Appendix F: Water Resources Technical Appendix

For Programmatic Environmental Impact Statement on Green Hydrogen Energy Facilities in Washington State

By

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For the

Shorelands and Environmental Assistance Program

Washington State Department of Ecology

Olympia, Washington

January 2025

DEPARTMENT OF ECOLOGY
State of Washington

Table of Contents

List of Figures and Tables

Figures

Tables

Acronyms and Abbreviations List

AF	acre-feet
BESS	battery energy storage system
BMP	best management practice
CFR	Code of Federal Regulations
CAO	Critical Area Ordinance
CARA	critical aquifer recharge area
CLOMR	Conditional Letter of Map Revision
CWA	Clean Water Act
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
FEMA	Federal Emergency Management Agency
FWPCA	Federal Water Pollution Control Act
HPA	Hydraulic Project Approval
HUC	hydrologic unit code
kg	kilogram(s)
LOMR	Letter of Map Revision
NFIP	National Flood Insurance Program
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
PEIS	Programmatic Environmental Impact Statement
RCW	Revised Code of Washington
RSLR	relative sea-level rise
SEPA	State Environmental Policy Act
SLR	sea-level rise
SMR	steam-methane reforming
SSA	sole source aquifer
SWPPP	stormwater pollution prevention plan
TMDL	Total Maximum Daily Load
USACE	U.S. Army Corps of Engineers
USGS	U.S. Geological Survey
WAC	Washington Administrative Code
WDFW	Washington Department of Fish and Wildlife
WRIA	Water Resource Inventory Area

Summary

This technical appendix describes the water resources conditions in the study area. It also describes the regulatory context and potential impacts and actions that could avoid or reduce impacts.

The technical appendix analyzes the following key features:

- Surface water quantity and quality
- Groundwater quantity and quality
- Wetlands and associated regulatory buffers
- Floodplains and frequently flooded areas
- Water availability and water rights

A green hydrogen facility developer would need to ensure that there is sufficient water available for a project, both physically and legally. Water availability will vary based on the project and location. If water is needed for a project and is not available, a project would not be feasible.

Findings for water resources impacts described in this technical appendix are summarized as follows:

- Through compliance with laws and permits, and with implementation of actions that could avoid and reduce impacts, the construction, operation, and decommissioning of facilities would likely result in **less than significant impacts** on:
  - Surface water
  - Groundwater
  - Wetlands
  - Floodplains
  - Water availability or water rights
- Through compliance with laws and permits, and with implementation of actions to avoid and mitigate significant impacts, green hydrogen facilities would have **no significant and unavoidable adverse impacts** on water resources from construction, operation, or decommissioning.

1 Introduction

This technical appendix describes water resources within the study area and assesses potential impacts associated with types of green hydrogen facilities evaluated, and a No Action Alternative. Chapter 2 of the State Environmental Policy Act (SEPA) Programmatic Environmental Impact Statement (PEIS) provides a description of the types of facilities evaluated.

This section provides an overview of the aspects of water resources evaluated and lists relevant regulations that contribute to the evaluation of potential impacts.

1.1 Resource description

In this technical appendix, the term "water resources" refers to surface water and groundwater, wetlands, and floodplains and frequently flooded areas. Water quality, water quantity, and water availability and water rights are key features of water resources.

In the study area, the following resources could have impacts that overlap with impacts to water resources. Impacts on these resources are reported in their respective technical appendices:

- **Biological resources:** Use and function of waters and wetlands as habitat are addressed in the *Biological Resources Technical Appendix*.
- **Air quality and greenhouse gases:** Information from *Air Quality and Greenhouse Gases Technical Appendix* is used to address impacts to the water quality sub-element.
- **Earth:** Aspects related to water impacts from erosion, deposition, and subsidence sub-elements are discussed in the *Earth Resources Technical Appendix*.
- **Environmental health and safety:** The *Environmental Health and Safety Technical Appendix* addresses impacts to ground and surface water sub-elements due to hazardous materials.
- **Tribal rights, interests, and resources:** Aspects related to the Tribes' treaty rights, and their unique and powerful connection to and reliance on water resources are considered in the *Tribal Rights, Interests, and Resources Technical Appendix*.
- **Public services and utilities:** Analysis of water supply and demand may cross over with issues addressed in the *Public Services and Utilities Technical Appendix*.

1.2 Regulatory context

Table 1 identifies the primary federal, state, and local regulations that relate to water resources. Section 3.3 identifies the water-related permits that may be required for facility implementation.

Table 1. Applicable laws, plans, and policies

Regulation, statute, guideline	Description
Federal	
42 U.S. Code (USC) 300 et seq., Chapter 6A, Safe Drinking Water Act	Principal federal law protecting drinking water for the public. Requires states to develop source water assessment programs. Authorizes U.S. Environmental Protection Agency (EPA) administration of the Sole Source Aquifer Protection Program.
42 USC 4001 et seq., National Flood Insurance Act of 1968 and Flood Disaster Protection Act of 1973	Establishes insurance requirements within high-risk flood areas.
33 USC 1251 et seq., Clean Water Act (CWA)	The Federal Water Pollution Control Act of 1948 was the first major U.S. federal law to address water pollution. The law was amended in 1972 and became commonly known as the Clean Water Act. The CWA establishes the basic structure for regulating pollutant discharges into waters of the United States and makes it unlawful to discharge any pollutant from a point source into those waters without a permit.
Section 404 of the CWA (Permit for Dredged or Fill Material)	Establishes a program to regulate the discharge or dredged or fill material into waters of the United States, including wetlands. The U.S. Army Corps of Engineers (USACE) issues Section 404 permit decisions.
Section 402 of the CWA (National Pollutant Discharge Elimination System [NPDES])	Establishes the NPDES program, requiring pollutant discharges to surface waters be authorized by a permit. EPA issues NPDES permits for federally owned facilities and Tribal lands in Washington. The Washington State Department of Ecology (Ecology) administers the NPDES permitting program for other facilities and lands in Washington.
Section 401 of the CWA	Provides states with the authority to ensure that federal agencies do not issue permits or licenses that violate state water quality standards or other protections of the CWA. An applicant for a federal permit must obtain a Section 401 Water Quality Certification from the state in which the activity would occur. Ecology, EPA, and some Tribes administer Section 401 of the CWA in Washington.
Section 303(d) of the CWA (Impaired Waters and Total Maximum Daily Loads)	Section 303(d) requires states to identify waters that do not meet or are not expected to meet water quality standards. Total Maximum Daily Loads are developed and are then prioritized on the 303(d) list. Administered by Ecology in Washington.
33 USC 403, Rivers and Harbors Act of 1899, Section 10	Requires USACE Section 10 authorization for the construction of any structure in or over any navigable water of the United States.

Regulation, statute, guideline	Description
16 USC 1451 et seq., Coastal Zone Management Act (CZMA) of 1972	The federal consistency provisions of the CZMA require that federal actions, including the issuance of federal licenses and permits, be consistent with the enforceable policies of the Washington Coastal Zone Management Program. This applies to federal actions within and outside of Washington's 15 coastal counties that could have reasonably foreseeable impacts on state coastal resources and uses. Administered by Ecology.
40 Code of Federal Regulations 131.45, Federal water quality criteria applicable to Washington	Establishes water quality standards for Washington; used during administration of the CWA. Includes human health criteria for priority toxic pollutants in surface waters in Washington.
Presidential Executive Order 11988, Floodplain Management	Requires avoidance, as feasible, of federal development and other activities within the 100-year floodplain.
Presidential Executive Order 11990, Protection of Wetlands	Provides the overall wetlands policy applicable to all agencies managing federal lands, sponsoring federal projects, or providing federal funds to state or local projects. Requires federal agencies to follow avoidance, mitigation, and preservation procedures and to obtain public input before new construction in wetlands. Consistency with the overall wetlands policy contained in Executive Order 11990 is achieved through CWA Section 404 compliance requirements.
State	
Chapter 36.70A Revised Code of Washington (RCW), Washington State Growth Management Act	Requires local governments to manage growth by identifying and protecting critical areas and natural resource lands, among other measures.
Chapter 77.55 RCW, Chapter 220.660 Washington Administrative Code (WAC), Washington State Hydraulic Code (Construction Projects in State Waters)	Requires a permit for any facility that will use, divert, obstruct, or change the natural flow or bed of any waters of the state. Requires entities who are planning such projects to obtain a Hydraulic Project Approval from Washington Department of Fish and Wildlife.
Title 86 RCW, Flood Control Management Act	Establishes regulations for floodplain management to ensure local government compliance with the National Flood Insurance Program (NFIP).
Chapter 90.03 RCW, Washington State Water Code	Centralized water rights administration; created an adjudication system and adopted the prior appropriation doctrine.
Chapter 90.14 RCW, Water rights—Registration—Waiver and relinquishment, etc.	Requires claim registration, waiver, tracking, relinquishment, recission, and abandonment processes for water rights.
Chapter 90.16 RCW, Appropriation of Water for Public and Industrial Purposes	Requirements of water appropriation. Includes RCW 90.16.020, Appropriation for industrial purposes.
Chapter 90.44 RCW, Regulation of Public Groundwaters	Establishes permit system for the use of groundwaters of the state.

Regulation, statute, guideline	Description
Chapter 90.48 RCW, Water Pollution Control Act	The Water Pollution Control Act sets standards to ensure the purity of all waters of the state and to work cooperatively with the federal government where interest overlaps in a joint effort to extinguish the sources of water quality degradation. Grants Ecology the jurisdiction to control and prevent the pollution of streams, lakes, rivers, ponds, inland waters, salt waters, water courses, and other surface and groundwater in the state, including wetlands. Tool Ecology uses to regulate certain activities in wetlands and waters that are non-jurisdictional under Section 404 of the CWA through the issuance of Administrative Orders.
Chapter 90.58 RCW, Washington State Shoreline Management Act	Establishes a state-local partnership for managing, accessing, and protecting Washington’s shorelines. The law requires local governments to prepare locally tailored policies and regulations for managing shoreline use in their jurisdictions called shoreline master programs (SMPs). Local governments review shoreline development proposals for compliance with SMP standards. Applies to shorelines of the state, including marine waters, streams and rivers with greater than 20 cubic feet per second mean annual flow, lakes 20 acres or larger, upland areas extending 200 feet landward from the edge of these waters, biological wetlands and river deltas connected to these water bodies, and some or all of the 100-year floodplain, including all wetlands.
Chapter 173-152 WAC, Water Rights	Establishes framework for Ecology to assess basins, process applications and perfect water rights, and change or transfer existing water rights.
Chapter 173-158 WAC, Flood Plain Management	Directs floodplain management and compliance with minimum requirements of the NFIP.
Chapter 173-160 WAC, Minimum Standards for Construction and Maintenance of Wells	Implements minimum standards for construction and decommissioning of all wells in the state.
Chapters 173-200 and 173-201A WAC, Water Quality Standards for Groundwaters of the State of Washington	Implements Chapter 90.48 RCW, the Water Pollution Control Act, which establishes authorities, jurisdiction, and other policies of the state related to water pollution control, and Chapter 90.54 RCW, the Water Resources Act of 1971 which requires protection and enhancement of instream flows, water quality, conservation, and administration of water. Maintains and protects existing and future beneficial uses of the groundwater through the reduction or elimination of the discharge of contaminants to the state's groundwaters. Establishes water quality standards for surface waters of the state.

Regulation, statute, guideline	Description
Chapter 173-216 WAC, State Waste Discharge Permit Program	Implements the permit program regulating discharge from industrial, commercial, and municipal operations into ground and surface waters of the state and into municipal sewage systems. Does not apply to point source discharges into waters regulated by the NPDES Permit Program, or pollutants discharged to waters regulated by the Waste Discharge General Permit Program.
Chapter 173-218 WAC, Underground Injection Control (UIC) program	Establishes Ecology as the responsible for administering the UIC created by 40 CFR of the Safe Drinking Water Act. All injection wells must receive either a program rule authorization or a state discharge (solid waste discharge) permit in order to operate.
Chapter 173-220 WAC, NPDES Permit Program	Establishes individual permit program that operates under state law as part of the NPDES system created by Section 402 of the Federal Water Pollution Control Act (FWPCA).
Chapter 173-226 WAC, Waste Discharge General Permit Program	Establishes state general permit program, in satisfaction of FWPCA Sections 307 and 402, for discharge of pollutants, wastes, and other materials to waters of the state.
Chapter 173-500 WAC, Water Resources Management Program Established Pursuant to the Water Resources Act of 1971	Outlines program to manage development of water resources to the extent of their availability for further appropriation.
Chapter 179-303 WAC, Dangerous Waste Regulations	Implements Chapter 70.105 RCW, the Hazardous Waste Management Act.
Chapter 220-660 WAC, Hydraulic Code Rules	Requires hydraulic project approval permits for hydraulic projects.
Chapter 508-12 WAC, Administration of Surface and Groundwater Codes	Directs administration of surface and groundwater codes in the state.
Washington State Executive Order 89-10, Protection of Wetlands	Establishes the importance of wetlands and requires development of action plans to preserve and enhance wetlands.
Local	
Comprehensive plan goals and objectives pertaining to water resources	A local planning effort by cities and counties that provides a vision for the community and identifies steps needed to meet that vision.
Critical areas ordinances	As required under Washington’s Growth Management Act, cities and counties have development regulations to protect critical areas including wetlands and their buffers, waterbodies and their buffers (fish and wildlife habitat conservation areas), critical aquifer recharge areas, and frequently flooded areas.
Floodplain codes	Local codes regulate floodplain development as required by Federal Emergency Management Agency NFIP regulations.
Shoreline codes	Local codes regulate development within shorelines of the state in accordance with Shoreline Master Programs and state Shoreline Management Act requirements.

2 Methodology

2.1 Study area

The study area for water resources includes the PEIS geographic scope of study for green hydrogen facilities (Figure 1), and the state's major hydrologic basins. The study area for the evaluation of water resources associated with the construction and operation of green hydrogen facilities would be determined by the presence (or absence) of water resources during project-specific reviews. Parameters could be streams, rivers, lakes, reservoirs, estuaries, marine waters, wetlands, groundwater, and floodplains.

Figure 1, which shows the PEIS geographic scope of study, does not include federal lands, national parks, wilderness areas, wildlife refuges, state parks, or Tribal reservation lands.

2.2 Technical approach

The PEIS analyzes a timeframe of up to 25 years of potential facility construction and up to 50 years of potential facility operations (totaling up to 75 years into the future).

The technical approach for this analysis included the following steps:

- Characterize key water resource conditions in the study area (e.g., major watersheds and rivers/streams, aquifers, floodplains, and wetlands) using existing data and information from publicly available sources.
- Qualitatively assess water resource impacts relative to baseline and predicted future conditions for the types and sizes of facilities and range of activities analyzed in the PEIS.
- Evaluate potential impacts relative to applicable laws and regulations (e.g., water quality standards, water rights laws, and wetland regulations).

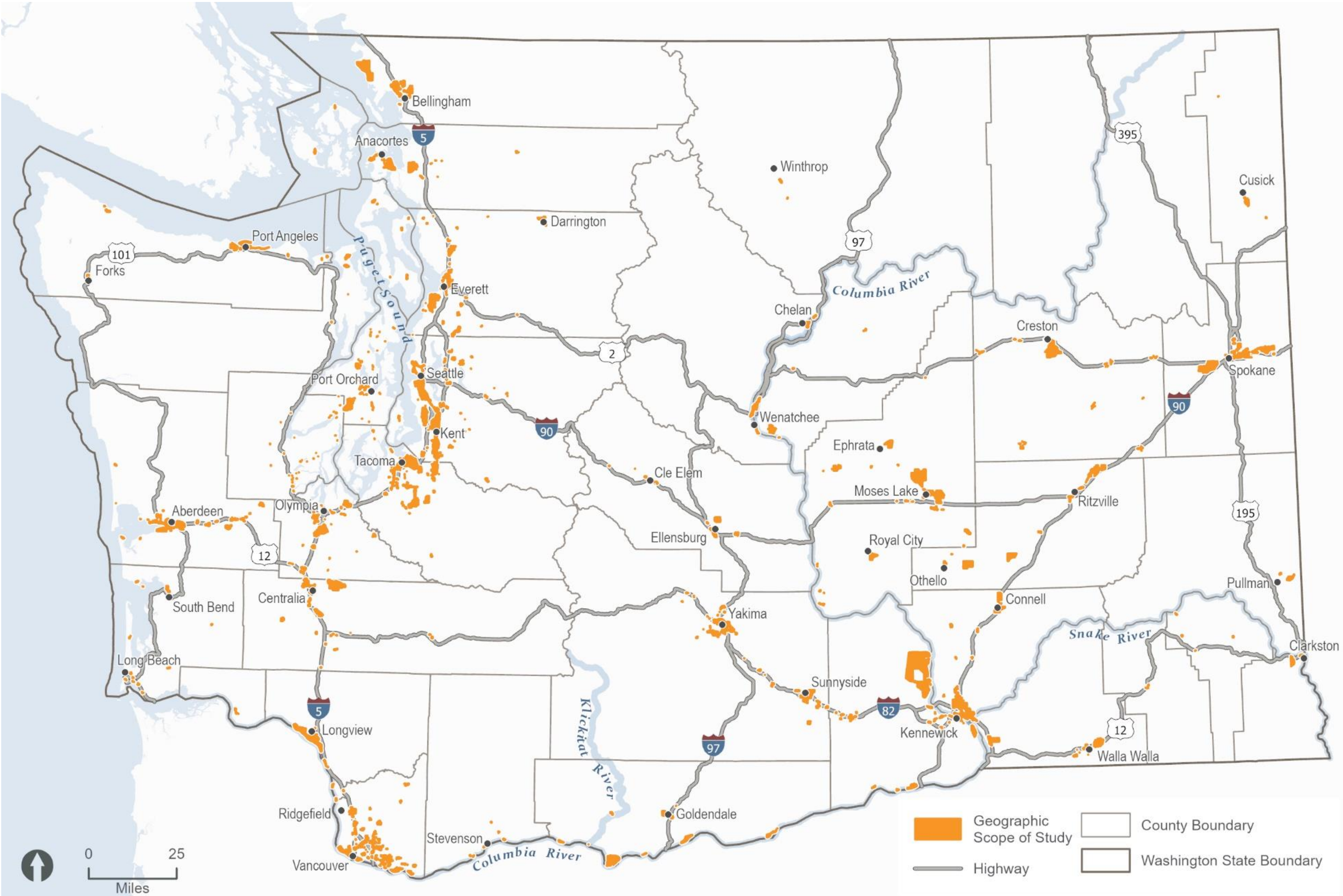

Figure 1. Green Hydrogen Energy Facilities PEIS geographic scope of study

2.3 Impact assessment approach

The assessment of probable impacts was conducted qualitatively, and impacts on water resources were evaluated for activities associated with site characterization, construction, operation, and decommissioning of facilities.

The impact analysis considered water resources that have the potential to be affected by construction and operation, including:

- Surface water quantity and quality
- Groundwater quantity and quality
- Streams and wetlands and associated regulatory buffers
- Floodplains
- Water availability and water rights

This analysis assumes the following for the facilities evaluated:

- Facilities would not include piers and docks over waterbodies.
- Water rights would be obtained as needed. If water is needed for a project and is not available, a project would not be able to operate.
- Construction blasting, if needed, would occur in upland areas.

For the purposes of this assessment, a **potentially significant impact** would occur if a facility resulted in the following:

- Substantial impacts to water quality in receiving waters. Impacts would include discharge of a pollutant to a water that already exceeds water quality standards or discharge of a pollutant in quantities that is likely to cause measurable degradation.
- Substantial disruption to the groundwater flow regime (including groundwater recharge); disruption would be widespread and would occur beyond the development footprint.
- Impairment of existing water rights, including waterways with established minimum instream flows. Possible diminishment of administratively closed waterways.
- Adverse impacts to wetlands, including permanent impacts that affect wetland functions, value, and area, including the capacity to maintain water quality and quantity.
- Adverse impacts to wetland buffers that affect wetland functions, value, and area, including the capacity to maintain water quality and quantity.
- Temporary or long-term alterations to floodplain functions or any loss of floodplain storage that would cause a net rise in flood elevation during the occurrence of the 100-year flood.
- Disturbance to known groundwater pollution or contamination.

3 Technical Analysis and Results

3.1 Overview

This section describes key elements of the affected environment for water resources and provides an overview of how those resources are managed and regulated in Washington. Potential impacts on water resources resulting from site characterization, construction, operation, and decommissioning of facilities are described. This section also evaluates measures that could avoid, minimize, and mitigate impacts, and determines whether there would be potential unavoidable significant adverse impacts on water resources.

3.2 Affected environment

3.2.1 Surface water quantity and quality

3.2.1.1 Surface water quantity

Surface water includes streams, rivers, lakes, reservoirs, estuaries, and marine waters. Wetlands are also surface waters and are discussed in Section 3.2.3 below. Surface waters in the study area vary considerably in size and flow. The study area encompasses land along surface waters ranging in magnitude from the Columbia River and major river tributaries including the Yakima, Snake, White Salmon, and Klickitat Rivers; to small to large-size perennial creeks; to unnamed smaller drainageways with only seasonal flow.

Most perennial streams rely on groundwater discharge to sustain flows following the spring/summer snowmelt cycle. However, stream discharge and flow may be affected by existing consumptive uses and withdrawals in the areas. Major rivers are generally regulated by dams and other flow control measures, and discharge is often guided by rule-curves that are informed by climate, storage capacity, water rights, flood management, and instream temperature and flow requirements.

The U.S. Geological Survey (USGS) has delineated drainage areas in the United States based on surface water features. Geographic areas are divided and subdivided into successively smaller hydrologic units, each with a defined numeric Hydrologic Unit Code (HUC), which describes the area of land upstream of a point on a waterbody that contributes surface runoff to that point. There are eight hydrologic sub-regions (HUC-4 basins) under the national HUC system that are entirely or partially within the State of Washington. The study area for the PEIS analysis includes portions within all of these sub-regions.

Washington has 62 Water Resource Inventory Areas (WRIAs) established under Washington Administrative Code (WAC) 173-500-040 to provide a framework for water resources management in the state (Ecology 2024a) (Figure 2). WRIAs are based on natural watershed boundaries and are used by the Washington State Department of Ecology (Ecology) and other natural resources agencies as a basis for study, planning, and regulation of activities affecting water resources. The study area for this analysis includes lands located within Washington's 62 WRIAs.

3.2.1.2 Water quality

Water quality is a key element of surface water regulation and management in Washington, and the state is required by the federal Clean Water Act (CWA) to perform a water quality assessment every 2 years to track the water quality status of the state's rivers, streams, lakes, and marine waterbodies (Ecology 2022). The assessments are conducted by Ecology and submitted to the U.S. Environmental Protection Agency (EPA) for review and approval. Waterbodies that are identified as impaired by pollutants are categorized as Category 5 waters and placed on the state's 303(d) list, indicating that they require a water improvement project. Ecology develops water cleanup plans, or Total Maximum Daily Loads (TMDLs), for impaired waters to reduce pollution with the goal of bringing the water into compliance with water quality standards. Many waters that are on the 303(d) list are found in the study area. Washington's Water Quality Assessment and 303(d) list are available to review on Ecology's website.[1]

Water quality conditions across the study area vary by location and are affected by physical conditions of the waterbody (width, depth, flows), underlying soils and geology, and human influences. In general, surface water quality conditions are typically better higher in a watershed, upstream of intensive land uses. Common water quality issues that affect some waters within Washington and the study area include the following:

- Elevated temperatures from land clearing and development (reduced shading), point source discharges, and dams
- Low dissolved oxygen from elevated water temperatures and excessive organic material decay
- High total suspended solids and turbidity from land disturbance and erosion
- Bacteria from livestock and failing septic systems
- Elevated nutrients and pesticides from agricultural activities
- Toxics from industrial activities
- Pollutants, including metals and petroleum hydrocarbons, in stormwater runoff from roads and other impervious surfaces

[1] Assessment of state waters 303d - Washington State Department of Ecology

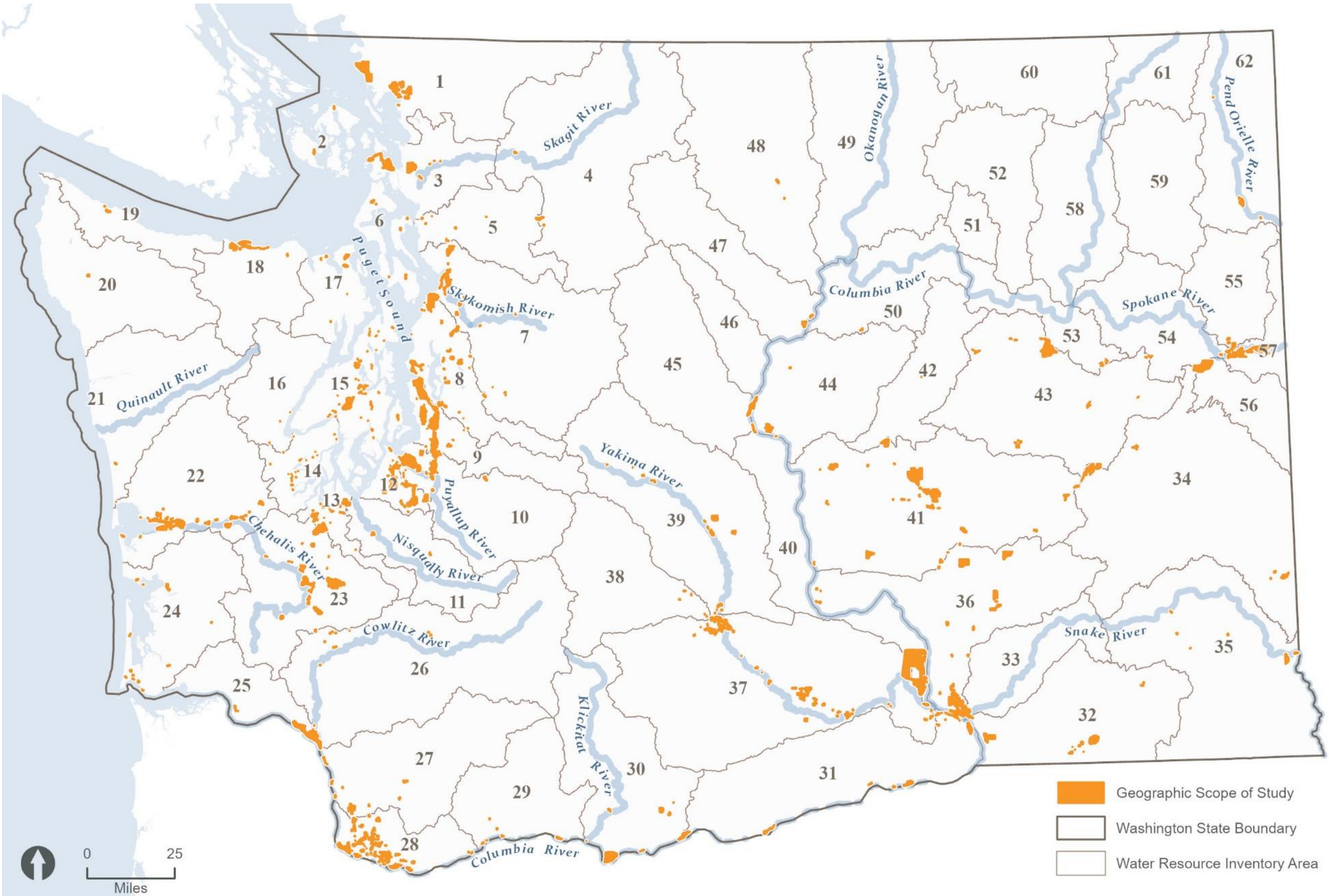

Figure 2. WRIAs

3.2.2 Groundwater quantity and quality

Groundwater is the water found underground in the spaces of saturated soil and rock. A saturated soil or rock layer with spaces that allow water to move through it is called an aquifer. Aquifers may be confined or unconfined. A confined aquifer is bound by impermeable layers (e.g., rock or clay) above and below it, and is usually under pressure. Unconfined aquifers have no upper confining layer; the top of the aquifer is the water table that is in equilibrium with atmospheric pressure and rises and falls in response to recharge or discharge.

Groundwater recharge occurs when water from the surface (e.g., rain or snowmelt, or surface waterbodies) seeps downward to groundwater. Groundwater flow is influenced by topography and generally moves toward surface water drainages and marine waterbodies.

Hazardous materials may be present and interact with groundwater within the study area. Ecology and EPA tracks formal and independent cleanups, hazardous sites, and cleanup and underground storage tank sites. Groundwater quality is managed and monitored through several programs in Washington. The Washington State Department of Health requires that municipal well operators collect and test groundwater samples. This program is the only active statewide groundwater monitoring program in Washington that includes pesticide testing (WSDA 2024). Given that the study area includes industrial lands, hazardous materials may be present at or near proposed facilities that have not been historically identified in the Ecology database or other sources.

3.2.2.1 Principal aquifers of Washington State

There are seven principal aquifers in Washington as identified in the USGS *Groundwater Atlas of the United States* (USGS 1994). The study area for this analysis includes land overlying portions of most of these aquifers, as shown in Figure 3. These aquifers are regionally extensive, with potential to be used as a source of drinking water.

Most of the study area in eastern Washington is on lands with Columbia Plateau basaltic-rock and Columbia Plateau basin-fill aquifers. Most of the study area in western Washington is on lands with Puget Sound aquifers. Smaller portions of the study area include areas with the Pacific Northwest basin-fill aquifer and Pacific Northwest basaltic-rock aquifer.

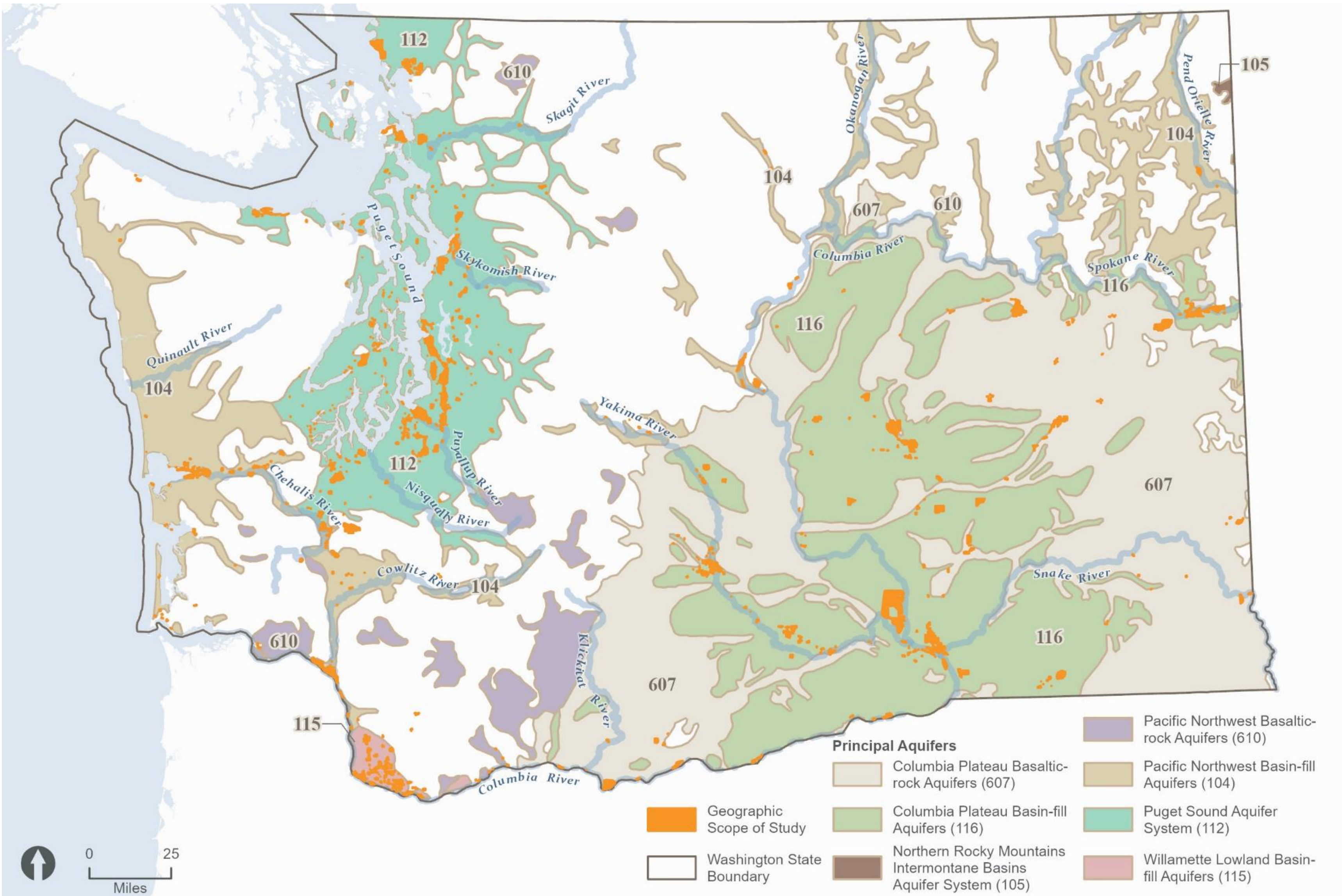

Figure 3. Principal aquifers

3.2.2.2 Sole Source Aquifers

EPA administers a Sole Source Aquifer (SSA) program through its authorities under the federal Safe Drinking Water Act of 1974 (Section 1424[e]). SSAs are defined as aquifers that supply at least 50% of the drinking water for their service area and for which there are no reasonably available alternative drinking water sources, should the aquifer become contaminated. Projects within SSAs that received federal funding must undergo EPA review to ensure that the projects will not contaminate the SSA.

EPA has designated 13 SSAs in Washington (EPA 2024a), 9 of which are in the study area for this analysis (Figure 4 and Figure 5), including:

- Camano Island Aquifer Area, located in Island County in the northwestern portion of the study area
- Central Pierce County Aquifer Area, located in Central Pierce County in the western portion of the study area
- Cross Valley Aquifer Area, located in Snohomish County in the western portion of the study area
- Vashon-Maury Island Aquifer Area, located in King County in the western portion of the study area
- Whidbey Island Aquifer Area, located in Central Pierce County in the northwestern portion of the study area
- Troutdale Aquifer System Source Area, located in Clark County in the southwestern portion of the study area
- Spokane Valley-Rathdrum Prairie Aquifer Source Area, located in Spokane County in the eastern portion of the study area
- Lewiston Basin Aquifer Area, located in Asotin and Garfield counties and overlaps with the southeastern portion of the study area
- Cedar Valley Aquifer Source Area, located in King County and overlaps with a small portion of the western part of the study area

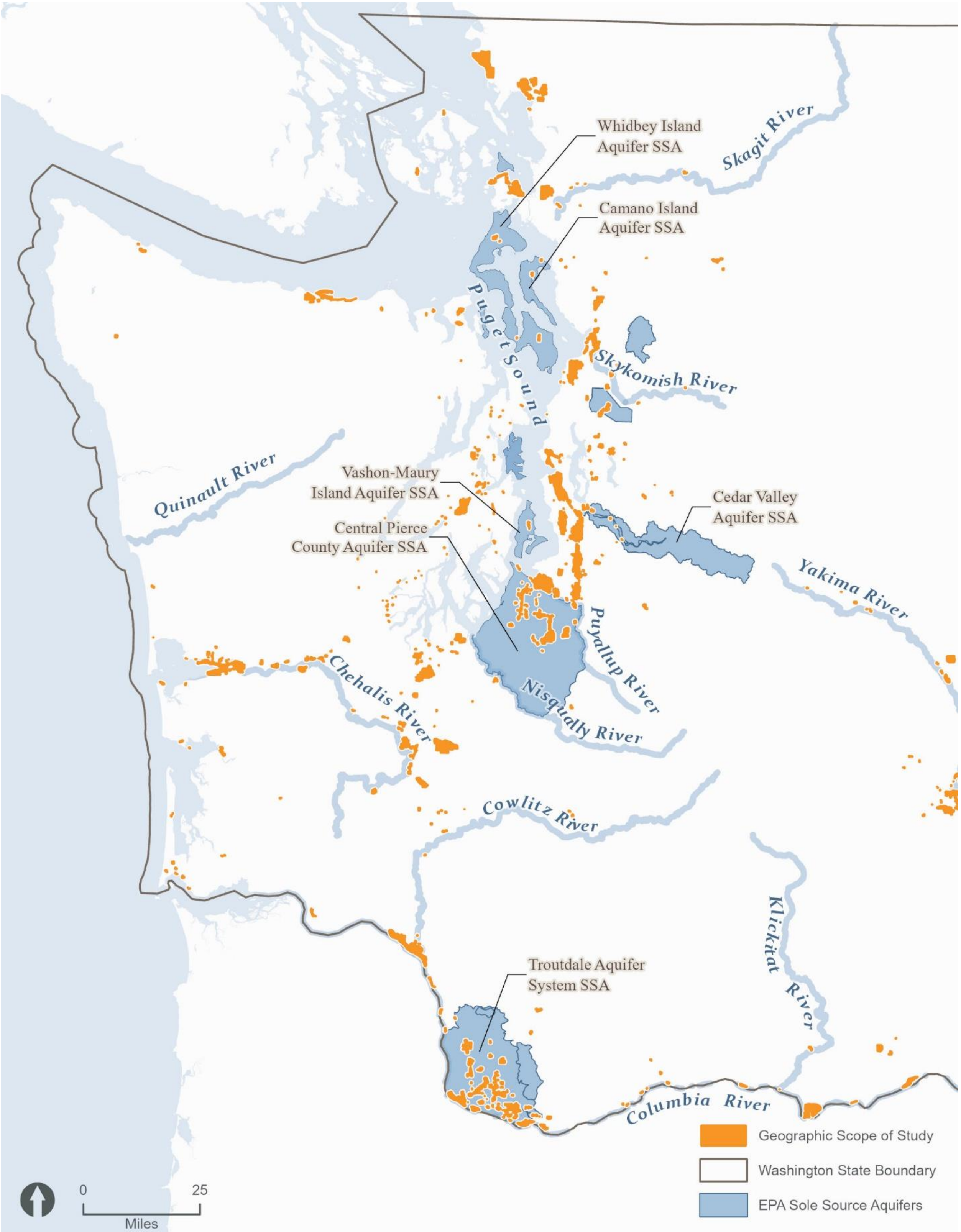

Figure 4. Sole source aquifers – western Washington

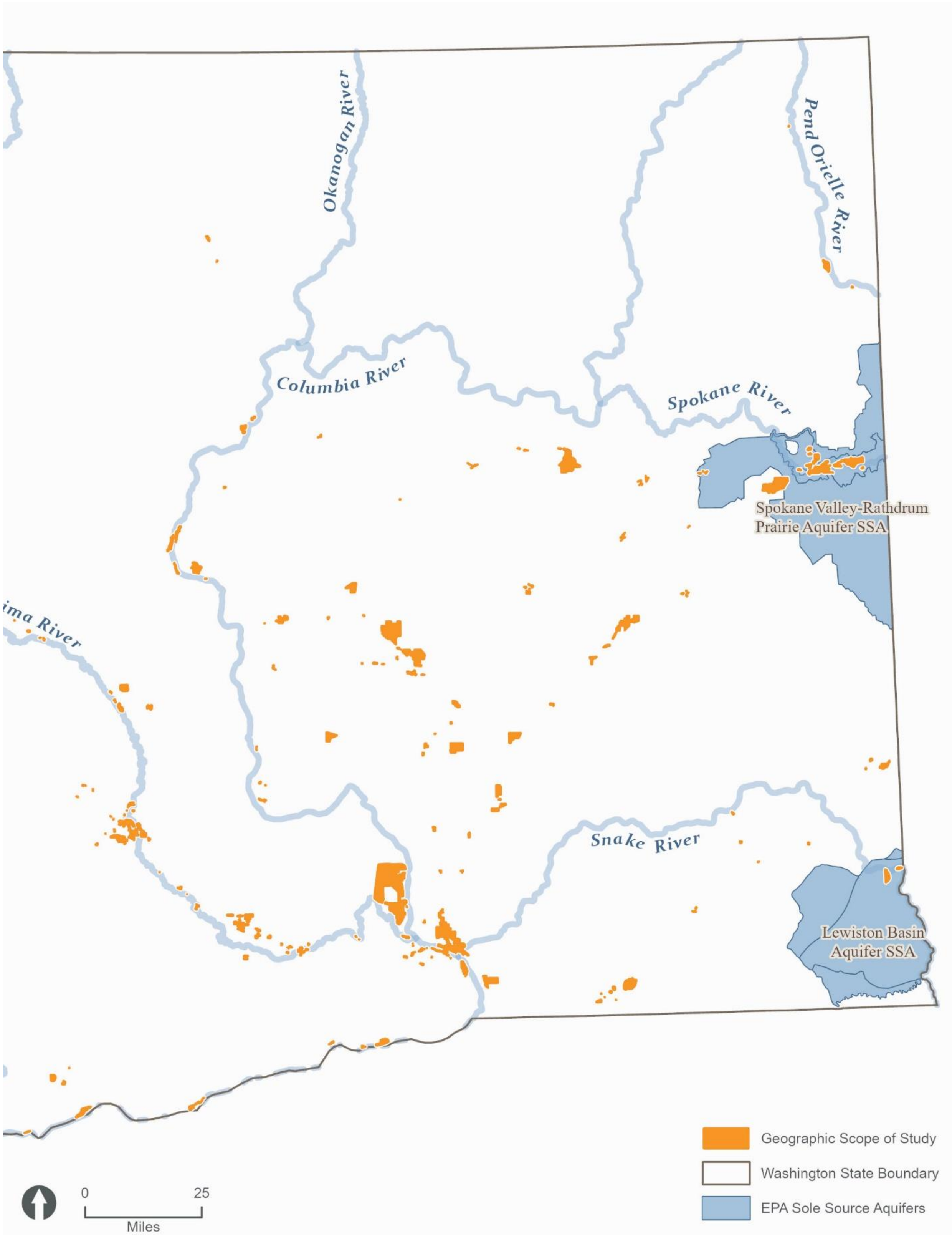

Figure 5. Sole source aquifers – eastern Washington

3.2.2.3 Critical aquifer recharge areas

Cities and counties in Washington protect groundwater resources by establishing critical aquifer recharge areas (CARAs), as required by the state's Growth Management Act. Development activities within critical aquifer recharge areas are regulated by city and county Critical Area Ordinances (CAOs) and codes. These codes establish standards and review processes intended to protect a community's drinking water by preventing pollution and maintaining supply.

3.2.2.4 Sea-level rise

Increases in sea level, or sea-level rise (SLR), occur due to two main processes: (1) thermal expansion, in which warm water expands, and (2) melting of land ice. SLR does not occur uniformly and is often described as relative sea-level rise (RSLR) or the long-term average sea surface height relative to a specific point on land. RSLR incorporates the effects of SLR, with respect to any subsidence or uplift (e.g., seismic, isostatic rebound) that may be occurring locally (Lavin et al. 2020). SLR can increase local flooding and result in saltwater intrusion of groundwater. SLR may increase coastal erosion and can degrade habitat and ecosystems that can buffer the effects of storms and flood events. The Washington Coastal Resilience Project has developed SLR projects to support coastal impact assessments (Ecology 2024e). RSLR may affect coastal locations throughout the study area.

3.2.3 Wetlands

Wetlands are waters of the state and are a specific type of water resource that often occur in transitional areas between terrestrial and aquatic systems. They include areas that are commonly referred to as swamps, marshes, bogs, or fens. Wetlands are characterized as areas where the underlying water table is at or near the soil surface (saturated) or where the ground is covered by shallow water (inundated) for an extended duration during the growing season. Such conditions result in the development of anaerobic (low-oxygen) conditions in the upper part of the soil column and the formation of hydric soils. Wetlands also support hydrophytic or "water-loving" vegetation, which can include herbs, shrubs, vines, and trees that are specifically adapted to growing in saturated or flooded soil conditions.

Wetlands can occur in and adjacent to stream and river channels, on floodplains, in low-lying areas and depressions, around the edges of ponds and lakes, on slopes, and in estuaries and coastal areas. They are often supported by perennial water sources such as springs, permanently flowing streams, or permanent waterbodies. However, wetlands can also occur in association with intermittent or ephemeral waters including seasonally flowing drainageways and vernal pools. In the marine environment, wetlands can occur in estuarine areas where freshwater enters the ocean or along coastlines where they are supported by tidal action, waves, or ocean spray with minimal influence from freshwater (Cowardin et al. 1979).

Wetlands occur throughout the study area where green hydrogen facilities are considered. However, unlike many streams, rivers, lakes, and marine waters whose locations and boundaries are often evident and relatively well mapped, there is no detailed single source that identifies and maps the presence, extent, and condition of all wetlands. Remote mapping of wetlands using aerial photography and satellite imagery is often challenging because the most visible aspects of wetlands, vegetation cover and hydrology, are highly variable and often change both seasonally and over longer periods in response to variations in climate and other factors such as land use. The presence of hydric soils is something that must be determined by direct observation in the field and is not something that can be detected remotely.

Wetland buffers are vegetated upland areas adjacent to wetlands that can reduce impacts from adjacent land uses through various physical, chemical, and biological processes.

As such, developers of green hydrogen facilities would be required to conduct quantitative analyses and site surveys (e.g., wetland determination or delineations, wetland rating and functions and values assessments, critical area assessments) to determine the extent, type, and category of wetlands on and around potential facility sites, and the width and condition of associated wetland buffers. Information on the potential occurrence of wetlands in the landscape is available from the following sources:

- U.S. Fish and Wildlife Service's National Wetlands Inventory (U.S. Fish and Wildlife Service 2024)
- Ecology's 2016 Modeled Wetland Inventory (Ecology 2016)[2]
- USGS National Hydrography Dataset (USGS 2024)
- Available local wetland inventories
- Aerial photography and Light Detection and Ranging imagery
- USGS topographic maps
- Natural Resources Conservation Service (NRCS) Web Soil Survey (NRCS 2024)

Although these sources can offer general information on the likelihood of a site to support wetlands, they do not provide a definitive indication of the presence or absence of wetlands. The definitive presence of wetlands and a demarcation of their boundaries can only be determined through a wetland delineation performed in accordance with 1987 *Corps of Engineers Wetlands Delineation Manual* (Environmental Laboratory 1987) and the appropriate regional supplement.[3]

Wetlands provide a number of important ecosystem functions, including habitat for terrestrial, aquatic, and amphibious species; water quality improvement; flood flow reduction/protection; shoreline stabilization; groundwater recharge; and streamflow maintenance (Ecology 2023). Many of these functions, such as flood flow reduction and shoreline stabilization, are particularly valuable to humans. This technical appendix focuses on hydrological wetland functions and values, including those related to water quality, flood protection, shoreline stabilization, and groundwater recharge. Wetland functions and values associated with the

[2] The Ecology (2016) Modeled Wetland Inventory only covers the western portion of the state.

[3] Two regional supplements to the 1987 Manual are applicable to Washington: (1) *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Western Mountains, Valleys, and Coast Region (Version 2.0)* (USACE 2010); and (2) *Regional Supplement to the Corps of Engineers Wetlands Delineation Manual: Arid West Region (Version 2.0)* (USACE 2008).

provision of habitat for aquatic and terrestrial species are addressed in the *Biological Resources Technical Appendix*.

Because of their ecological importance and value to humans, wetlands are regulated under various federal, state, and local laws including Sections 401 and 404 of the CWA, the Washington State Water Pollution Control Act, and county and municipal critical areas ordinances. Although the definitions of the jurisdictional limits of wetlands are similar under these various laws, there are differences in whether or not a wetland is subject to federal or state regulation. In particular, federal regulations typically apply only to wetlands that are directly connected to certain surface waters that are considered to be waters of the United States. Those wetlands determined to be non-jurisdictional by the federal government are generally regulated under state and local laws.

As part of state and local regulation of wetlands in Washington, wetlands are rated and categorized using the Washington State Wetland Rating System, which was developed by Ecology. The rating system includes specific regional methods for the western (Hruby and Yahnke 2023) and eastern (Hruby 2014) portions of the state. These methods are designed to consider regional differences in climate, landforms, hydrology, and wetland types that are characteristic of those areas. Ecology's wetland rating system is used to differentiate wetlands based on their sensitivity to disturbance, significance in the watershed, rarity, ability to be replaced, and the beneficial functions they provide to society. The rating system evaluates wetlands on their ability to provide water quality improvement, hydrologic, and wildlife habitat functions based on the wetland's physical characteristics (site potential), surrounding environment (landscape potential), and the importance of those functions to humans (value) in the vicinity. The categories derived using the rating system include the following:

- **Category I wetlands** represent a unique or rare wetland type, are more sensitive to disturbance, or are relatively undisturbed and contain ecological attributes that provide a high level of functions. These types and functions are very difficult to replace.
- **Category II wetlands** provide high levels of some functions. These types and functions are very difficult to replace.
- **Category III wetlands** have moderate levels of functions. They have been disturbed and are often less diverse or more isolated from other resources in the landscape than Category II wetlands.
- **Category IV wetlands** have the lowest levels of functions. These wetlands are often heavily disturbed.

Wetland categories are also used by local entities to assign protective buffers to wetlands under their critical areas' regulations and shoreline master programs within shoreline jurisdiction.

Because Category I and II wetlands typically represent relatively unique or rare wetland types or wetlands of high conservation value that are difficult to replace and that provide high levels of function, impacts to those wetland types would be difficult to mitigate for and would be determined on a case-by-case basis.

As shown in Table 2, Ecology has identified typical Category I and II wetlands for both the eastern and western portions of the state. Green hydrogen facilities are most likely to encounter wetlands in the western side of the state. There are fewer wetlands in the southeast portion, particularly in the Columbia Plateau Ecoregion. While the density of wetlands is lower in this ecoregion, green hydrogen facilities may still overlap or be sited adjacent to wetlands, particularly near larger waterbodies such as the Columbia River, Snake River, and Moses Lake.

Table 2. Typical Category I and II wetlands in eastern and western Washington

Wetland type	Description
Eastern Washington Category I wetlands	
Alkali Wetlands	Wetlands characterized by the presence of shallow saline water with a high pH. Such wetlands provide primary habitat for several species of migratory shorebirds and are also heavily used by migratory waterfowl. They also support unique plants and animals not found anywhere else in eastern Washington, including important pollinators (e.g., alkali bees) that are vital to agriculture in the western United States.
Wetlands of High Conservation Value	Wetlands previously called Natural Heritage Wetlands that have been identified by the Washington Natural Heritage Program as important ecosystems for maintaining plant diversity in the state.
Bogs and Calcareous Fens	Bogs: Wetlands with peat soils and a low pH (typically <5) that support plants and animals specifically adapted to such conditions. Bogs do not tolerate changes or disturbance well, with even minor changes in water quality or nutrient inputs potentially resulting in major adverse effects on the plant and animal communities. They are also extremely slow to develop. Calcareous Fens: Wetland with peat soils that exhibit neutral or alkaline conditions (pH > 5.5) that are maintained by groundwater rich in calcium and magnesium bicarbonates (or sometimes calcium and magnesium sulfates) and that support rare plants and animals. Considered to be one of the rarest wetland types in the United States and one of the rarest peat wetland types in Washington. Found only in north-central to northeastern part of the state.
Mature and Old-growth Forested Wetlands with Slow-growing Trees	Wetlands containing mature or old-growth forested wetlands that are over 0.25 acre and dominated by slow-growing tree species such as redcedar (*Thuja plicata*), Alaska yellow cedar (*Chamaecyparis nootkatensis*), pines (mostly western white pine, *Pinus monticola*), western hemlock (*Tsuga heterophylla*), Oregon white oak (*Quercus garryana*), and Engelmann spruce (*Picea engelmannii*).
Forests with Aspen Stands	Forested wetlands that include quaking aspen (*Populus tremuloides*) stands. Aspen stands are a Washington Department of Fish and Wildlife Priority Habitats and Species habitat.
Wetlands that Perform Many Functions Very Well	Wetlands scoring 22 points or more (out of 27) from the rating of functions.
Eastern Washington Category II wetlands	
Forested Wetlands in the Floodplains of Rivers	Forested wetlands in the floodplain that are critical to the proper functioning and dynamic processes of rivers, including influencing channel form and providing habitat for many aquatic species.

Wetland type	Description
Mature and Old-growth Forested Wetlands with Fast-growing Trees	Mature and old-growth forested wetlands with over 0.25 acre of forest dominated by fast-growing native trees such as red alder (*Alnus rubra*), cottonwood (*Populus* spp.), willow (*Salix* spp.), quaking aspen (*Populus tremuloides)*, and birch (*Betula* spp.)
Vernal Pools	Vernal pool ecosystems are formed when small depressions in the scabrock or in shallow soils fill with snowmelt or spring rains. They retain water until the late spring when they dry out as a result of reduced precipitation and increased evapotranspiration. Vernal pools hold water long enough throughout the year to allow some strictly aquatic organisms to flourish, but not long enough for the development of typical wetland characteristics.
Wetlands that Perform Functions Well	Wetlands scoring between 19 and 21 points (out of 27) on the questions related to functions. Includes wetlands judged to perform most functions relatively well or one group of functions very well and the other two moderately well.
Western Washington Category I wetlands	
Large Undisturbed Estuarine Wetlands	Relatively undisturbed estuarine wetlands that are larger than 1 acre.
Wetlands of High Conservation Value	Wetlands previously called Natural Heritage Wetlands that have been identified by the Washington Natural Heritage Program as important ecosystems for maintaining plant diversity in the state.
Bogs	Wetlands with peat soils and a low pH (typically <5) that support plants and animals specifically adapted to such conditions. Bogs do not tolerate changes or disturbance well, with even minor changes in water quality or nutrient inputs potentially resulting in major adverse effects on the plant and animal communities. They are also extremely slow to develop.
Wetlands with Mature/Old-growth Forests	Mature and old-growth forested wetlands over 1 acre in size.
Wetlands in Coastal Lagoons	Relatively undisturbed wetlands in coastal lagoons (shallow bodies of water that are partly or completely separated from the sea by a barrier beach) that are larger than 0.1 acre.
Interdunal Wetlands Larger than 1 Acre that Score High (8 or 9 points) for Habitat Functions	Interdunal wetlands are a type of wetland that form in the deflation plains and swales that are geomorphic features in areas of coastal dunes. These dune forms are the result of the interaction among sand, wind, water, and plants. For the purpose of rating, any wetlands that are located west of the upland boundary mapped in 1889 (western boundary of upland ownership) are considered to be interdunal.
Wetlands that Perform Functions at High Levels	Wetlands scoring 23 points or more (out of 27) on the questions related to functions are Category I wetlands.
Western Washington Category II wetlands	
Smaller Estuarine Wetlands	Any estuarine wetland smaller than 1 acre, or those that are disturbed and larger than 1 acre.
Wetlands that Perform Functions Well	Wetlands scoring between 20 and 22 points (out of 27) on the questions related to functions. Includes wetlands judged to perform most functions relatively well or one group of functions very well and the other two moderately well.

Wetland type	Description
Interdunal Wetlands Larger than 1 Acre or those in a Mosaic	Interdunal wetlands larger than 1 acre and that score 7 or lower for habitat, or those found in a mosaic of wetlands and dunes larger than 1 acre.

Source: Hruby 2014; Hruby and Yahnke 2023

Category III and IV wetlands are the most common types of wetlands in the state. As a result, most wetlands that would be encountered on potential development sites for green hydrogen facilities are likely to be those types. Category III and IV wetlands typically provide moderate to low levels of functions and support relatively common plant and animal species. While such wetlands are still important (and regulated), they have likely experienced some level of disturbance and are easier to replace through compensatory mitigation. Permits that may be required for impacts to such areas are described in Section 3.3.

3.2.4 Floodplains and frequently flooded areas

A floodplain is any land area susceptible to being inundated by floodwaters from any source (FEMA 2024). Frequently flooded areas are floodplains and other areas subject to flooding (WAC 365-190-110). Federal Emergency Management Agency (FEMA) Flood Insurance Rate Maps identify flood hazard areas regulated under the National Flood Insurance Program (NFIP) (Figure 6 and Figure 7). Maps are typically prepared for floods that have a 1% and 0.2% chance of occurring each year (i.e., 100-year and 500-year flood events, respectively). Special flood hazard areas are defined as areas that would be inundated by the flood event having a 1% chance of being equaled or exceeded in any given year (i.e., the "100-year" flood) and generally form the basis for state and local floodplain management regulations. Local governments (cities and counties) are responsible for managing development in floodplains under the NFIP, and construction and development activities that involve grading or structural improvements in the floodplain typically require a floodplain development permit from the local jurisdiction.

Flood risks vary across the study area based on location and setting. Information on flood risks for a given site should be evaluated using FEMA's Risk Mapping, Planning, and Assessment (RiskMAP) program tools available on the FEMA website.[4]

Local CAOs include requirements to define and protect frequently flooded areas. Local governments—other than just those whose boundaries are established in the FEMA minimum requirements—may require greater protection from floods.

[4] https://www.fema.gov/flood-maps/tools-resources/risk-map

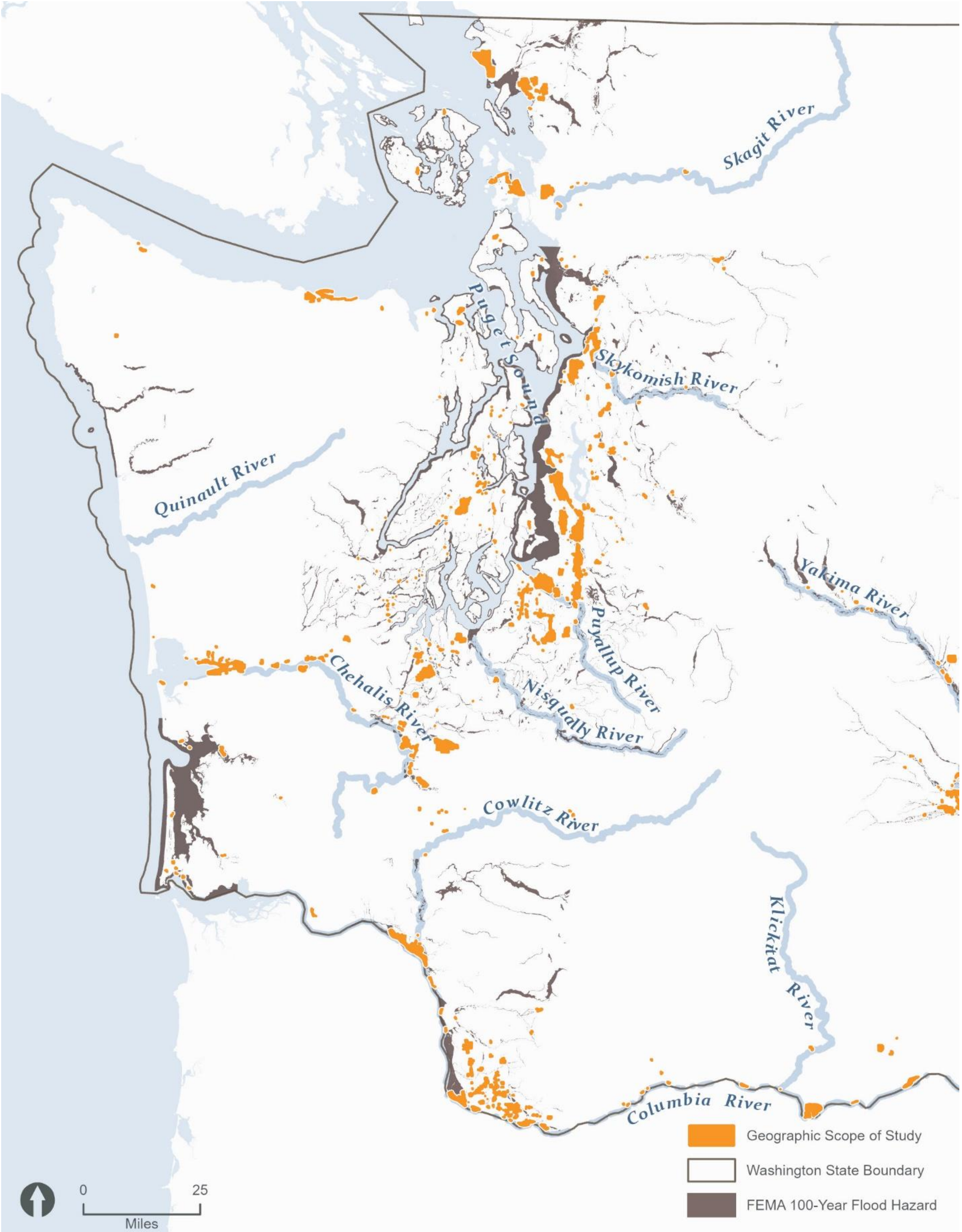

Figure 6. FEMA flood hazards – western Washington

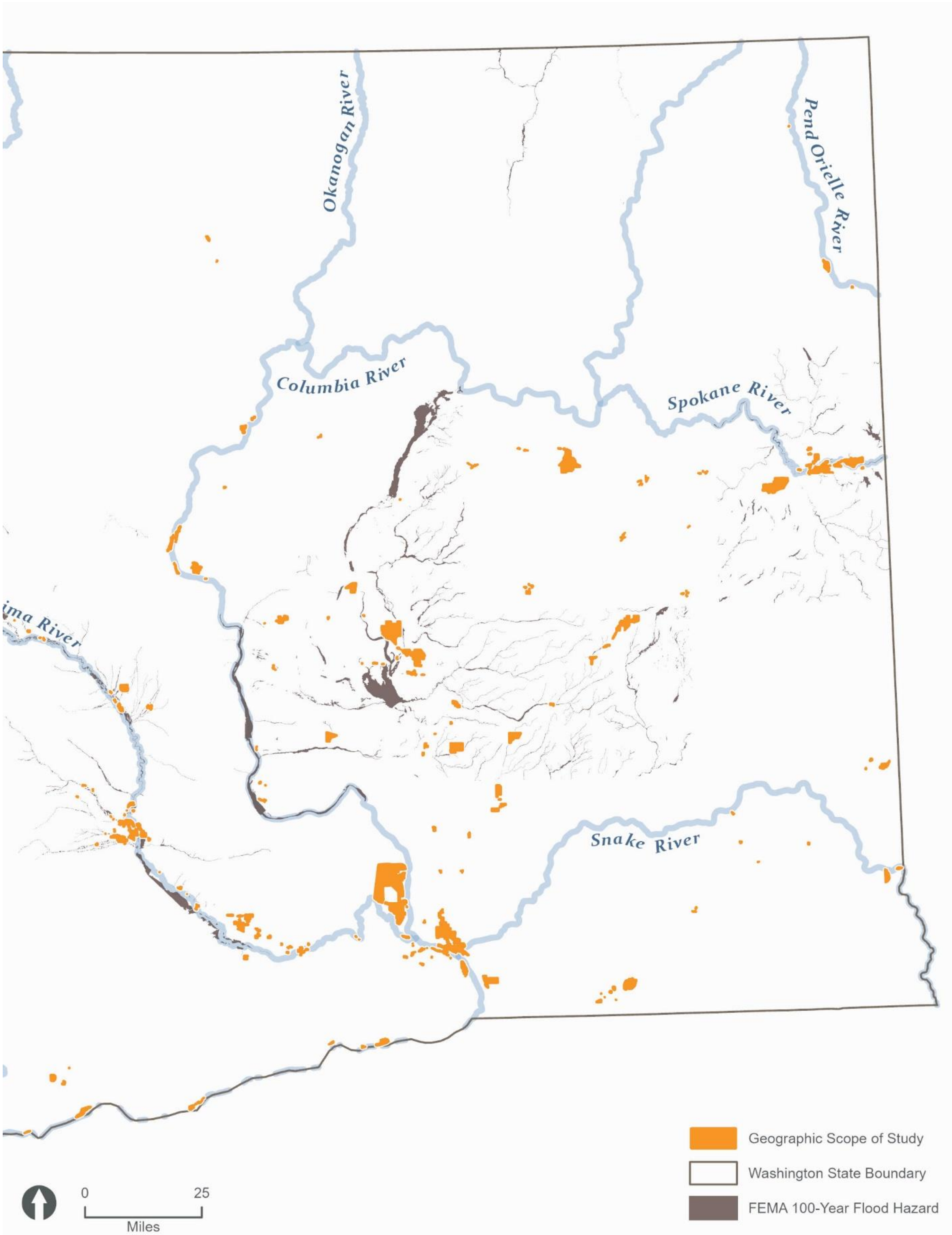

Figure 7. FEMA flood hazards – eastern Washington

3.2.5 Water availability and water rights

3.2.5.1 Water rights

Across the study area, water availability varies by location and is dependent on many factors such as local hydrology and climate conditions (precipitation, air temperature, snowpack), land uses, and existing water rights including minimum instream flows. Ecology has responsibilities for managing waters of the state, including issuing rights to use water while protecting instream resources for public benefit. Washington State law requires that streamflows be managed in a way that protects instream resources and values including fish and wildlife, water quality, recreation, aesthetics, and navigation.

Water rights in Washington are issued based on a prior appropriation system, whereby a senior water rights holder who established a right first cannot be impaired by a junior water rights holder who was granted rights later. USGS compiles and publishes data on water withdrawals by state, tracking use trends over time. For the most recent publication reporting 2015 data (USGS 2018), total water withdrawals in Washington were estimated to be approximately 4,255 million gallons per day across eight use categories, ranked as follows:

- Irrigation 59%
- Public Supply 20%
- Industrial 10%
- Aquaculture 6%
- Domestic 3%
- Thermoelectric 1%
- Livestock 1%
- Mining less than 1%

While irrigation and public supply comprise nearly 80% of the state's water use overall, water use differs substantially between western and eastern Washington. The dominant water use in the western part of the state, where most of the state's population resides, is public supply. In the drier and more sparsely populated eastern portions of the state, where much of the state's agricultural production is based, crop irrigation is by far the dominant water use category. The areas of highest water use in the state are in central Washington, for crop irrigation (USGS 2018).

Under the current system, there are three types of water rights documents in Washington. Administered by Ecology, they include:

- **Claim** – A claim to a water right that predates the surface water or groundwater water rights permitting system. Can be confirmed only by a judicial process.
- **Permit** – The first step to obtaining a water right. Enables the water to be put to beneficial use with certain conditions and a set project development schedule.
- **Certificate** – Issued after a permitted use has been fully perfected and all conditions of the permit have been met.

All surface diversions and many groundwater withdrawals in Washington require a permit prior to water use. However, the groundwater code provides a qualified exemption to groundwater withdrawal permitting for certain uses including water for industrial purposes not exceeding 5,000 gallons per day. Daily limits may be less, or water may not be available based upon local conditions.

3.2.5.2 Instream flow requirements

The Water Resource Act of 1971 includes provisions for the protection and enhancement of instream flows, water quality, conservation of water use, and administration of water for the public. Adopted rules set instream flow requirements, establish requirements for new permitted water uses or through permit-exempt wells, and may close basins to all new unmitigated uses. In addition, several court decisions provide critical guidance for instream flow protection and management. For example, courts have held that well withdrawal that could affect surface water flows can be restricted by Ecology. Areas within basins within the study area that have instream flows and stream closures established are mapped by Ecology on their Instream Flow Rule Status map. Ecology conditions new permits to ensure that instream flow levels are protected, and stream closures are maintained (Ecology 2024d).

3.2.5.3 Adjudications

Water right adjudication is the civil legal process to resolve conflict over a water source and to prioritize water rights (Ecology 2024a). Adjudication results in a final, comprehensive inventory of rights to use water in the adjudicated area. Water rights adjudications are initiated by Ecology and processed in Superior Court (Washington Courts 2024). An adjudication is concluded when the Court either denies or confirms a water right and then directs Ecology to issue a Certificate of Adjudicated Water Right for the rights confirmed. Only a small portion of Washington’s water rights have been adjudicated (Ecology 2006, 2024c).

3.2.5.4 Basins with supply constraints and restrictions

Water availability varies throughout the state and is broadly tracked by Ecology and USGS. Prescription, a key component influencing water availability, has become less predictable due to human-induced climate change (Stanford University 2021). In addition to physical availability, water availability is dependent upon the legal availability as dictated by instream flow requirements and water rights held by others within each watershed, sub-basin, aquifer, or similar body of water. Water availability for a proposed facility can be understood through review of the WRIA. In many areas of the state, Ecology has designated rules that require new uses of water be fully mitigated or balanced through return of an equal amount of water to the watershed (Ecology 2024b).

3.3 Potentially required permits

Construction, operation, and decommissioning activities for typical green hydrogen facilities would require the following permits related to water resources:

- **CWA Section 404 Permit (U.S. Army Corps of Engineers [USACE]):** Required for activities that involve the discharge of dredged or fill materials in waters of the United States, including wetlands.
- **CWA Section 401 Water Quality Certification (Ecology/EPA/Tribes):** Required for activities affecting a water of the United States, including wetlands, and needing a federal permit or license (e.g., USACE Section 404 permit). Verifies whether projects can meet state water quality standards.
- **CWA Section 402 National Pollutant Discharge Elimination System (NPDES) Construction Stormwater Permit (Ecology/EPA):** Required for construction that disturbs more than 1 acre of land and would have the potential to discharge stormwater to state surface waters, or construction disturbance of any size that would have the potential to be a significant contributor of pollutants or may be expected to cause a violation of any water quality standard (including groundwater standards).
- **Chapter 90.48 Revised Code of Washington (RCW) authorization (Ecology):** Impacts to non-federally regulated waters, including wetlands, may require authorization from Ecology pursuant to Chapter 90.48 RCW (Water Pollution Control Act).
- **NPDES Industrial Stormwater General Permit (Ecology/EPA):** Required to operate sites with certain industrial activities that could discharge stormwater pollutants to surface waters of the state or certain facilities that have the potential to be significant contributors of pollutants or may be expected to cause a violation of any water quality standard (including groundwater standards).
- **Conditional Letter of Map Revision (CLOMR) or Letter of Map Revision (LOMR) (FEMA):** A CLOMR is a letter from FEMA commenting on whether a proposed project, if built as proposed, or proposed hydrology changes would meet minimum NFIP standards. A LOMR is a letter from FEMA officially revising the current NFIP map to show changes to floodplains, regulatory floodways, or flood elevations.
- **Hydraulic Project Approval (Washington Department of Fish and Wildlife [WDFW]):** Required for projects in, near, or over state waters that use, divert, obstruct, or change the natural flow or bed of any of the salt or fresh waters of the state. Intended to ensure that construction is done in a way that protects fish and aquatic habitats.
- **State Wastewater Discharge Permit – Industrial to Publicly Owned Works (Permit authority varies):** Required by industrial facilities that discharge wastewater to privately or publicly owned wastewater treatment plants unless they have obtained a pretreatment discharge permit issued by a delegated municipality.
- **Water Right Permit – New (Ecology):** Required to use any amount of surface water for any purpose. A permit for a water right would be required to withdraw groundwater from a well for any uses not covered by a groundwater permit exemption (e.g., typically domestic and industrial uses less than 5,000 gallons per day each, although some areas are more restrictive).
- **Water Right Change or Transfer Authorization (Ecology):** Required to change certain elements of a water right.
- **Waterworks Operator Certification (Washington Department of Health):** Required to operate waterworks, or a portion of waterworks, including treatment facilities or distribution systems.

- **Notice of Intent to Construct or Decommission a Well (Ecology):** Required for all drilling activities including, deepening, alteration, reconstruction, or decommissioning of a well.
- **State Waste Discharge Permits (Ecology):** Required for discharge to either groundwater or publicly owned treatment works.
- **Floodplain Development Permit (local):** Required for construction and development within FEMA mapped, special flood hazard areas.
- **Critical Areas Permit (local):** Must be obtained for construction and development activities within designated critical areas regulated by local jurisdictions, including vegetated buffers adjacent to streams and wetlands, critical aquifer recharge areas, and frequently flooded areas.
- **Shoreline Permit (local):** Required for development within shorelines of the state and regulated by local jurisdictions under the Shoreline Master Program and city or county code.

3.4 Green hydrogen production facility

This section describes potential impacts of green hydrogen production facilities. For the purposes of the PEIS, the estimated footprint of a green hydrogen production facility, based on existing facilities in other areas, ranges from 1 acre to 10 acres, depending on the production method, type of storage facilities, and the layout of external pipes and tanks, a parking area, and security fencing. The estimated height of structures is up to 100 feet.

A green hydrogen production facility would typically include a connection to the electricity grid to power all, or a portion of, the facility's equipment needs and buildings. Facilities typically connect to the main transmission line through distribution lines that can be up to 100 feet and between 1 and 8 miles in length, which would be determined by the project developer based on the distance between a selected site and existing electricity grid infrastructure. This technical appendix includes evaluation of impacts associated with distribution line connections to main transmission lines.

Off-site access roads may be needed to connect a facility to the existing state routes. Most of study area is less than 10 miles from a state route (63% within 1 mile and 99% within 10 miles). If needed, the project developer would determine the length of off-site access road needed, based on the distance between a selected site, existing road infrastructure, and coordination with state and local departments of transportation.

The extent and magnitude of impacts on water resources would vary depending on the geographical region of the facility as well as the size, and the production type and capacity of the facility. In general, the larger the facility, the greater the potential for impact. This would result from the larger disturbance footprint, the increased need for construction materials, the increased scale of the supporting infrastructure, and—dependent upon the type of facility—an increased need for water to produce green hydrogen. Conversely, smaller facilities require fewer structures, have reduced needs for supporting infrastructure, have less disturbance, and dependent upon the type of production, have less demand for water to produce green hydrogen.

3.4.1 Impacts from construction and decommissioning

Construction would require a water supply for fugitive dust control, equipment cleaning, and concrete mixing and pouring. Actual water use would vary depending on weather (rainy/dry), conditions of the site (dusty/muddy/paved), frequency of water application for dust suppression, whether dust suppressants/soil stabilizers are used (may require less water), how often equipment would be cleaned, and concrete composition. The total gallons of water estimated for a 1-acre site for 1 year of construction is 759,398 gallons and approximately 21,580,990 gallons for 3 years of construction of a 10-acre site. Table 3 provides a breakdown of the assumptions used to estimate construction water use.

Table 3. Green hydrogen construction – water supply demand

Water Need	1-acre site, 1-year period	10-acre site, 3-year period
Fugitive dust control [a]	702,000 gallons	21,060,000 gallons
Equipment cleaning [b]	8,998 gallons	36,990 gallons
Concrete [c]	48,400 gallons	484,000 gallons
Total	759,398 gallons	21,580,990 gallons

Notes:

a. Application rate of 0.25 inch, applied two times per week (26 inches per year). One inch of water over 1 acre is approximately 27,000 gallons.

b. Assume equipment is washed once per week, 30 gallons per equipment, based on equipment use from CalEEMod.

c. A total of 25% of site would be paved surfaces. Assume depth of 1 foot. Forty gallons water needed per cubic yard of concrete.

3.4.1.1 Surface water

Water quantity

Site characterization, construction, and decommissioning activities could impact surface water flows for facilities that involve elements within or adjacent to waterbodies, such as for a facility access road crossing of a stream. Streamflows could be temporarily re-routed from their natural channels by diversions needed to construct such crossings. Permanent alterations to streams could occur if culvert installations are needed at access road crossings, which if not adequately designed and sized, could restrict streamflow conveyance. These impacts would be minimized by following design guidelines and adhering to water crossing regulations, including WDFW's Water Crossing Guidelines for fish-bearing streams.

Ground disturbance for facility construction would impact flow rates and volumes of surface runoff reaching nearby streams. Vegetation clearing and soil compaction in site investigation and construction areas would reduce the land's potential to absorb and infiltrate precipitation, potentially leading to increases in stormwater peak flows.

Construction of site access, vehicle access and service roads, and foundations associated with green hydrogen production facilities would add impervious surface area (foundation pads, structures, paved surfaces) comprising up to 23,958 square feet of a facility on a 1-acre site and up to 239,580 square feet of a facility on a 10-acre site (or 55% of a site). The addition of impervious surfaces would increase surface water runoff from those areas and, depending on how stormwater drainage is managed, could permanently change the amount and timing of surface flows reaching nearby waterbodies.

In addition to increased stormwater runoff from impervious surface additions, construction of facility elements would alter drainage patterns in other ways. Facility changes in site topography from grading for site improvements, installation of vehicle access or service roads interrupting natural surface runoff patterns, and installation of utility trenches acting as a conduit for surface flow all affect how surface runoff moves across a site to nearby waterbodies.

Facilities would be required to comply with applicable requirements (such as an HPA, Water Right Permit, and NPDES construction permit) and implement BMPs to manage surface water flows and runoff. Applicants would be required to complete activities in compliance with applicable permits. Implementation of permit requirements, such as a Water Quality Monitoring and Protection Plan, would reduce impacts to surface water. Any blasting adjacent to waters, including wetlands, would also require site-specific BMPs.

Through compliance with laws and permits, and with implementation of actions that could avoid and reduce impacts, construction and decommissioning activities would likely result in **less than significant impacts** on water quantity.

Water quality

Site characterization and construction activities that involve in-water work and influence stormwater could adversely affect surface water quality in several ways. Typical construction equipment for industrial facilities includes bulldozers, front-end loaders, graders, portable generators, mobile cranes, pumps, pile-drivers, and trucks. Potential pollutants from operating such equipment would include fuel (gasoline and diesel fuel), oil, grease, coolant, and hydraulic fluid.

In-water

The presence of construction equipment and materials would increase the potential for associated pollutants to enter surface waters during in-water construction or through. Additional equipment may be needed for in-water work. In-water construction for elements such as new stream crossings for roads would temporarily elevate stream turbidity levels from sediment disturbance and temporary water management (e.g., bypassing and then re-introducing flows).

Construction would include on-site concrete mixing and pouring. Concrete work could create the potential for introducing high-pH discharges to surface waters if not properly managed, which could elevate in-water pH levels. Discharge of construction wastewater could increase flow rates, temperature, dissolved oxygen, or turbidity of receiving surface waters.

Stormwater

The presence of construction equipment and materials would increase the potential for associated pollutants to enter surface waters through stormwater runoff from areas of upland construction. Erosion would temporarily increase soil disturbance from establishing site access or from activity anywhere on a site. This would temporarily increase erosion potential and soil transport to receiving waters in runoff or by wind, contributing soil and associated pollutants such as metals and organics. The erosion potential of the soils, the proximity of disturbance to surface waters, and the size and nature of construction activity would all influence the potential for water quality issues from ground disturbance.

Fuel may be stored on the facility in an aboveground storage tank for equipment and vehicle use. Hazardous materials used during construction would be typical of most industrial facility construction, such as fuels, oils, solvents, compressed gases, paint, coatings, herbicides, pesticides, and battery electrolytes. Improper handling or spills could affect surface water. Hazardous material storage requirements and federal requirements for facilities storing more than 1,320 gallons of petroleum fuel would require secondary containment. For these types of quantities, spills would likely be to secondary containment, within buildings, or to soil and able to be cleaned up. Spills which reach water would need to be contained, assessed, and remediated, with hazardous waste transported and disposed of in compliance with state and federal regulations. Potential impacts of spills are further discussed in the *Earth Resources Technical Appendix* and *Environmental Health and Safety Technical Appendix*.

Industrial land use areas may have areas that have been contaminated from previous activities. Construction within or near contaminated soil, groundwater, or sediment may impact water quality. Prior to construction, conducting an Environmental Site Assessment would help evaluate potential on-site hazards. Plans could be implemented based on findings to avoid risks of release. Contamination is further discussed in below in Section 3.4.1.2 Groundwater.

Facilities would be required to obtain water quality permits for construction and best management practices (BMPs) would be implemented to manage stormwater and wastewater discharges as well as any in-water work. Applicants would be required to complete activities in compliance with applicable permits. Implementation of permit requirements, such as implementation of a Water Quality Monitoring and Protection Plan, would reduce impacts to surface water quality. Any blasting adjacent to waters, including wetlands, would also require site-specific BMPs.

The potential for temporary water quality impacts to surface waters from facility and road decommissioning would be similar to some of the impacts associated with construction. Demolition of concrete pads and foundations could result in water coming into contact with freshly exposed concrete surfaces and debris/dust, which could lead to elevated water pH levels. Temporary ground disturbance from structure and access road removal and from site grading to restore original grades after structure and road removal would temporarily increase the erosion potential of the site and increase the potential for exposed soils to reach nearby waterbodies through runoff or by wind. In-water work to remove any intake or discharge pipes could disturb sediments, thereby causing turbidity. Revegetation of temporary disturbance areas would limit the length of time soils are exposed. Structure removal at decommissioning would restore pre-facility drainage patterns.

Hazardous materials may be present during decommissioning from equipment or may be present on site in known contaminated areas. These materials could mobilize during construction and directly impact groundwater quality.

Through compliance with laws and permits, and with implementation of actions that could avoid and reduce impacts, construction and decommissioning activities would likely result in **less than significant impacts** on water quality.

3.4.1.2 Groundwater

Site characterization, construction, and decommissioning activities for green hydrogen production facilities—including groundwater or geotechnical drilling and testing to gather information or construction of foundations for buildings—would include subsurface excavation, fill, and concrete work, and could potentially require dewatering during construction. Such activities would depend on the site but could locally affect shallow groundwater flows to approximately the depth of the excavation.

Construction of site access, vehicle access and service roads, and foundations associated with green hydrogen production facilities would add impervious surface area (foundation pads, structures, paved surfaces) comprising up to 23,958 square feet of a facility on a 1-acre site and up to 239,580 square feet of a facility on a 10-acre site (or 55% of a site). could locally change surface-to-groundwater interactions and reduce groundwater recharge capability within those footprints. These make up a small portion (approximately 10%) of a facility site. This would result from impervious surfaces preventing infiltration of rainfall and snowmelt in the impervious surface footprints and directing runoff to locations adjacent to those footprints. Facilities would be required to obtain water quality permits for construction, and BMPs would be implemented to manage stormwater and wastewater discharges.

Industrial sites in more rural environments may include on-site water well installation and groundwater extraction to support construction and would require a water right (see Section 3.4.1.3). Wells using groundwater may result in localized water table drawdown. Industrial lands in developed areas would likely have water sourced from a water utility provider connection on-site or nearby because of established connections associated with an already-developed area.

Industrial land use areas may have areas that have been contaminated from previous activities. Hazardous material contamination may be present in the soil, surface water, or groundwater from previous industrial uses—many of which are classified as persistent organic pollutants, such as dichlorodiphenyltrichloroethane (DDT) and polychlorinated biphenyls (PCBs) (Ecology 2024b). Additional discussion of hazardous material contamination and cleanup sites is presented in the *Environmental Health and Safety Technical Appendix.* Construction within or near an existing groundwater pollution plume could cause contaminants to move between aquifers and result in disruption to groundwater beyond the development footprint.

Hazardous materials used during construction would be typical of most industrial facility construction and include solids, fluids, and gases. Table 4 describes anticipated hazardous materials used in construction and decommissioning of a facility similar in type and scale to a 10-acre site.

Table 4. Common hazardous materials potentially present during construction of typical industrial facility

Material	Use	Approximate volumes stored/generated on site
Fuels: diesel, gasoline, kerosene, and propane	Vehicles, construction machinery, generators, and equipment maintenance	<5,000 gallons
Other petroleum fluids such as lubricating oils, hydraulic fluids, brake fluids, and fuels; coolants and battery electrolytes	Vehicles, construction machinery, generators, and equipment maintenance	<3,500 gallons
Compressed gases: oxygen, acetylene, and nitrogen	Welding, cutting, and purging	<6,000 cubic feet
Solvents and cleaning agents	Cleaning, maintenance, and preparing surfaces for paint or other treatment	<1,000 gallons
Paints, primers, thinners, corrosion control coatings, sealants, and adhesives	Weatherproofing and preservation of equipment and structures, other construction and maintenance processes	<500 gallons
Herbicides and pesticides	Vegetation and insect control	<25 gallons
Battery electrolytes	Vehicle and equipment batteries	<250 gallons
Dielectric fluids (transformer oil)	Anti-conductive insulation for electric components, such as wires	<10,000 gallons
Concrete, cement, and asphalt	Paving, building structures, retaining walls	1,570–13,186 cubic yards

Improper handling or spills of the materials listed in Table 4 could result in the infiltration of pollutants into groundwater. Hazardous materials in Table 4 would be located inside containers or buildings with secondary containment and have low risk of reaching water. Spills that reach water would be required to be contained, assessed, and remediated, with hazardous waste transported and disposed of in compliance with state and federal regulations.

Prior to construction, conducting an Environmental Site Assessment would help evaluate potential on-site hazards. Plans could be implemented based on findings to avoid risks of release. Identification of UIC wells and potential use of an UIC well for stormwater drainage would be documented. Washington State's Model Toxics Control Act dictates the handling and cleanup of these types of hazardous materials. Releases would need to be contained, assessed, and remediated, with hazardous waste transported and disposed of in line with state and federal regulations. A spill prevention, control, and countermeasure (SPCC) plan would be required if more than 1,320 gallons of fuel is stored on site to reduce the risk of hazardous materials entering waterbodies, including through soil that might affect the flow toward navigable waters or adjoining shorelines. See the *Environmental Health and Safety Technical Appendix* for further discussion of the risks associated with use of hazardous materials.

Removal of structures and their foundations and access roads and restoration to pre-facility conditions would allow surface-groundwater interactions, including infiltration of rain and snowmelt and groundwater recharge.

Hazardous materials may be present during decommissioning from decommissioning equipment or may be present on site in known contaminated areas. These materials could mobilize during construction and directly impact groundwater quality.

Through compliance with laws and permits, and with implementation of actions that could avoid and reduce impacts, construction and decommissioning activities would likely result in **less than significant impacts** on groundwater.

3.4.1.3 Wetlands

Impacts to areas and functions of wetlands could occur during both the site characterization and construction of green hydrogen production facilities. Impacts to wetlands and buffers would typically be avoided during site characterization efforts because the extent and footprint of these activities is limited. Wetlands may need to be cleared and/or filled for the construction of staging and laydown areas, permanent site access routes, and other supporting infrastructure. Wetland functions (absorb floodwaters, filter contaminants, reduce erosion, support groundwater and surface water) may be lost or reduced during these activities. Sedimentation and/or overall reductions in water quality and quantity of surface and groundwater sources feeding wetlands could occur. Spills of pollutants could impact wetlands if materials reach waters. Roads and other infrastructure constructed in the vicinity of wetlands could introduce invasive plant species, change surface drainage patterns, or introduce sediments or pollutants into adjacent wetlands via runoff.

Alteration of drainage patterns during construction could alter surface or groundwater connections and could introduce pollutants and sediments or alter the depth, timing, and frequency of surface waters flowing into wetlands. Increases in impervious and hardened surfaces may limit surface water infiltration, resulting in a decrease of groundwater availability for nearby wetlands. Additionally, groundwater withdrawals necessary for construction could interface with surface waters and reduce water availability for wetlands.

The removal of facilities, access roads, and culverted road crossings from wetlands (or areas adjacent to wetlands) during facility decommissioning could introduce invasive plant species and temporarily increase erosion potential in those areas. Decommissioning activities could result in or increase soil compaction that could affect soil infiltration and alter drainage patterns, potentially affecting wetlands that occur in the vicinity.

As with construction and operation, decommissioning work would increase the potential for spills and leaks of fuel and other vehicle fluids from equipment to enter wetlands. Such impacts would be minimized by the implementation of erosion control measures and BMPs and via prompt revegetation and decompaction of disturbed soils.

Wetlands may be present on a potential facility site and the types of wetlands would be identified as part of site characterization. The type, size, and extent of wetlands would determine the degree of potential impact. If wetland impacts are likely, project developers would comply with a mitigation sequencing process in order to achieve the state goal of no net loss of wetland acreage and function. For projects involving impacts to wetlands that cannot be avoided, compensatory mitigation would generally be required to ensure there is no net loss of wetland functions for wetlands and wetland buffers. A facility would require a project-specific wetland mitigation plan before permits are issued.

Through compliance with laws and permits, and with implementation of actions that could avoid and reduce impacts, construction and decommissioning activities would likely result in **less than significant impacts** on wetlands.

3.4.1.4 Floodplains and frequently flooded areas

Site characterization, construction, and decommissioning activities could impact floodplains for green hydrogen production facilities that involve elements within or adjacent to waterbodies, such as for a facility access road crossing of a stream. The amount of impermeable surface required for a green hydrogen facility (approximately 10% of a 10-acre site) would not be likely to affect floodplain functions.

Potential decommissioning-related impacts on floodplains would be similar to those described previously for surface waters. Temporary work activity and ground disturbance in the floodplain could result in temporary impacts on floodplain functions. Floodplain functions could be restored to pre-facility conditions following structure and road removal, and restoration grading and planting.

Permanent alterations to waterbodies could occur with culvert installations at access road crossings, which could restrict natural surface water flow and floodplain functions for flood storage, sediment transport, large wood transport, and could also restrict aquatic species movements. WAC 220-660-190 requires that culverts for fish-bearing streams be designed to pass 100-year flood flow and debris. Development in floodplains is regulated under the NFIP through county and city code. Floodplain development permits are required to prevent development that would lead to alteration of floodplain functions, loss of storage, increase hazards, or cause a net rise in flood elevation during a 100-year flood.

Through compliance with laws and permits, and with implementation of actions that could avoid and reduce impacts, construction and decommissioning activities would likely result in **less than significant impacts** on floodplains.

3.4.1.5 Water availability and water rights

Construction of green hydrogen production facilities would create a water use need for supplying drinking water to construction workers, which are estimated to number between approximately 10 and 100 workers. Additionally, facilities would require a water supply during construction for fugitive dust control, equipment cleaning, and concrete work. Water for some facilities may be available from existing municipal sources or may be transported by truck to the site, depending on the volume required. Some facility sites may require obtaining water from new surface water diversions or groundwater withdrawals.

Water sourced from new surface water diversion or groundwater could temporarily alter surface water quantity and availability in areas hydraulically downstream of green hydrogen production facilities during facility construction. Increases in impervious and hardened surfaces could limit infiltration, resulting in increases in stormwater flows, either temporarily or permanently, which would affect the overall availability of surface waters.

Facility construction could impact stream buffers or permanently alter local drainages and drainage patterns, which could alter the quantity and availability of surface waters in nearby water bodies. Permanent alterations could occur with culvert installations at access road crossings, which, if not adequately designed and sized, could restrict streamflow conveyance. Additionally, groundwater withdrawals, if necessary for activities including concrete pouring, could interface with surface waters and reduce surface water quantity. Diversions of surface water for construction would require obtaining a water right prior to diversion. For a 1-acre site, water need on average per day is approximately 2,080 gallons per day. For a 10-acre site, water needed on average per day is 19,708 gallons per day. Groundwater pumping would also require a water right if withdrawals exceeded groundwater permit exemption thresholds of 5,000 gallons per day for industrial uses. Water used for construction activities that exceed 5,000 gallons per day would require a water right. Water availability and the likelihood of obtaining new water rights for construction vary by location. Water rights may not be granted in watersheds that are already over-appropriated and subject to instream flow requirements that are often not met. If facilities need a water supply from ground or surface water on-site, they would be required to obtain a water right for construction water needs. If water is not available, a water right would not be issued.

A green hydrogen facility developer would need to ensure that there is sufficient water available for a project, both physically and legally. Water availability will vary based on the project and location. If water is needed for a project and is not available, a project would not be able to operate. With this assumption, through compliance with laws and permits, and with implementation of actions that could avoid and reduce impacts, the construction and decommissioning of facilities would likely result in **less than significant impacts** on water rights and water availability.

3.4.2 Impacts from operation

Impacts from operations would vary by the type of production facility and its water requirements and discharges. Chapter 2 of the PEIS provides a summary of the water requirements and discharges for the facility types evaluated. Additional details relative to the operations water resource impact analysis are provided below.

Operations water requirements

Electrolysis and steam-methane reforming (SMR) processes require the greatest amount of water to produce green hydrogen; pyrolysis does not require water, and bio-gasification water needs are dependent on the water present in the feedstock. Potential annual ranges of water requirements for electrolysis and SMR production range from slightly over 2 acre-feet (AF[5]) per year for the smallest electrolysis facility (1-acre site) to nearly 900 AF per year for the largest SMR facility (10-acre site) (Table 5).

Table 5. Green hydrogen production – water requirements

Production type	Electrolysis at 2–3 gallons of water per kg of H_2	SMR at 6–8 gallons of water per kg of H_2	Bio-gasification at 1.3 gallons of water per kg of H_2
Range: typical facility daily water requirements (gallons)	2,000–27,000	12,000–800,000	50,000–100,000
Range: typical facility annual water requirements (gallons)	730,000–9,855,000	4,380,000-292,000,000	23,725,000–474,500,000
Range: typical facility daily water requirements (cubic feet)	267–3,609	1,604–106,944	8,689–17,378
Range: typical facility annual water requirements (cubic feet)	97,587–1,317,422	585,521–39,034,722	3,171,571–6,343,142
Range: typical facility daily water requirements (acre-feet [AF])	0.006–0.085	0.037–2.455	0.199–0.399
Range: typical facility annual water requirements (AF)	2.240–30.244	13.442–896.114	72.809–145.618
Range: typical facility daily water requirements (gallons)	2,000–27,000	12,000–800,000	50,000–100,000
Range: typical facility annual water requirements (gallons)	730,000–9,855,000	4,380,000–292,000,000	23,725,000–474,500,000

Note: kg = kilogram(s)

As with all estimates, numbers have been developed for typical facilities. It should be noted that the bio-gasification process has very broad range and numbers represented are variable. Estimates were based on the green hydrogen production facility technologies and inputs presented in Chapter 2 of the PEIS.

[5] An acre-foot (AF) is the amount of water required to cover 1 acre of land (about a football field) with water to a depth of 1 foot. There are 325,851 gallons or 43,560 cubic feet of water in 1 AF. The Grand Coulee Dam on the Columbia River has a storage capacity of about 9,386,000 AF of water.

Water supply would be needed during production, with electrolysis and SMR having the greatest water needs. Potential annual ranges of water requirements for electrolysis and SMR production are broad, ranging from annual requirements slightly over 2 AF per year for the smallest electrolysis facilities to nearly 900 AF per year for the largest SMR facilities. Water availability varies by location, sufficient water may not be available to meet the needs of a proposed facility.

Operations water discharges

Reverse osmosis would be required for the electrolysis process and could be used for the SMR process. For electrolysis, to produce 1 kg of hydrogen, on-site water treatment through reverse osmosis would produce approximately 1 gallon of wastewater. For SMR, 1 kg of hydrogen production would process 2 to 3 gallons of wastewater. Potential ranges of wastewater generated during the electrolysis and SMR production process are specified in Chapter 2 of the PEIS and are detailed in are detailed in Table 6. The pyrolysis production process would not produce wastewater.

Table 6. Ranges: Daily and annual wastewater generation by production facility type

Production type	Range: daily wastewater generated (gallons)	Range: annual wastewater generated (gallons)	Range: daily wastewater generated (cubic feet)	Range: annual wastewater generated (cubic feet)	Range: daily wastewater generated (AF)	Range: annual wastewater generated (AF)
Electrolysis - Reverse osmosis wastewater generated per kg of H_2	1,000–9,000	365,000–3,285,000	133.7–1,203.1	48,793.4–439,140.6	0.003–0.027	1.120–10.081
SMR - Reverse osmosis wastewater generated per kg of H_2	2,000–100,000	730,000–36,500,000	267.4–13,368.1	97,586.8–4,879,340.3	0.006–0.307	2.240–112.014
Bio-gasification – estimated wastewater generated at 30% of water consumption	15,000–30,000	5,475,000–10,950,000	2,005.2–4,010.4	731,901.0–1,463,802.1	0.046–0.092	16.8–33.6

3.4.2.1 Surface water

Water quantity

Water supply would be needed to operate green hydrogen production facilities. All production types would require small volumes of water for potable and sanitary water supply needs as well as for irrigation of vegetation and other miscellaneous facility maintenance and operation needs. Water quantity is discussed below by production type.

Electrolysis

Operation and maintenance of the electrolysis production method would require about 2 to 3 gallons of water to produce 1 kg of hydrogen. The electrolysis process typically requires demineralized water, which would be produced on-site through the reverse osmosis.

Steam-methane reforming (SMR)
Operation and maintenance of the SMR production method would require approximately 6 to 8 gallons of water per kg of hydrogen produced water (steam). The SMR process may also require demineralized water produced through reverse osmosis.

Pyrolysis
Operation and maintenance of the pyrolysis production method would not require water.

Bio-gasification
Operation and maintenance of the bio-gasification production method would require approximately 1.3 gallons of water per 1 kg of hydrogen produced.

Bio- gasification could require water for processes such as steam production, cooling, and flue gas desulfurization. Generally, biomass contains sufficient water to be processed without additional water; however, water could be required to supplement certain bio-gasification feedstocks used during the bio-gasification production process.

Water quantity impact conclusion
Impacts to surface water quantity during operations would vary by production facility type due to differences in production processes. Compared to electrolysis and bio-gasification, SMR would have the highest water needs for production. To produce 1 kg of hydrogen, electrolysis would require approximately 2–3 gallons of water; SMR would require approximately 6–8 gallons of water; and approximately 1.3 gallons of water would be required for bio-gasification.

Water needs during operation of green hydrogen production facilities would be comparable to the needs of other industrial facilities that produce fuels. Other industries that produce fuels, like gasoline, require approximately 1–11 gallons of water to produce 1 kg of gasoline (EPA 2024b).

When siting a green hydrogen production facility, water availability through a water right or municipal supply, drought conditions, and water scarcity would need to be considered in relation to potential water quantity needed. Operations impacts related to water availability and water rights are discussed below in Section 3.4.2.5.

Through compliance with laws and permits, and with implementation of actions that could avoid and reduce impacts, operation and maintenance activities would likely result in **less than significant impacts** on surface water quantity.

Water quality
Operation and maintenance of green hydrogen production facilities would involve the on-site storage and production, of hazardous materials including methane, alkaline electrolyzers, and hydrogen (see Table 9 of the *Environmental Health and Safety Technical Appendix*); and the use of nickel or biomass gasification byproducts. Fuel and oil for generators would be required to provide backup power. Fuel is expected to be stored in aboveground storage tanks with containment. If more than 1,320 gallons are stored on site, a facility must have an SPCC plan to

prevent, control, and respond to spills. Hazardous material storage requirements and federal requirements for facilities storing more than 1,320 gallons of petroleum fuel would require secondary containment. For these types of quantities, spills would likely be to secondary containment or nearby soil and able to be cleaned up. Environmental health and safety impacts are discussed in the *Earth Resources Technical Appendix* and the *Environmental Health and Safety Technical Appendix*.

The addition of impervious surfaces for buildings and vehicle access roads, combined with on-site oil and fuel storage and the periodic presence of maintenance vehicles and equipment on the site, would create some potential for pollutants in stormwater discharges. Maintenance of facilities could also involve periodic use of herbicides to manage unwanted vegetation, which could impact water quality in receiving waterbodies if not applied properly.

Periodic ground disturbance required to maintain access, fencing, buildings, utility lines and infrastructure, and vegetation could temporarily increase erosion potential and soil transport to receiving waters, resulting in decreased surface water quality. Use of certain dust-suppression methods could degrade water quality through introduction and increase of total dissolved solids concentrations in surface waters. Transport would occur, due primarily to runoff resulting from precipitation or due to atmospheric deposition through wind-driven transport.

All production facilities would include small volumes of sanitary wastewater from other operations and maintenance activities such as office building kitchens and restroom facilities. Smaller facilities may be remotely operated, while larger facilities may have one to three operations personnel on site 24 hours per day, 7 days per week. Sanitary water usage in industrial settings is approximately 10 gallons per person per shift where there are just toilets at the facility, and up to 25 gallons per person per shift where there are toilets, showers, and full kitchen services (i.e., food preparation and dish washing) (EPA 2024c).

Impacts to surface water quality during operations would vary by production facility type (electrolysis, SMR, pyrolysis, and bio-gasification) due to differences in the types of chemicals and pollutants used and stored on-site, and differences in production processes and wastewater discharges. Production of green hydrogen facilities could result in production of air emissions as a byproduct that could be transported to receiving waters through atmospheric deposition. The level of atmospheric pollutant deposition depends on the concentration of pollutants in the atmosphere, and meteorological conditions (e.g., wind, rain, temperature). Atmospheric pollutants are addressed in the *Air Quality and Greenhouse Gases Technical Appendix.* Any inadvertent release of liquid or gaseous hydrogen would become gaseous and would not impact water resources.

If required, the operation and maintenance of in-water intake and discharge pipes could lead to impacts to water quality. Operation of these pipes involves water intake and water discharge. Discharges could erode sediment, leading to turbidity. Discharged water could be a different temperature as well, depending on the production method and discharge location. Maintenance of these systems could require in-water work, which could cause turbidity.

Wastewater is discussed below by production type.

Electrolysis

Operation and maintenance of the electrolysis production method would involve the on-site storage and use of potential hazardous materials in the form of alkaline electrolyzers (usually potassium hydroxide and sodium hydroxide) and the production of hydrogen. These hazardous materials could be stored on-site in solid or liquid state. If in liquid state, the storage volume could range from 1,000 to 30,000 gallons or more as the size of the plant is increased. Liquid electrolytes pose a risk of spill. Proper handling and spill prevention measures would be in place to reduce these spill risks and reduce the risks of contaminating soil, surface water, and groundwater. Impacts to soil resources are discussed in the *Earth Resources Technical Appendix*.

The electrolysis production method would also create wastewater from the reverse osmosis process. Wastewater from the reverse osmosis process would be treated on-site or routed to a wastewater treatment plant. To produce 1 kg of hydrogen through electrolysis, on-site water treatment through reverse osmosis would produce approximately 1 gallon of wastewater.

SMR

Operation and maintenance of the SMR production method would involve the on-site storage and production of potential hazardous materials in the form of methane and hydrogen. Nickel would be in the nickel-based catalysts and contained in the reformer tubes; catalysts would be replaced as part of routine maintenance every 5 to 6 years. Improper disposal of nickel-based catalysts could lead to soil, groundwater, and surface water contamination. The operator would need to consult with local disposal facilities and review local and federal disposal standards for nickel-based catalysts to avoid contaminating the site and surrounding area. Impacts to soil resources are discussed in the *Earth Resources Technical Appendix*.

The SMR process also results in wastewater produced from cooling tower blowdown, boiler blown water, reverse osmosis reject water, and de-aerator vent water. As with electrolysis, wastewater from the reverse osmosis process would be contained and treated on site or routed to a wastewater treatment plant. For SMR, 1 kg of hydrogen production would process 2 to 3 gallons of wastewater.

Pyrolysis

Operation and maintenance of the pyrolysis production method would involve the on-site storage and production of potential hazardous material in the form of methane and the production of hydrogen. The pyrolysis production method would produce methane but would not produce wastewater.

Nickel would be in pellet form within the catalyst inside the reformer tubes. It would not be stored on site or released from the reformer tubes during hydrogen production. The catalyst would be replaced as part of routine maintenance every 5 to 6 years. Improper disposal of nickel-based catalysts could lead to soil, groundwater, and surface water contamination. The operator would need to consult with local disposal facilities and review local and federal disposal standards for nickel-based catalysts to avoid contaminating the site and surrounding area. Impacts to soil resources are discussed in the *Earth Resources Technical Appendix*.

The pyrolysis production method would produce methane but would not produce wastewater.

Bio-gasification

Operation and maintenance of the bio-gasification production method would not involve the on-site storage of pollutants, but could output biomass as moisture, ash (solid carbon), carbon dioxide, hydrogen, nitrogen, chlorine, sulfur, or oxygen as hazardous and non-hazardous compounds. Bio-gasification production would produce carbon monoxide and dioxide. The bio-gasification production method would require on-site storage and management of feedstocks. Type and volume of these feedstocks would be highly variable as based upon the type and size of the bio-gasification facility. Storage would be closely managed to ensure effective function of the material during the bio-gasification process. Contaminated water from scrubbers would be contained and treated on site to NPDES requirements or routed to a wastewater treatment plant. Mineralized water could result from bio-gasification production, requiring demineralization. Demineralized water would need to be disposed of according to plans and permits, which could include being trucked off-site.

Production of green hydrogen and operation of bio-gasification facilities could result in production of air emissions as a byproduct that could be transported to receiving waters through atmospheric deposition. The level of atmospheric pollutant deposition depends on the concentration of pollutants in the atmosphere, and meteorological conditions (e.g., wind, rain, temperature). These atmospheric pollutants are addressed in the *Air Quality and Greenhouse Gases Technical Appendix.*

Water quality impact conclusion

Storage and treatment of wastewater from reverse osmosis could create the potential for pollutants to enter surface waters and degrade water quality. BMPs and regulatory requirements for storage of hazardous materials would reduce the risk of inadvertent impacts to surface waters. Water intake and discharge could create the potential for impacts to aquatic resources, cause turbidity and water temperature increases. With implementation of BMPs such as screening, monitoring turbidity, and complying with temperature standards through the NPDES permit and HPA permit for in-water work would avoid or reduce these impacts.

Green hydrogen facilities may be required to comply with NPDES standards and requirements. Wastewater would be treated on site to meet NPDES permit requirements or routed to a wastewater treatment plant. Facilities proposed in locations discharging to impaired surface waters with TMDLs could receive a Water Quality-based Effluent Limitation consistent with TMDL waste load allocations. If an NPDES permit is not required, developers would still be required to manage projects to prevent pollutants from reaching surface waters. Developers can reference the most recent version of Ecology’s stormwater management manuals for BMPs.

Through compliance with laws and permits, and with implementation of actions that could avoid and reduce impacts, operations activities would likely result in **less than significant impacts** on surface water quality.

3.4.2.2 Groundwater

On-site storage and use of generator fuel and transformer oil present some risk of spills or releases of pollutants to the subsurface and could present a potential source of groundwater contamination. Buildings for operation of green hydrogen facilities could include sanitary wastewater discharges (e.g., from restrooms) to the subsurface through on-site septic systems. Septic systems could present risks of bacterial contamination of groundwater if not designed and maintained in accordance with local codes.

Groundwater withdrawals could impact groundwater quantity through a reduction in volumes and availability. Groundwater availability and quantity could be lowered through surface water diversion or reduction. Localized water table drawdown would be limited due the requirement to obtain a water right for use of more than 5,000 gallons of groundwater per day. If water is not available, a water right would not be issued. This would limit potential for surface water diversions to impact groundwater.

Improperly designed groundwater wells could create conduits for poor-quality groundwater, as well as contaminants, to move between aquifers, including previously stationary groundwater pollution plume. Chemical, fuels, and wastewater spills could result in infiltration of pollutants and pathogens into groundwater. Hazardous material requirements and BMPs discussed in relation to surface water would prevent similar impacts to groundwater.

SLR could result in the intrusion of saltwater into groundwater aquifers, causing decreased groundwater quality and the need to either increase water treatment for use in facility operations or develop a new water source.

As described above for surface water quality, green hydrogen facilities may be required to comply with NPDES standards and requirements. Wastewater would be treated on site to NPDES requirements or routed to a wastewater treatment plant. If an NPDES permit is not required, developers would still be required to manage projects to prevent pollutants from reaching groundwater. Developers can reference the most recent version of Ecology's stormwater management manuals for BMPs. In coordination with Ecology, UIC may also be used to manage wastewater. All applicable laws and regulations would be followed for use of on-site groundwater wells, and coordination with local treatment facilities would be necessary for off-site disposal and discharges to wastewater treatment facilities.

Through compliance with laws and permits, and with implementation of actions that could avoid and reduce impacts, operations activities would likely result in **less than significant impacts** on groundwater.

3.4.2.3 Wetlands

General operating procedures are unlikely to affect wetlands because they typically involve relatively passive activities that do not readily alter the landscape once the facility is installed. Potential water quality impacts on wetlands could occur during rain events, which could create runoff that carries sediment. Spills of hazardous materials used or stored at the facility could impact nearby wetlands if outside of containment. Surface and groundwater withdrawal to support green hydrogen production and facility operations could reduce the amount of water available to support wetlands. This would result in degradation to the function of nearby wetlands and associated buffers.

Runoff from parking areas, buildings, and other facility infrastructure or septic system discharges would also degrade water quality in adjacent wetland areas.

Maintenance activities such as vegetation removal, access road maintenance, excavating a section of pipeline within a wetland, would also affect wetlands. Potential soil transport to nearby wetlands, resulting in decreased water quality and function, could occur as a result of periodic ground disturbance. Materials transported into wetlands could temporarily degrade water quality. Transport by winds would be minimized through incorporation of standard BMPs and would subside following completion of facility maintenance and any necessary site stabilization measure (e.g., hydroseeding or revegetation).

Employee and fleet vehicles and other maintenance equipment utilized during operations and maintenance would increase the likelihood that pollutants could be discharged and enter wetlands.

As described above for surface water quality, green hydrogen facilities may be required to comply with NPDES standards and requirements. Wastewater would be treated on site to meet NPDES permit requirements or routed to a wastewater treatment plant. If an NPDES permit is not required, developers would still be required to manage projects to prevent pollutants from reaching surface waters. Developers can reference the most recent version of Ecology's stormwater management manuals for BMPs.

If wetland impacts are likely, project developers would comply with a mitigation sequencing process to achieve the state goal of no net loss of wetland acreage and function. For projects involving unavoidable impacts to wetlands, compensatory mitigation would generally be required to ensure that there is no net loss of wetland area and functions for wetlands and wetland buffers. A facility would require a project-specific wetland mitigation plan before permits are issued.

Through compliance with laws and permits, and with implementation of actions that could avoid and reduce impacts, operations activities would likely result in **less than significant impacts** on wetlands.

3.4.2.4 Floodplains and frequently flooded areas

Potential operation and maintenance impacts on floodplains would be similar to those described previously for surface waters. Maintenance of facility elements within floodplains could interfere with floodplain functions. For example, if vegetation maintenance at facilities and along access roads were to prevent natural vegetation from re-establishing, it could affect vegetation support for floodplain functions for water quality, habitat, and water velocity attenuation. Due to floodplain development permit requirements, facility operation is not expected to lead to alterations to floodplain functions and/or any loss of floodplain storage that would cause a net rise in flood elevation during a 100-year flood.

Through compliance with laws and permits, and with implementation of actions that could avoid and reduce impacts, operations activities would likely result in **less than significant impacts** on floodplains.

3.4.2.5 Water availability and water rights

Water supply would be needed during production, with electrolysis and SMR having the greatest water needs. Potential annual ranges of water requirements for electrolysis and SMR production are broad, ranging from annual requirements slightly over 2 AF per year for the smallest electrolysis facilities to nearly 900 AF per year for the largest SMR facilities. Water availability varies by location, and sufficient water may not be available to meet the needs of a proposed facility.

Water could be obtained from local wholesalers and providers, or it may be obtained through on-site surface water diversions or groundwater withdrawal. Water would also be required, in smaller volumes, for potable and sanitary water supply needs as well as for irrigation of vegetation and other miscellaneous facility maintenance and operation needs. Water may be obtained as a result of water right modifications that alter the use of an existing permit or perfected right from another consumptive use (e.g. agricultural, mining).

Operations and maintenance of green hydrogen production facilities would also require water for potable and sanitary water supply needs, irrigation of vegetation, and other miscellaneous facility maintenance actions. Impacts to surface water and groundwater quantity are described above and could include a reduction of volumes and overall availability.

Water for some facilities may be available from existing municipal sources and supplies. In this instance, it is assumed that a developer would obtain a letter of water availability from a wholesaler for the project-level review. The letter would confirm that water requirements of a particular facility could be met. Other facilities may require obtaining water from new on-site surface water diversions or groundwater withdrawals. If facilities need a water supply from ground or surface water on-site, they would be required to obtain a water right for operation water needs. If water is not available, a water right would not be issued.

A green hydrogen facility developer would need to ensure there is sufficient water available for a project, both physically and legally. Water availability will vary based on the project and location. If water is needed for a project and is not available, a project would not be able to operate.

The PEIS assumes that a project developer will have water rights as needed. With this assumption, through compliance with laws and permits, and with implementation of actions that could avoid and reduce impacts, the operation of facilities would likely result in **less than significant impacts** on water rights and water availability.

3.4.3 Actions to avoid and reduce impacts

This section identifies the types of actions that should be considered to avoid and reduce impacts to water resources. Site-specific measures to avoid and minimize impacts on water resources would need to be developed at the project level.

3.4.3.1 Siting and design considerations

- Identify water use and suitable source availability for the anticipated life of the facility.
- Characterize and quantify the potential volume of wastewater and pollutant loading to be discharged. Identify potential treatment options as applicable.
- Site facility in location where anticipated pollutant loading is compatible with receiving water body assimilative capacity.
- Conduct a hydrologic study of the site to understand the local surface water and groundwater hydrology. Identify site surface runoff and drainage patterns and groundwater levels and flow direction.
- Perform a wetland delineation on the site to identify and map any potential wetlands that may be present. Assess wetland functions and rate all on-site wetlands using the appropriate Washington State Wetland Ratings System method to determine their categories and local buffer requirements. Examine adjacent properties for the presence of off-site wetlands that could be affected by facility construction and operation, map their locations, and identify any off-site connections to surface waters.
- Avoid siting structures and roads within waterbodies, wetlands, associated buffers, shorelines of the state, mapped floodplains and other frequently flooded areas, and critical aquifer recharge areas.
- Avoid siting structures in areas of known soil or groundwater contamination, and in direct proximity to impaired receiving waters.
- Avoid crossing waters of the state. Where crossings of waterbodies or streams cannot be avoided, prevent impacts to surface waters by spanning the waterbody (e.g., road bridges or aboveground lines) or using horizontal directional drilling to cross beneath it (e.g., underground lines).
- Where in-water work and wetland impacts cannot be avoided, minimize impacts to water quality by working below the ordinary high water mark during the dry season when no rain is predicted
- Where in-water work cannot be avoided, minimize impacts to aquatic species by working within the WDFW-recommended in-water work window, following applicable

design guidelines (e.g., WDFW Water Crossing Design Guidelines [Barnard et al. 2013]), and adhering to regulations, including WAC 220-660-190 (Water Crossing Structures).
- Avoid alteration of existing drainage patterns to the extent practicable, especially in sensitive areas such as erodible soils or steep slopes.
- If floodplains cannot be avoided, design the structures located within them so as not to restrict or redirect flows from their natural flow path.
- Use design and construction methods to avoid impacts to waters of the state.
- Avoid siting proposed facilities and infrastructure within shoreline jurisdiction where possible.

3.4.3.2 Permits, plans, and best management practices

- Diverting and using surface water requires a water right. In general, pumping groundwater from a well requires a water right unless it falls under the statutory groundwater permit exemption (RCW 90.44.050), which limits domestic and industrial uses to no more than 5,000 gallons per day each. Some WRIAs have more restrictive administrative groundwater permit exemptions, which should be verified for the facility location early in the planning process.
- If water diversion is required, a new water right would be issued by Ecology. Water availability for new water rights varies dramatically across the state. Many areas have administrative rules that close or limit water sources for new consumptive water rights. In those areas, all requests for new water rights will need to be fully mitigated. As an alternative, local water purveyors may have existing water right capacity to serve new green hydrogen facilities.
- An HPA would need to be obtained from WDFW for facilities in, near, or over state waters that use, divert, obstruct, or change the natural flow or bed of such waters.
- A DNR aquatic use authorization may be required for activities involving use of state aquatic lands.
- Coverage under the Ecology NPDES Construction Stormwater General Permit would be needed for all facilities disturbing more than 1 acre of ground with potential to discharge to surface waters of the state, and NPDES Industrial Stormwater General Permit coverage may be needed during operation for sites with on-site oil and fuel storage and maintenance activities. Ecology requires that stormwater pollution prevention plans (SWPPPs) be prepared and implemented to ensure compliance with state and federal water quality standards. The SWPPPs need to include BMPs from the most recent version of Ecology's *Stormwater Management Manual for Eastern Washington* or *Stormwater Management Manual for Western Washington*, depending on site location.
- Ecology prepares individual NPDES water quality permits for one entity when discharge characteristics are variable and do not fit a general permit category. As needed, an applicant would obtain an Individual State Waste Discharge Permit.
- If the facility has an aggregate storage capacity of oil greater than 1,320 gallons or where a discharge could reach a navigable waterbody, either directly or indirectly, an SPCC plan is required to prevent spills during construction and operation and to identify measures to expedite the response to a release if one were to occur. The SPCC plan

would be prepared in consultation with Ecology and pursuant to the requirements of Code of Federal Regulations (CFR) 112, Sections 311 and 402 of the CWA, Section 402 (a)(1) of the Federal Water Pollution Control Act, and RCW 90.48.080.

- Facilities that involve a discharge of dredged or fill material to a water of the United States, including wetlands, would need CWA Section 404 permit coverage from USACE. The application for Section 404 permit coverage would need to document BMPs the developer will implement to avoid and minimize impacts to water resources.
- For facilities that require a USACE Section 404 permit or another federal permit or license:
  - Section 401 Water Quality Certification is required. A pre-filing meeting request is required at least 30 days prior to submitting a request for a Section 401 Water Quality Certification. Additionally, when submitting a request for a Section 401 Certification, Ecology will require submittal of supporting documentation such as a Water Quality Monitoring and Protection Plan, wetland delineation, wetland mitigation plan, and SEPA determination.
  - Coastal Zone Management Act Federal Consistency is required if the facility is located within or outside of Washington's 15 coastal counties and could have reasonably foreseeable impacts on state coastal resources and uses. The activity must be consistent with the enforceable policies of the Washington Coastal Zone Management Program.
- Impacts to non-federally regulated waters, including wetlands, would require authorization from Ecology pursuant to Chapter 90.48 RCW (Water Pollution Control Act). Compensatory mitigation would be required for any impacts.
- Impacts to both jurisdictional and non-federally jurisdictional wetlands would require a wetland mitigation plan be developed in accordance with the state and federal interagency guidance in *Wetland Mitigation in Washington State* (Ecology et al. 2021).
- Impacts to waterbody and wetland buffers, floodplains and frequently flooded areas, and critical aquifer recharge areas would require local agency approvals pursuant to city and county floodplain and critical areas ordinances. Development within shorelines of the state would require local shoreline permits pursuant to Shoreline Master Program requirements and city or county code. Local agency requirements for water resources protection would need to be demonstrated and met for all of those approvals.
- Constructing structures in or over navigable waters of the United States would require authorization from the USACE under Section 10 of the Rivers and Harbors Act. Bridges constructed over navigable waters also require a permit from the U.S. Coast Guard. Use highly visible fencing and flagging around waterbodies, wetlands, and buffers to prevent unnecessary disturbance in sensitive areas and minimize the potential for water quality impacts.
- Minimize disturbance and removal of native vegetation in shorelines of the state.
- Manage stormwater runoff from buildings, parking areas, and access roads and properly maintain on-site sanitary wastewater systems to minimize water quality impacts to surface waters and wetlands from sediments and other potential contaminants.
- Implement BMPs for the use, transport, and storage of chemical and potentially hazardous materials at the facility.

- Install silt fencing throughout the site as a perimeter control, including on the contour down-gradient of excavations, around buildings.
- Use special construction techniques in areas of steep slopes, erodible soil, wetlands, impaired waterbodies, and waterbody crossings.
- Avoid creating potentially unstable slopes during excavation and blasting operations.
- Avoid creating hydrologic conduits between two aquifers (Chapters 173-200 and 173-201A WAC).
- If construction occurs near or within groundwater recharge areas, monitor activities to reduce the potential for contamination.
- Implement water conservation techniques to the extent practicable. Consider using soil stabilizers to reduce water needs for dust suppression. Avoid use of polyacrylamide dust-control methods near surface water features.
- Restore pre-construction contours, de-compact soil, and replant native hydrophytic vegetation in surface waters and wetlands temporarily disturbed by site characterization and construction activities
- Prepare a project-specific spill prevention and response plan (40 CFR 112).
- At least annually, conduct spill response training and training in applicable pollution-control laws and regulations for all relevant personnel.

3.5 Green hydrogen production facility with co-located battery energy storage system (BESS)

This section describes potential impacts of green hydrogen production facilities with up to two co-located BESS containers. The BESSs would be used to balance loads or to provide up to 15% of power in case of an outage or power quality deviation. One BESS would provide 2.85 megawatts of electricity for 4 hours (a capacity of 11.4 megawatt hours or 11,400 kilowatt hours). Each container would be approximately 60 by 12 feet wide and 10 feet tall.

3.5.1 Impacts from construction, operation, and decommissioning

The potential impacts on water resources described for facilities also apply to construction, operation, and decommissioning of facilities with co-located BESSs.

Co-locating BESSs would require a small additional construction-related ground disturbance and increased building footprint relative to facilities with no BESSs. A battery storage container would be installed on a concrete foundation designed for secondary containment.
A warehouse-type enclosure of a similar scale and size may also be used.

A BESS would add another stormwater consideration to a facility and potentially another regulated element to be included in an SWPPP. Specific stormwater management controls during construction, operation, and decommissioning for each facility would be dependent on the facility design and project site. Firefighters are not expected to use water for combatting a fire at a BESS. Emergency response actions are to allow the fire to burn to prevent water contaminated with pollutants to affect surface water and groundwater quality.

Through compliance with laws and permits, and with implementation of actions that could avoid and reduce impacts, the construction, operation, and decommissioning of facilities with co-located BESSs would likely result in **less than significant impacts** on water resources.

3.5.2 Actions to avoid and reduce impacts

The actions for reducing impacts through avoidance and minimization measures, permits, plans, and BMPs are the same as those identified in Section 3.4.3, with the added recommendation that:

- BESSs and associated infrastructure should be located away from surface waters and wetlands, as well as buffer areas.

3.6 Green hydrogen storage facility (gas or liquid form)

This section describes potential impacts of green hydrogen storage facilities. A green hydrogen storage facility could store hydrogen in gas or liquid form. Gaseous hydrogen would be stored in stationary, aboveground, cylindrical storage systems, each of which employs different construction materials to achieve maximum working pressure ratings. Liquid hydrogen would be stored in double-walled, vacuum-insulated cryogenic storage tanks. The footprint of a storage facility would depend on the amount of hydrogen needed to store but would be less than 1 acre. This includes the storage tanks, separation space between tanks (if more than one), on-site access roads, and ancillary equipment.

3.6.1 Impacts from construction, operation, and decommissioning

Potential construction, operation, and decommissioning impacts to water resources, as described for green hydrogen production facilities, largely apply to green hydrogen storage facilities. However, a green hydrogen storage facility would only have water resource requirements, water resource discharges, or types and volumes of hazard materials as a green hydrogen production facility on a 1-acre site. Construction and decommissioning ground disturbance would be needed for these storage facilities and the associated impacts to water resources would be similar to that described for production facilities.

During operations, if hydrogen was released from either type of storage, it would become gaseous and would not impact water resources. The amount of hydrogen stored on site could be higher than a green hydrogen production facility, but the same BMPs and precautions described previously would reduce the risk of liquid hydrogen leaks.

Water is not a required input for either storage method, or for the liquification process. Wastewater would not be generated through the storage for liquid or gas green hydrogen. Sanitary wastewater associated with potable consumption during operation would be anticipated, similar to that of green hydrogen production facilities due to similar number of on-site operation staff (some facilities may be remotely operated sites, while larger facilities may have one to three operations personnel).

Through compliance with laws and permits, and with implementation of actions that could avoid and reduce impacts, activities associated with green hydrogen storage facilities would likely result in **less than significant impacts** on water resources.

3.7 No Action Alternative

Under the No Action Alternative, agencies would continue to conduct environmental review and permitting for green hydrogen facilities under existing laws on a project-by-project basis. The potential impacts would be similar to the impacts for the types of facilities described above for construction, operation, and decommissioning, depending on facility size and design, and would be **less than significant**.

3.8 Unavoidable significant adverse impacts

Through compliance with laws and permits, and with implementation of actions to avoid and mitigate significant impacts, green hydrogen facilities would have **no significant and unavoidable adverse impacts** on water resources from construction, operation, or decommissioning.

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