversity areas and corridors may be considered. Note: The Bald Eagle was removed from the federal Endangered Species List in 2007; but the species remains classified as a State Sensitive species by WDFW.

**Landscape Planning for Washington's Wildlife: Managing for Biodiversity in Developing Areas (Washington Department of Fish and Wildlife, Habitat Program, Olympia, WA, December 2009).** This document gives examples of stressors linked to residential land uses that influence wildlife, considerations for developing Habitat Management Plans (HMP) at the site-scale and planning at the

watershed-scale. This document may be a required reference for HMPs and/or development standards for PHS biodiversity areas and corridors.

**Management Recommendations for Washington's Priority Habitats.** This is a series of documents that provides recommendations for protection and management of habitat of priority species. HMPs are currently required to use these management recommendations. Updated management recommendations for the Great Blue Heron were published in 2012.

**Fish Passage Program.** WDFW maintains a centralized database of fish passage, diversion screening, fish use, and habitat information from inventory efforts conducted throughout Washington State. WDFW's Fish Passage and Diversion Screening Inventory (FPDSI) database is a main data source for planning fish passage projects. The map application shows human-made barriers where a fish passage barrier inventory has been conducted.

### **Aquatic Habitat Guidelines**

### **Stream Habitat Restoration Guidelines**

### **Water Crossing Design Guidelines**

These documents provide support for the existing CAO and could be used to update development standards.

### *Other Sources and Legislative Changes*

**Wild Fish Conservancy Water Type Assessment Project Summary – West Sound Watersheds Phase III Report (Wild Fish Conservancy, Duvall, WA, September, 2016).** Wild Fish Conservancy (WFC) conducted water type surveys using state-sanctioned protocols to accurately map previously unmapped and incorrectly mapped water courses and generate species-specific distribution data to assist with restoration project identification and prioritization efforts. This stream data was added to the City's GIS for use and support of planning and permitting activities.

**State of the Island's Waters (Prepared by Cami Apfelbeck, Department of Public Works, City of Bainbridge Island, July 2012).** Describes the surface water resources of Bainbridge Island, summarizes observed pollutants and common sources and reviews general water quality concerns.

**Stream Benthos and Hydrologic Data Evaluation for the City of Bainbridge Island (Prepared by Curtis DeGasperis and Chris Gregersen, Water and Land Resources Division, Seattle, WA, 2015).** This document is an in-depth assessment of the City's continuous flow and stream benthic

macroinvertebrate monitoring data using metrics researched and developed over the last 15 years by King County's Department of Natural Resources and Parks – Water and Land Resources Division.

**Springbrook Creek Watershed Study:** A watershed-scale assessment to identify and develop conceptual designs for future salmon habitat improvement and protection which may include removing fish passage barriers, enhancing riparian habitat, returning the stream to historical flow channels, and protecting intact habitat through acquisition or conservation.

**WAC 365-190-130** was added in 2010 to address and amend prior regulations on fish and wildlife habitat conservation areas. Applicable changes will be included in the CAO update.

### III. FREQUENTLY FLOODED AREAS

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Local governments must address flood-prone areas under two separate statutes: The GMA and the Floodplain Management Statute. A Floodplain Management ordinance under chapter 86.16 RCW is necessary for a city to qualify for FEMA's National Flood Insurance Program (NFIP). If all of a local government's floodplain management issues are adequately addressed in its floodplain management regulations, then the frequently flooded areas chapter may incorporate the floodplain management regulations by reference. The City's floodplain management regulations are contained in BIMC 16.15, Flood Damage Prevention. The City updated its FEMA floodplain maps and corresponding regulations in January, 2017 (Ordinance 2017-04). This update was reviewed by FEMA and Ecology. Both agencies found the revisions bring the City into compliance with federal and state floodplain regulations.

The CAO update will adopt by reference BIMC 16.15 to meet the requirements regarding designation and mapping as well as standards for habitat protection included in the FEMA Puget Sound Biological Opinion on the NFIP.

### IV. GEOLOGICALLY HAZARDOUS AREAS

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The most noteworthy new science applicable to geologically hazardous areas in the City is the availability of 2015 LiDAR (light detection and ranging) imagery. The City's technical consultant is using this imagery to update the GIS data layer for landslide hazard areas.

The United States Geologic Society (USGS) and Washington Department of Natural Resources (DNR) have updated mapping applications and web tools. These are useful resources but do not require revisions to current critical areas regulations.

In general, the City currently regulates geologically hazardous areas consistent with BAS and WAC guidance; however, the City's technical consultant has recommended several changes to landslide hazard regulations to improve clarity and ease of administration. The changes are consistent with the technical consultant's review of BAS and regulations in other Western Washington jurisdictions. Additionally, WAC guidance provides that critical facilities should be restricted in hazard zones.

## V. WETLANDS

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The most recent documents pertaining to wetlands have been prepared by state and federal agencies describing general guidance for CAO updates, new methodologies for identifying and characterizing wetlands, buffer effectiveness and new approaches to mitigation.

### General Guidance Documents

**Wetland Guidance for CAO Updates, Western Washington Version (Washington State Department of Ecology Publication #16-06-001, Olympia, WA, June 2016).** This document replaces *Wetlands & CAO Updates: Guidance for Small Cities*, originally published in 2010 and revised in 2012. This new Ecology

guidance document will be used to update regulations related to the updated 2014 rating system, updated definitions, buffer tables, small wetlands and agricultural activities.

**Wetlands in Washington State, Volume 1: A Synthesis of the Science (Washington State Department of Ecology Publication #05-06-006, Olympia, WA, March 2005).** This volume is the result of an extensive search of over 17,000 scientific articles and synthesizes over 1,000 peer-reviewed works relevant to the management of Washington's wetlands. This document was the primary source of best available science used in the 2005 CAO update. Proposed revisions should be consistent with the science in this document unless specifically updated in other, more recent documents.

**Wetlands in Washington State, Volume 2: Managing and Protecting Wetlands (Washington State Department of Ecology Publication #05-06-008, Olympia, WA, April 2005).** This volume contains guidance on protecting and managing wetlands and their functions based on the synthesis of the science provided in Volume 1, including recommended buffer strategies. Appendix 8-C, providing options for buffer strategies, was revised in October 2014.

### Delineation and Categorization

**Washington State Wetland Rating System for Western Washington: 2014 Update (Washington State Department of Ecology Publication #14-06-29, Olympia, WA, October 2014).** The current CAO uses the 2004 State Rating System, or as amended, to categorize wetlands for the purposes of establishing wetland buffer widths, wetland uses and replacement ratios for wetlands. The City formally adopted the 2014 update in June 2016. The update of the rating systems incorporates "lessons learned" from using the rating system for 10 years and provides a more accurate rating of the functions and values of a wetland. While Ecology updated the rating system, it is not proposing any changes to recommended buffer widths; however, the City's CAO will be updated to reflect the changes made to the wetland scoring system.

**Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Western Mountains, Valleys, and Coasts (Corps, 2010).** The regional supplement updates portions of the 1987 Corps' Wetland Delineation Manual and provides additional technical guidance and updated procedures for identifying and delineating wetlands. State law requiring the Washington State Wetlands Identification and Delineation Manual (Ecology, 1997) was repealed in 2011. The Regional Supplement is now required by state law (WAC 173-22-035).

### Mitigation

**Wetland Mitigation in Washington State – Part 1: Agency Policies and Guidance (Version 1) (Washington State Department of Ecology Publication #06-06-011a, Olympia, WA, March 2006).** Part 1 provides a brief background on wetlands, an overview of the factors that go into the agencies' permitting decisions, and detailed guidance on the agencies' policies of wetland mitigation, particularly compensatory mitigation. It outlines the information the agencies use to determine whether specific mitigation plans are appropriate and adequate.

**Wetland Mitigation in Washington State–Part 2: Developing Mitigation Plans (Version 1) (Washington State Department of Ecology Publication #06-06-011b, Olympia, WA, March 2006).** Part 2 provides

technical information on preparing plans for compensatory mitigation. Some of this information has been superseded by more recent guidance discussed below however, wetland mitigation ratios listed in this document were the basis for the City's wetland mitigation ratios.

**Selecting Wetland Mitigation Sites Using a Watershed Approach (Washington State Department of Ecology Publication #09-06-032, Olympia, WA, December 2009).** Provides guidance on selecting off-site mitigation sites.

**Interagency Regulatory Guide: Advance Permittee-Responsible Mitigation (Washington State Department of Ecology Publication #12-06-015, Olympia, WA, December 2012).** Use of this document can be referenced and encouraged; however, advance mitigation is uncommon within the city.

**Calculating Credits and Debits for Compensatory Mitigation in Wetlands of Western Washington (Washington State Department of Ecology Publication #12-06-015, Olympia, WA, December 2012).** This document describes Ecology's newest methodology for estimating whether a project's compensatory mitigation plan adequately replaces lost wetland functions and values using a functions and values-based approach to score functions lost at the project site (i.e., "debits") compared to functions gained at a mitigation site (i.e., "credits"). Use of the method can be encouraged.

### Buffer Effectiveness

**Update on Wetland Buffers: The State of the Science (Washington State Department of Ecology Publication #13-06-011, Olympia, WA, October 2013).** This document provides new information on buffers and revisits the conclusions and key points in the 2005 synthesis (see Wetlands in Washington State, Volume 1: A Synthesis of the Science, above).