

Riverine Flooding: An Introduction

What is riverine flooding?

How may riverine flooding affect me?

How much riverine flooding should I expect, and when?

Why should I care now?

What can I do about it?

Where can I learn more about riverine flooding in Washington?

Flood events can impact small or large areas, from a single section of road to entire towns and river valleys. Many coastal towns in Washington are built in the floodplains of rivers, so it is important to learn where rivers flowed before your town was built.

Riverine flooding can combine with coastal flooding, which will occur more often as sea levels rise. Like coastal flooding, the probability of riverine flooding is described by “recurrence intervals.”

Prepare for riverine flooding:

- **Understand where drainage bottlenecks occur and where rivers are impacted by tides.**
- **Support local coastal planning efforts.**
- **Adapt your project to combined impacts from riverine and coastal flooding.**

What is riverine flooding?

When the volume of water in a waterway (creeks, rivers or constructed channels) exceeds the waterway's capacity, it will overflow the waterway's banks. Areas which are usually dry can then become flooded.

Some floods develop slowly, while others such as flash floods can develop in just a few minutes and without visible signs of rain. Additionally, floods can be local or very large - impacting a neighborhood, community or an entire river basin. Floods often occur at bends, meanders, or low points along waterways.

There are three general types of floods: coastal, riverine, and pluvial floods. Pluvial floods (stormwater and surface water) are grouped here, as they bear similarities to riverine flooding – especially in areas where floodplains have been replaced by impervious surfaces. Coastal floods are described separately, but can combine with riverine and pluvial floods to increase the height, spread, and duration of flooding.



Flooding in Hoquiam, which lies at the confluence of the Hoquiam and Chehalis Rivers (source: mynorthwest.com).

How may riverine flooding affect me?

Flooding (<https://mil.wa.gov/flood>) is the most prevalent natural hazard facing Washington state residents — and the most expensive. Floods can cause loss of life and damage to structures, crops, land, flood control structures, roads, utilities and more. Floods can also cause erosion and landslides, and can transport debris and toxic products that cause secondary damage.



SR 4 west of Naselle is closed between US 101 & SR 401 due to a collapsed culvert (source: mynorthwest.com).

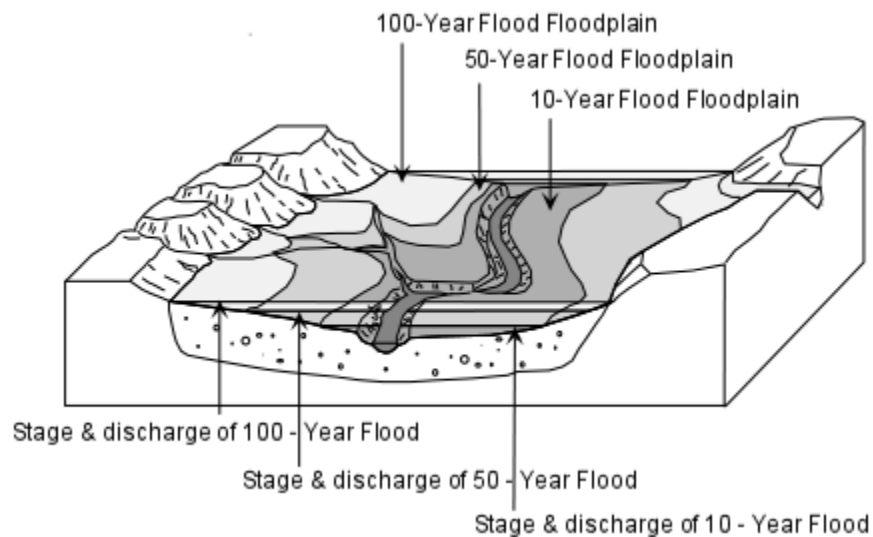
How much riverine flooding should I expect, and when?

Washington has a long history of damaging floods, with 32 Presidential Disaster Declarations over the last 60 years. Every county in the state has had a Disaster Declaration due to flooding. Although floods can happen at any time during the year, there are typical seasonal patterns for flooding in Washington State (<https://mil.wa.gov/flood>), based on the variety of natural processes that cause floods:

- Heavy rainfall on wet or frozen ground, before a snow pack has accumulated, typically causes fall and early winter floods.
- Rainfall combined with melting of the low-elevation snow pack typically causes winter and early spring floods.
- On rare occasions, summer thunderstorms embedded in winter-like rainstorms cause flash floods in Western Washington.

The height, spread and duration of the flood will depend on how much rain has fallen, how much snow pack has melted, how much area drains into the waterway, how steep the waterway is and how flat the land is on either side of the creek or river. For example, a steep waterway with little drainage area may produce small floods which quickly rise and fall. Impervious surfaces and development in floodplains can drastically increase the amount of flooding that an area is subjected to.

The likelihood of flooding in your area can be described by “recurrence intervals.” Expressed as percentages, recurrence intervals describe the likelihood that water levels will reach a specific magnitude during a specific time range. These percentages are sometimes referred to in terms of years, such as the term “100-year flood.” This term means that there is a 1-in-100 (1%) chance that an extreme flood of this magnitude will happen in any given year. A “20-year flood” means that there is a 1-in-20 (5%) chance, and a “5-year flood” means that there is a 1-in-5 (20%) chance.



This conceptual diagram shows water levels (“stage & discharge”) for a 10-year flood, 50-year flood, and 100-year flood (source: Stephen A. Nelson, Tulane University).



The five most flood prone counties in Washington (source: washingtonnature.org).

Why should I care now?

Planning for riverine flooding can keep your community safe by identifying strategies to minimize flood exposure, increase protective measures and adapt existing structures. However, planning (and the projects it leads to) takes much time, so the time to act is now!

By considering which areas are susceptible to flooding, coastal communities can develop a diversified set of strategies to adapt to high waters such as: structural flood protection measures (e.g., dikes and levees), early warning systems, risk-informed land planning, nature-based solutions (e.g., natural floodplains, wetlands), and social protection and risk financing instruments (e.g., flood insurance). These strategies can make your community more resilient to flooding.

What can I do about it?

- Educate yourself:
 - Learn about flooding risks in our area, especially if your property is at low elevation and near a river, stream, or lake. The Washington Nature Conservancy has a map showing flood risk by county (<https://www.washingtonnature.org/flood-risk-infographic>) in Washington. Check out Emergency Management Division's Washington State Hazard Mitigation Plan Flood Profile. (<https://mil.wa.gov/asset/5ba41fc712fcd>)
 - Learn more about common riverine flooding triggers: rainfall, snow pack melt, thunderstorms. Check out USGS Flood Information website (https://www.usgs.gov/mission-areas/water-resources/science/usgs-flood-information?qt-science_center_objects=0#qt-science_center_objects) to discover real-time and historic flood data and scientific investigations.
 - Learn more about forward-thinking floodplain management (e.g., Floodplains by Design (<http://www.floodplainsbydesign.org/>)).
 - Learn about the latest coastal hazards science and risks via the Washington Coastal Hazards Resilience Network (<https://wacoastalnetwork.com/>) (this website!).

- Plan and Prepare:
 - Plan ahead – Have several days of emergency supplies, food, and water.
 - Have an evacuation route – Ensure that your route is away from streams that may carry landslides or debris flow. Do not assume that highways will always be safe.
 - Check out Washington Department of Health (<https://www.doh.wa.gov/Emergencies/BePreparedBeSafe/Floods>) and Emergency Management Division's (<https://mil.wa.gov/preparedness>) preparedness tips before, during, and after flooding events.
 - Contact local planners, planning commissions or Marine Resource Committees to share experiences, voice concerns, recommend that public projects account for hazards or attend a public meeting. (<https://wacoastalnetwork.com/events/>)
 - Engage with local Shoreline Master Program (<https://ecology.wa.gov/Water-Shorelines/Shoreline-coastal-management/Shoreline-coastal-planning/Shoreline-Master-Programs>) or Comprehensive Plan (Growth Management Act) (<https://www.commerce.wa.gov/serving-communities/growth-management/periodic-update/>) updates to encourage wise planning for the future.

- Adapt your project to riverine flooding:
 - Consider riverine flooding early in a project, when new permits are required, during renovations or during repairs.
 - Visit the Washington Coastal Hazards Risk Reduction Project Examples Mapper (<https://waecy.maps.arcgis.com/apps/Shortlist/index.html?appid=58bac8d897ea48559d624eb06836a0d2>) to see how other people in Washington have adapted to coastal hazards or connect with an expert (<https://wacoastalnetwork.com/chrn/other-projects/connect-with-a-chrn-member/>) via the Washington Coastal Hazards Resilience Network.

This document was produced as part of the Washington Coastal Resilience Project, working to increase the state's capacity to prepare for coastal hazards related to sea level rise. The project was led by the Washington State Department of Ecology and Washington Sea Grant, with funding provided by NOAA Regional Coastal Resilience Grants Program (grant #NA16NOS4730015)