Southwest Washington Planners' Forum

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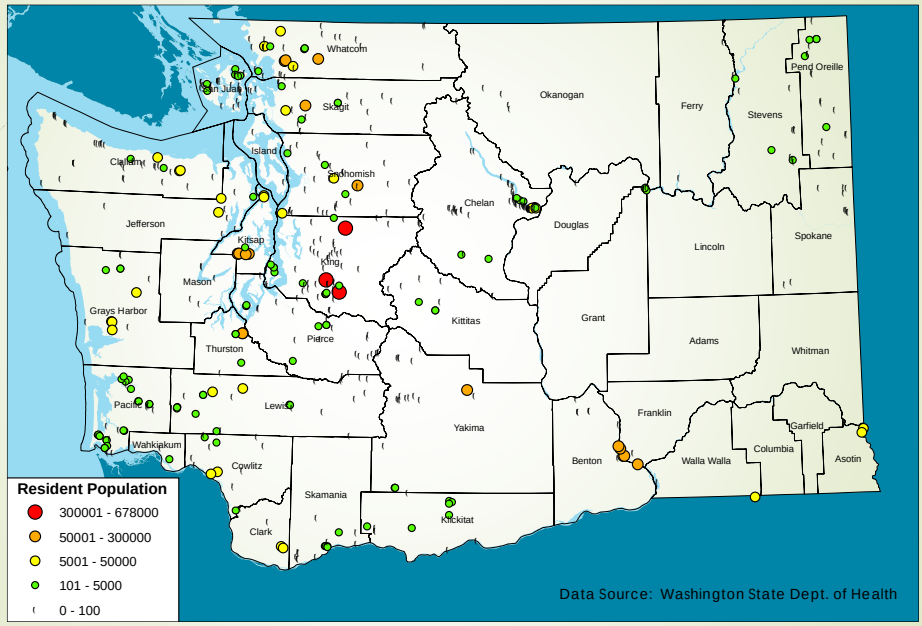
July 21, 2016

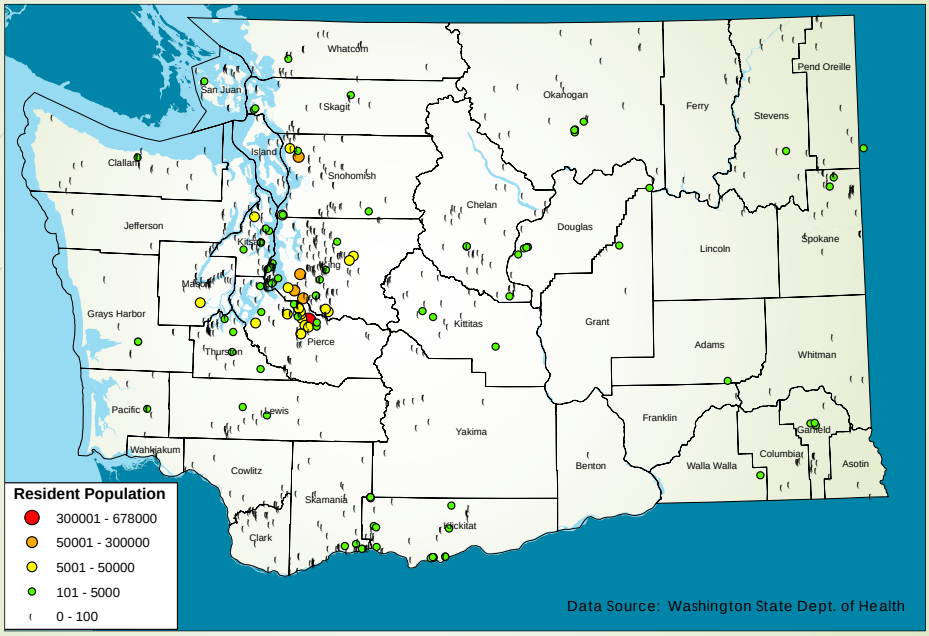
Critical Aquifer Recharge Areas

- Protecting drinking water quality & quantity
- LID: Out of the Sound, into the Ground
- Agricultural Nitrate mapping

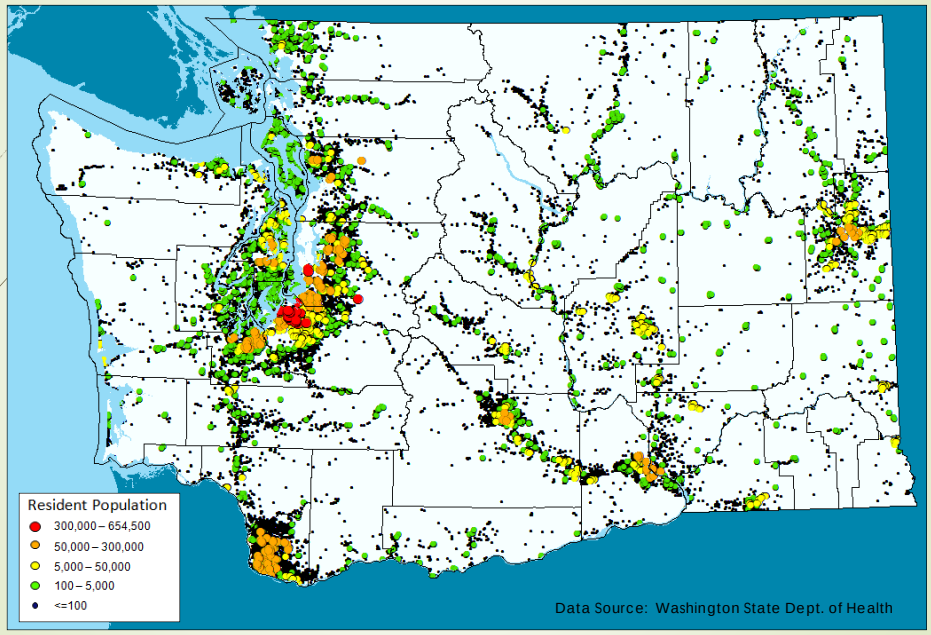
Public Water Supply System Surface Water Sources



Public Water Supply System Spring Sources



Public Water Supply System Groundwater Sources



Confirmed and Suspected Groundwater Contamination Sites – Ecology Toxics Cleanup Program

Contaminant Name
Arsenic
Asbestos
Base/Neutral/Acid Organics
Benzene
Conventional Contaminants, Inorganic
Conventional Contaminants, Organic
Corrosive Wastes
Dioxin/Dibenzofuran Compounds
Halogenated Organics
Halogenated Pesticides
Halogenated Solvents
Lead
LUST - Other Hazardous Substance
Mercury
Metals - Other
Metals Priority Pollutants
Methyl tertiary-butyl ether
Non-Halogenated Pesticides
Non-Halogenated Solvents
Other Deleterious Substances
Other Halogenated Organics
Other Non-Halogenated Organics
Other Reactive Wastes
PBDE
Pesticides-Unspecified
Petroleum Products-Unspecified
Petroleum-Diesel
Petroleum-Gasoline
Petroleum-Other
Phenolic Compounds
Polychlorinated biPhenyls (PCB)
Polynuclear Aromatic Hydrocarbons
Radioactive Wastes
Tributyltin

Protecting Groundwater Quality

- How contaminants get into groundwater and then into drinking water
- Common sources of contamination
- Prevention
- Authority to act – Go look at City of Vancouver Ordinance
- Combine protection for water resources (stormwater, surface water, groundwater)

Critical Aquifer Recharge Area Guidance

Point Sources

Non-Point Sources

City of Vancouver 1 and 5 Year Time of Travel Zones for Source Water Protection

Steps for Protecting drinking water quality & quantity

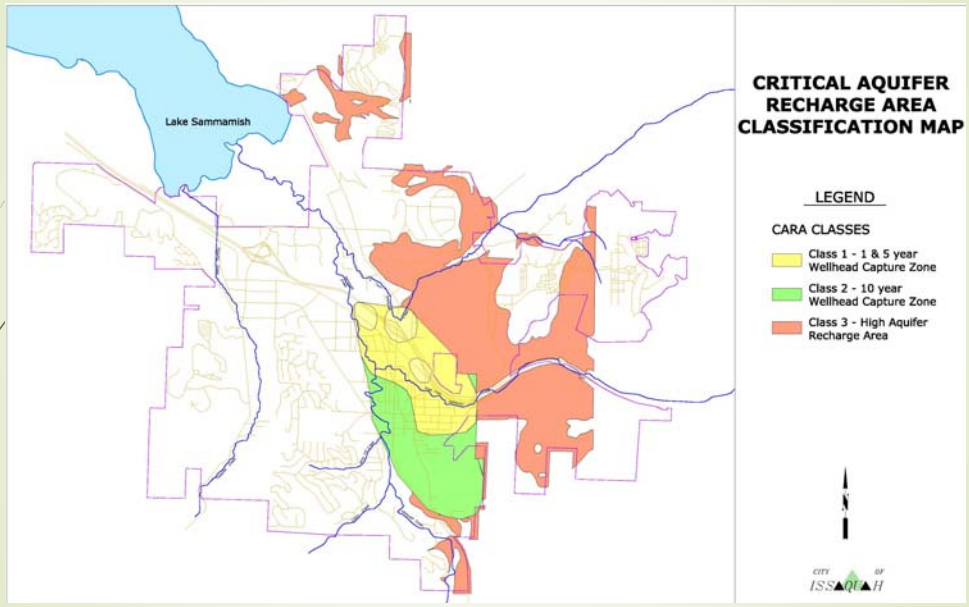
Functions and Values - Clean, Safe, and Available

- **Identify** where groundwater resources are located.
- **Analyze** the susceptibility of the natural setting where ground water occurs.
- **Inventory** existing potential sources of groundwater contamination.
- **Classify** the relative vulnerability of ground water to contamination events.

Steps, continued

- **Designate** areas that are most at risk to contamination events.
- **Protect** by minimizing activities and conditions that pose contamination risks.
- **Ensure** that contamination prevention plans and best management practices are followed.
- **Manage** groundwater withdrawals and recharge impacts to:
  - **Maintain availability** for drinking water sources.
  - **Maintain stream base flow** from ground water to support in-stream flows, especially for salmon-bearing streams.

http://www.ci.issaquah.wa.us/index.aspx?NID=405



Groundwater Quantity – Legal Framework

- GMA
  - Critical Aquifer Recharge Areas
  - Anadromous Fish Species
  - Interconnection with other Critical Areas
  - Comprehensive Plan
- Other Considerations
  - Water Availability requirement for approving building permits
  - Water Resources Law

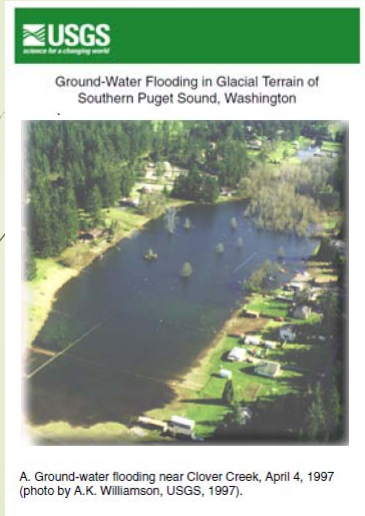
Ground Water and Other Critical Areas

Ground water is inextricably linked with all of the critical areas including wetlands, fish and wildlife habitat, critical aquifer recharge areas, frequently flooded areas, and geologically hazardous areas.

Ground water is a source of water to streams, lakes, estuaries, wetlands, and springs; and therefore serves a critical function for wildlife and fish habitat.

Special Consideration for Anadromous Fisheries

The GMA also requires that local jurisdictions give special consideration to conservation or protection measures necessary to preserve or enhance anadromous fisheries. Since ground water is an important component of stream flow, it is necessary to maintain the groundwater supply to streams where needed to protect salmon and other anadromous species.



http://wa.water.usgs.gov/projects/pugethazards/urbanhaz/PDF/fs111_00.pdf

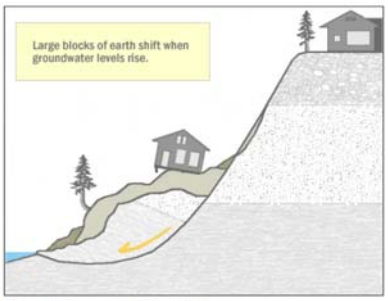


Figure 2 Deep-seated Landslide

http://www.ecy.wa.gov/programs/sea/landslides/about/deep.html

Ground water is often a key factor in flooding and geologic hazards

Groundwater Quantity -On the Ground Hydrology

- Groundwater depletion
  - Large quantity groundwater users
  - Stream base flow dependent on groundwater
  - Decreasing stream flow over time
  - Changing hydrology due to impervious surfaces
- Groundwater supplies that are dependent on fracture flow
- Keeping watch (groundwater levels, lake levels, stream hydrographs, precipitation, and snowpack)
- Well deepening is expensive – May be needed if groundwater levels drop
- Sole source aquifers – Limited options to replace water supply
- Artificial Recharge, methods to improve groundwater availability (LID, spreading basins, Aquifer Storage and Recovery)

Predicted Impacts of Climate Change on Groundwater Resources of Washington State

Estimated Baseflow Characteristics of Selected Washington Rivers and Streams: Water Supply Bulletin No. 60

Chapter 365-190 WAC
MINIMUM GUIDELINES TO CLASSIFY AGRICULTURE, FOREST, MINERAL LANDS AND CRITICAL AREAS

365-190-080
Critical areas.

(1) Counties and cities **must protect critical areas**. Counties and cities required or opting to plan under the act must consider the definitions and guidelines in this chapter when designating critical areas and when preparing development regulations that protect the function and values of critical areas. The department provides additional recommendations for adopting critical areas regulations in WAC 365-196-485.

(2) Counties and cities **must** include the **best available science** as described in chapter 365-195 WAC, when designating critical areas and when developing policies and regulations that protect critical areas. Counties and cities **must give special consideration** to conservation or protection measures necessary to preserve or enhance **anadromous fisheries**. Counties and cities are **encouraged to also protect both surface and groundwater** resources, because these waters often recharge wetlands, streams and lakes.

(3) Counties and cities are encouraged to develop a coordinated regional critical areas protection program that combines interjurisdictional cooperation, public education, incentives to promote voluntary protective measures, and regulatory standards that serve to protect these critical areas.

(4) Counties and cities should designate critical areas by using **maps and performance standards**.

(a) Maps may benefit the public by increasing public awareness of critical areas and their locations. County and city staff may also benefit from maps which provide a useful tool for determining whether a particular land use permit application may affect a critical area. However, because maps may be too inexact for regulatory purposes, counties and cities should rely primarily on performance standards to protect critical areas. Counties and cities should apply performance standards to protect critical areas when a land use permit decision is made.

(b) Counties and cities should clearly state that maps showing known critical areas are only for information or illustrative purposes.

365-190-100
Critical aquifer recharge areas.

(1) Potable water is an essential life sustaining element for people and many other species. **Much of Washington's drinking water comes from groundwater**. Once groundwater is contaminated it is difficult, costly, and sometimes impossible to clean up. Preventing contamination is necessary to avoid exorbitant costs, hardships, and potential physical harm to people and ecosystems.

(2) The quality and quantity of groundwater in an aquifer is inextricably linked to its recharge area. Where aquifers and their recharge areas have been studied, affected counties and cities should use this information as the basis for classifying and designating these areas. Where no specific studies have been done, counties and cities may use existing soil and surficial geologic information to determine where recharge areas exist. To determine the threat to groundwater quality, existing land use activities and their potential to lead to contamination should be evaluated.

(3) Counties and cities must classify recharge areas for aquifers according to the aquifer vulnerability. Vulnerability is the combined effect of hydrogeological susceptibility to contamination and the contamination loading potential. High vulnerability is indicated by land uses that contribute directly or indirectly to contamination that may degrade groundwater, and hydrogeologic conditions that facilitate degradation. Low vulnerability is indicated by land uses that do not contribute contaminants that will degrade groundwater, and by hydrogeologic conditions that do not facilitate degradation. Hydrological conditions may include those induced by limited recharge of an aquifer. Reduced aquifer recharge from effective impervious surfaces may result in higher concentrations of contaminants than would otherwise occur.

(4) A classification strategy for aquifer recharge areas should be to maintain the quality, and if needed, the quantity of the groundwater, with particular attention to recharge areas of high susceptibility.

(a) In recharge areas that are highly vulnerable, studies should be initiated to determine if groundwater contamination has occurred. Classification of these areas should include consideration of the degree to which the aquifer is used as a potable water source, feasibility of protective measures to preclude further degradation, availability of treatment measures to maintain potability, and availability of alternative potable water sources.

(b) Examples of areas with a critical recharging effect on aquifers used for potable water may include:

(i) Recharge areas for sole source aquifers designated pursuant to the Federal Safe Drinking Water Act;

(ii) Areas established for special protection pursuant to a groundwater management program, chapters 90.44, 90.48, and 90.54 RCW, and chapters 173-100 and 173-200 WAC;

(iii) Areas designated for wellhead protection pursuant to the Federal Safe Drinking Water Act;

(iv) Areas near marine waters where aquifers may be subject to saltwater intrusion; and

(v) Other areas meeting the definition of "areas with a critical recharging effect on aquifers used for potable water" in these guidelines.

(c) Some aquifers may also have critical recharging effects on streams, lakes, and wetlands that provide critical fish and wildlife habitat. Protecting adequate recharge of these aquifers may provide additional benefits in maintaining fish and wildlife habitat conservation areas.

Low Impact Development

Out of the Sound, into the Ground

- Overall principles,
  - Keep contaminants from the Puget Sound and other surface waters
  - Keep impervious surfaces from sending stormwater overland to rivers instead of infiltrating

2012 Stormwater Management Manual for Western Washington

https://fortress.wa.gov/ecy/publications/documents/1410055.pdf

Benefits

- Recharge ground water supply
- Support stream and lake base flow
- Decrease peak stream flow
- Less stream erosion that occurs from higher peak flows
- Support wetlands
- Protect surface water quality

Building Cities in the Rain: Watershed Prioritization Guidance for Stormwater Retrofits

USGS Puget Sound Partnership Proposal

Skagit County Water Storage Study – Senate Bill 6589

Water Quality Risks

- Polluting groundwater that we need for a drinking water supply.
- Polluting groundwater that feeds lakes, streams, wetlands, estuaries
  - Cation exchange Capacity is limited
  - Spills or errors are difficult and expensive to clean up and are hard to detect
  - Limited design life - You can't replace the ground with new vadose zone like you can an engineered filter

Other Risks

- Flooding
- Slope Stability

Requirements and Guidance

- Infiltrating Stormwater into Drywells
  - Underground Injection Control WAC 173-218
  - Groundwater Quality Standards WAC 173-200
  - Guidance for UIC Wells that Manage Stormwater
  - UIC Website
- Infiltrating Stormwater Infiltration Trenches, Infiltration Ponds, and Rain Gardens
  - 2012 Stormwater Management Manual for Western Washington
  - Industrial Stormwater Permit
  - Municipal Stormwater Permit
  - Stormwater Technical Resources

Industrial Stormwater General Permit Excerpts

B. Significant Contributors of Pollutants

Ecology may require a *facility* to obtain coverage under this permit if *Ecology* determines the *facility*:

1. Is a *significant contributor of pollutants* to *waters of the state*, including *ground water*;

C. Facilities Not Required to Obtain Coverage

Ecology does not require the types of facilities listed below to obtain coverage under this permit, unless determined to be a *significant contributor of pollutants*.

1. Industrial facilities that submit an *application* and qualify for a Conditional "No Exposure" Exemption. (Condition S1.F)
2. Industrial facilities that *discharge stormwater* only to a municipal *combined sewer* or *sanitary sewer*. *Discharge* of stormwater to sanitary or *combined sewers* shall only occur as authorized by the municipal sewage authority.
3. Industrial facilities that *discharge stormwater* only to groundwater (e.g., on-site infiltration) with no *discharge* to *surface waters of the state* under any condition.

Redmond Ordinance for Infiltrating Stormwater

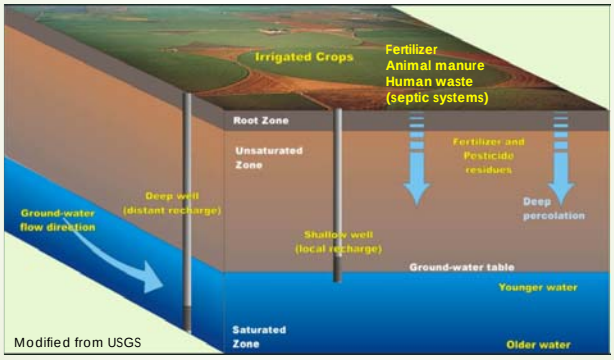
- Stormwater Infiltration Systems. Design and construction of new stormwater infiltration systems must address site-specific risks of releases posed by all hazardous materials on-site. These risks may be mitigated by physical design means or equivalent best management practices in accordance with an approved Hazardous Materials Management Plan. Design and construction of said stormwater infiltration systems shall also be in accordance with RMC Chapter 15.24.020 and the City of Redmond Clearing, Grading and Stormwater Technical Notebook, and shall be certified for compliance with the requirements of this section by a professional engineer or engineering geologist registered in the State of Washington.

http://online.encodeplus.com/regs/redmond-wa/doc-viewer.aspx?secid=1044&keywords=critical+aquifer#secid-1048

Great Examples

- Spokane County – Spokane Aquifer, hazardous materials inventory, a comprehensive plan that recognizes and speaks about the inter-relatedness of surface water, ground water and wetlands.
- Thurston County – A Comprehensive Plan that integrates groundwater, including availability and inter-relation with surface water, stormwater and wetlands. Plans for sub-watersheds.
- Redmond – Outstanding ground water pollution prevention
- King County – Best Available Science document
  - Groundwater Quality
  - Groundwater Quantity
- City of Vancouver – Pollution prevention for stormwater, surface water and groundwater in a single integrated program.

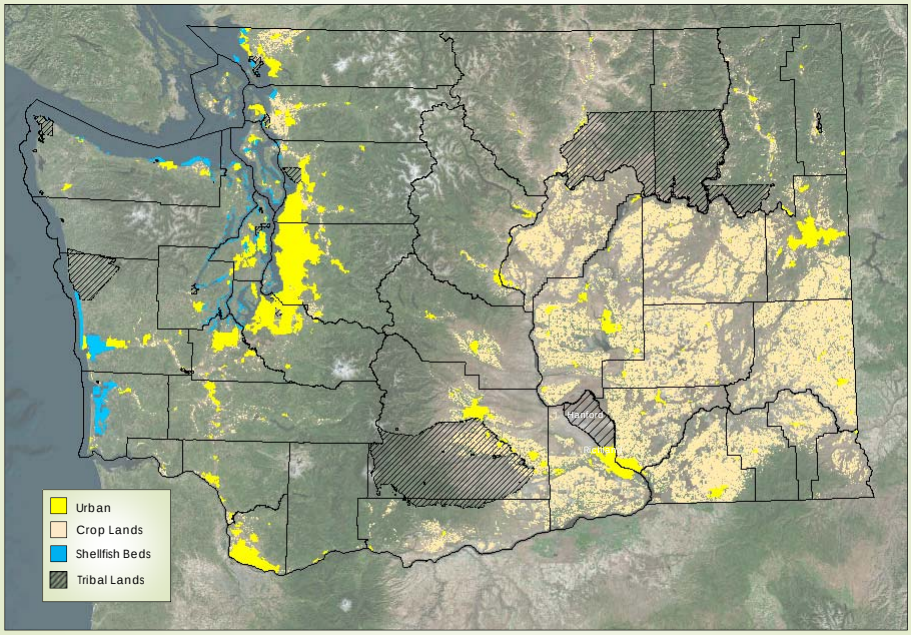
Protecting Washington's Groundwater The Nitrate Project



Modified from USGS

Story Map

Washington Urban Areas, Agricultural Areas and Tribal Lands



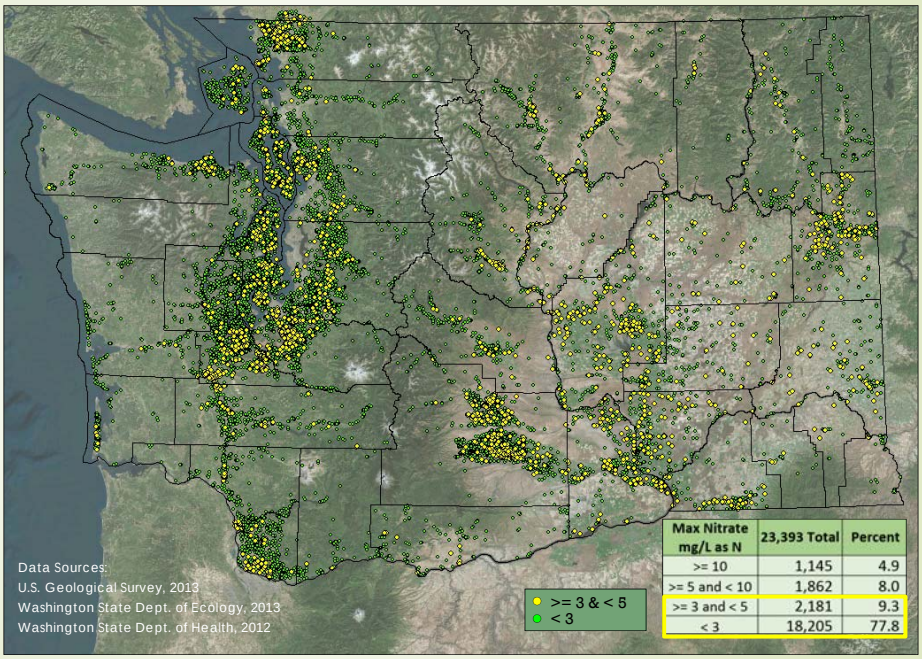
The vast majority of water wells sampled had very low nitrate levels

Ecology collected nitrate sampling data from

- Washington State Dept. of Health Drinking Water Program
- USGS National Water Information System
- Ecology's Environmental Information System

This and the next map are of the maximum nitrate level for each well record.

This indicates whether conditions at that location tend to allow high nitrates.



Max Nitrate mg/L as N	23,393 Total	Percent
>= 10	1,145	4.9
>= 5 and < 10	1,862	8.0
>= 3 and < 5	2,181	9.3
< 3	18,205	77.8

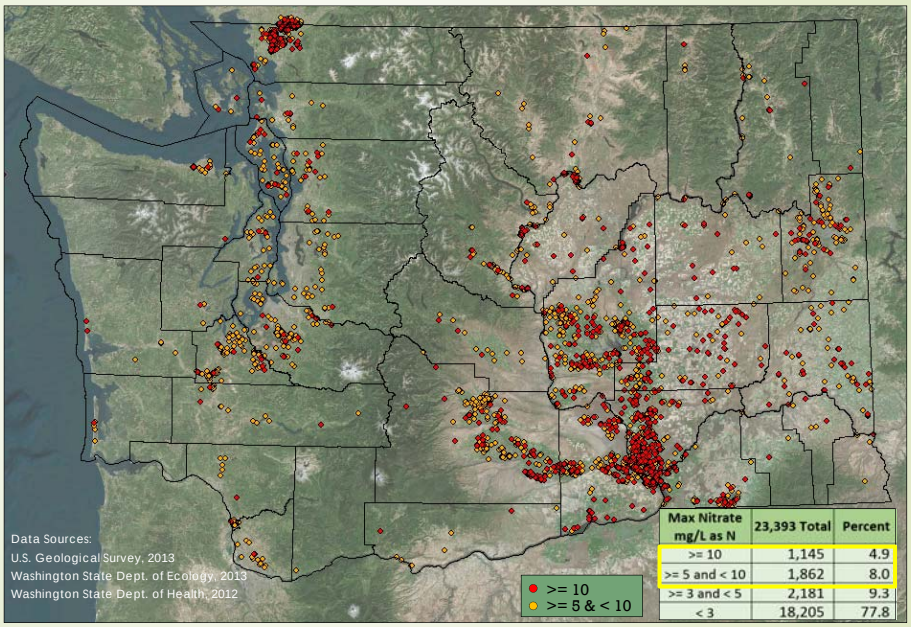
Some areas of Washington are susceptible to high nitrates in groundwater

This map is of the nitrate levels >= 5 mg/L as N based on the maximum nitrate level for each well record. This indicates whether conditions at that location tend to allow high nitrates in groundwater.

Some areas of the state have clusters of wells that have had nitrate levels above 10 mg/L as N (the Maximum Contaminant Level).

Public water supplies are regulated by the Washington State Dept. of Health and Local Health Jurisdictions. Sampling is required and measures must be taken to make sure delivered water is clean and safe.

Single domestic well users are not regulated in the same way and must take it upon themselves to have their well water tested.



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Major Unconsolidated Deposits of Washington.

Some parts of our Washington landscape have much more coarse geology than others.

Coarser geologic materials allow water to travel down through faster than finer materials.

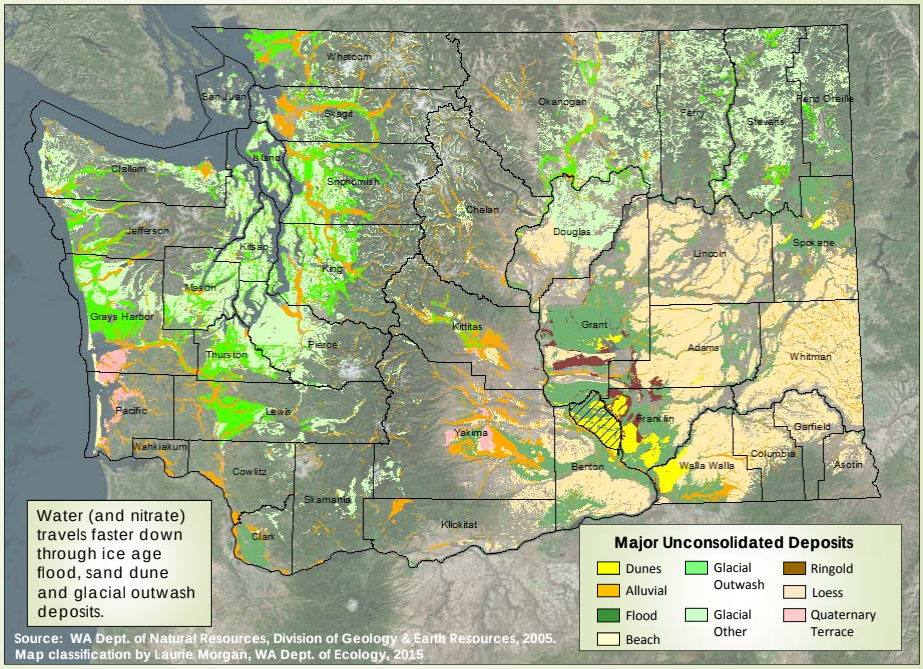
Here are three examples:

Glacial outwash - Sandy to gravelly material

Sand dunes formed in the Pasco basin. Wind-blown deposits called

Ice age flood deposits created areas of coarse sands and gravels, as well as some areas of very fine deposits. These deposits are called "**Flood**" on the map.

These processes form landscape patterns that we can map from geologic and soils maps.



Source: WA Dept. of Natural Resources, Division of Geology & Earth Resources, 2005.
Map classification by Laurie Morgan, WA Dept. of Ecology, 2015

Soil Landscape Patterns

"**Drainage class**" identifies the natural drainage condition of the soil. It refers to the frequency and duration of wet periods (USDA, 2014). Soils rated as excessively drained remove water rapidly and are typically coarse textured.

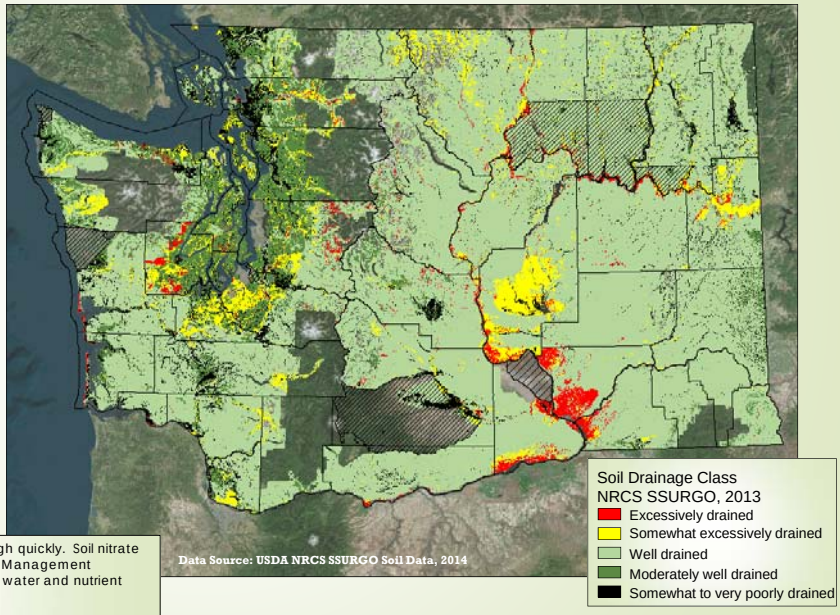
Areas with excessive drainage could be subject to excessive watering and fertilizing because of the loss of water and nitrate downward.

Soil Drainage classes are only related to whether soils drain or are too wet to grow crops without artificial drainage. Shallow groundwater areas can rate as poorly drained, even with coarse soil or coarse geologic materials like glacial outwash.

It is important to combine soil drainage characteristics with other information about soil and geologic materials to understand the tendency of areas to build up nitrate in groundwater when there are nitrate sources.

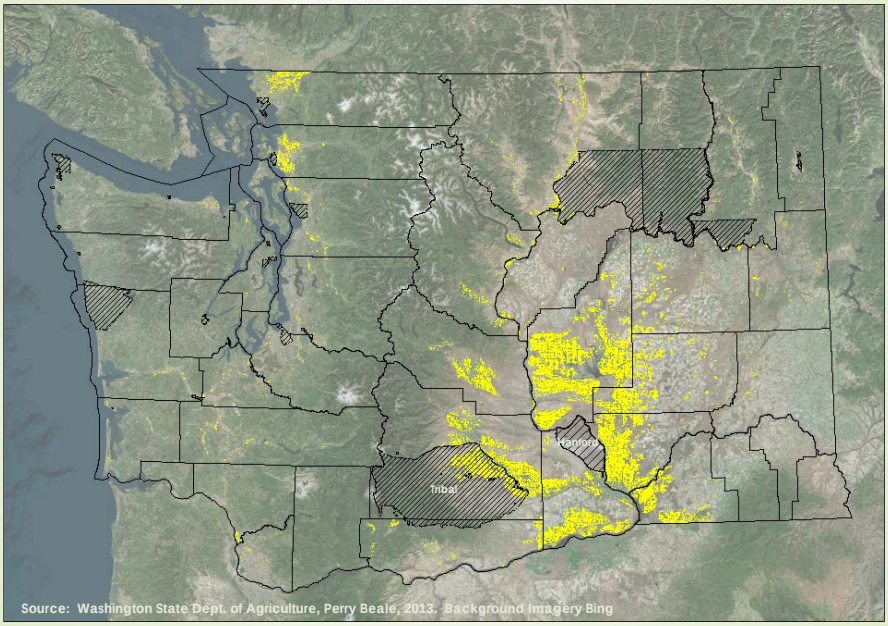
Excessively draining soils don't hold water – nitrate passes through quickly. Soil nitrate tests are not useful pollution prevention controls in these areas. Management measures are important in these areas to specifically target the water and nutrient needs of the crop.

Excessive drainage is a risk factor for nitrate contamination of groundwater



NRCS Web Soil Survey – Find soil information and maps online

Irrigated Agricultural Areas of Washington



USGS Nitrate Risk Studies

USGS Nolan Study

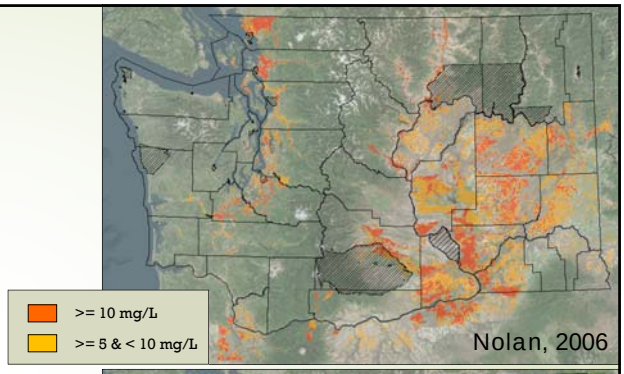
USGS Bernard Nolan (et al): Vulnerability of Shallow Groundwater and Drinking-Water Wells to Nitrate in the United States
- High N Application
- High Water Input
- Well-Drained Soils
- High effective porosity soil/ fractured rock
- Lack of attenuation processes

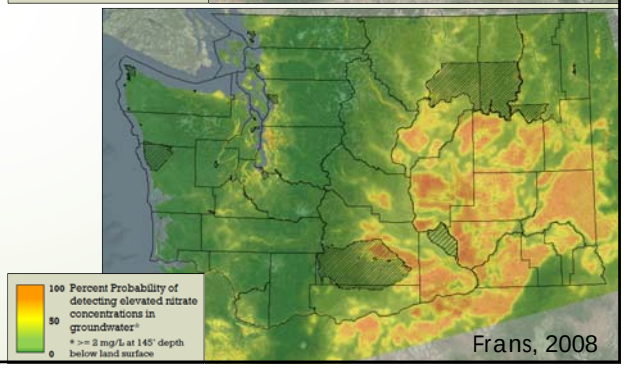
"As N loading at the land surface increases, nitrate concentration in shallow groundwater increases."

The bottom map shows the statistical probability of elevated concentrations of nitrate in groundwater.

USGS Frans Study

USGS Lonna Frans: Estimating the Probability of Elevated Nitrate Concentrations in Ground Water in Washington State
- Well depth
- Ground-water recharge rate
- Precipitation
- Population density,
- Fertilizer application amounts
- Soil characteristics (e.g. soil drainage class)
- Land-use



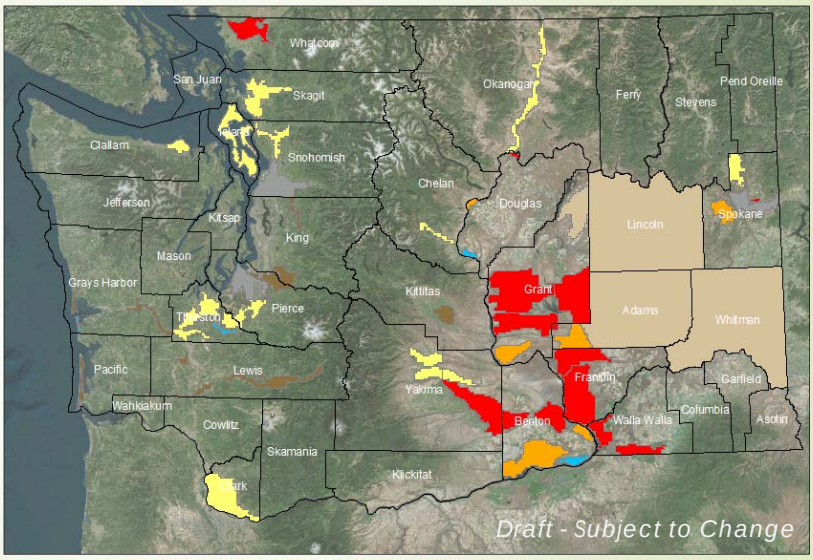


Nitrate Priority Areas

- Based on nitrate levels, geology, soils, irrigation, land use, USGS risk maps and topography
- Areas and categories may change based on new information

Recommended Categories

Priority Bin		Description
1	Very High	Top tier by number of well locations with maximum nitrate results over 10 mg/L
2	High	Next tier by number of well locations with maximum nitrate results over 10 mg/L
3	Eastern Washington Dryland	Eastern Washington Dryland – Lincoln, Adams, Whitman and part of Grant County outside of the Columbia Irrigation Project
4	Moderate	Vulnerable conditions, many results over 5 mg/L but few over 10 mg/L
5	Insufficient Data	Vulnerable conditions, little monitoring
6	Low	Few nitrate results over 5 mg/L
7	Highly Urbanized	Highly Urbanized areas (such as the Spokane aquifer)



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