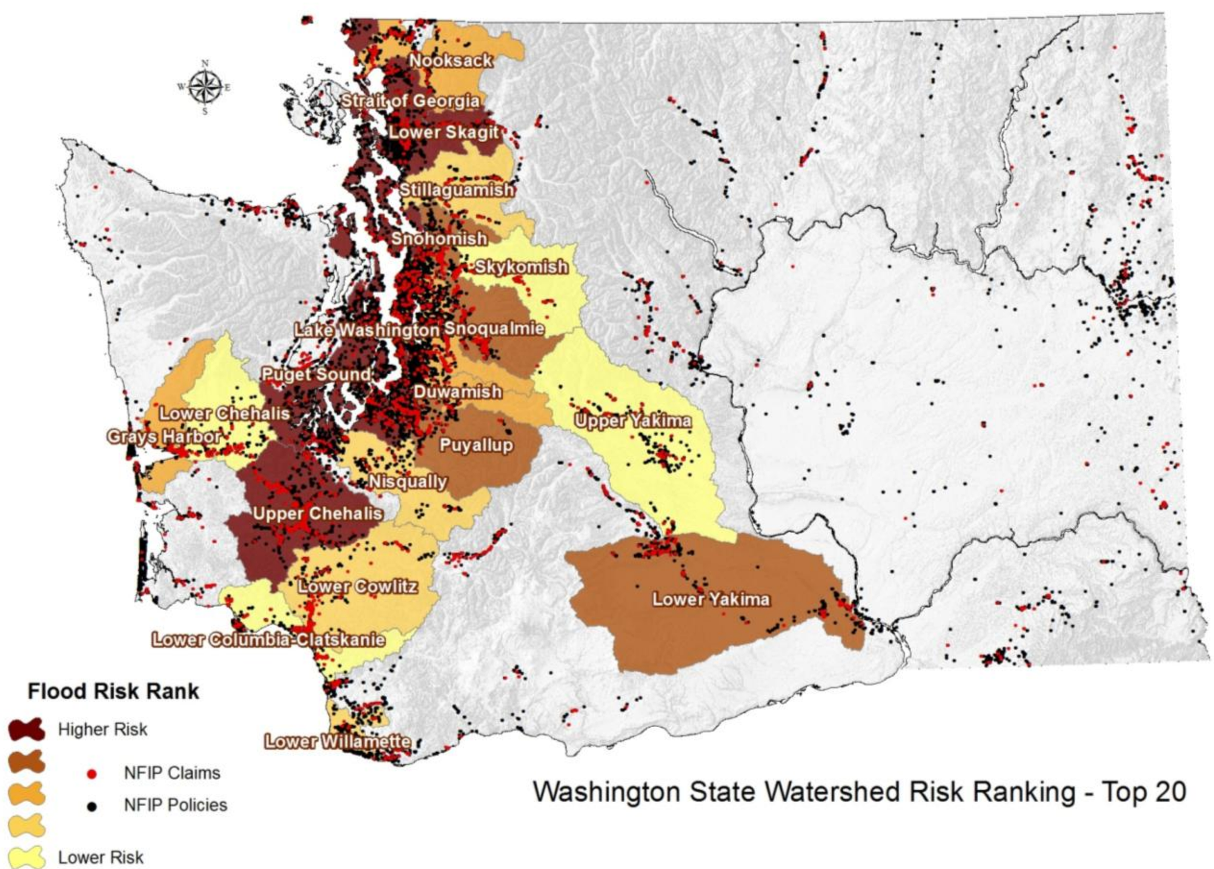
Washington State Watershed Risk Assessment

Introduction

This Risk Assessment is a product of Washington State's Business planning process that heavily engages in digital and spatial platforms to assess flood hazards that provide instant quantitative information spatially across the state with dynamic capabilities to assess evolving risks. The purpose of this Risk Assessment is to provide a valuable planning and sequencing tool to the FEMA-WA State partnership. This Assessment was developed and delivered in GIS database with searchable tables, links to dynamic tables for editing and updating attribute data, and database-driven mapping.



Risk Assessment Factors

Three risk assessment factors were developed and assigned to FEMA's standard HUC8 level watersheds:

- Population Density 60%
- NFIP Policies & Claims 30%
- Floodplain Area 10%

FEMA provided total population values by watershed from Federal Census data. The State recalculated total population values into population density values by watershed area and generated an attribute in the HUC8 GIS spatial data table representing population density.

FEMA also provided NFIP policies and claims data in a spatial point file feature with attribute tables. The State spatially joined NFIP policies point features to the HUC8 watershed data table as an attribute of total policies and claims per watershed.

The State generated the floodplain area attribute by intersecting FEMA's Q3 data with the HUC8 watershed spatial data and calculated the percent floodplain to watershed area in the attribute table.

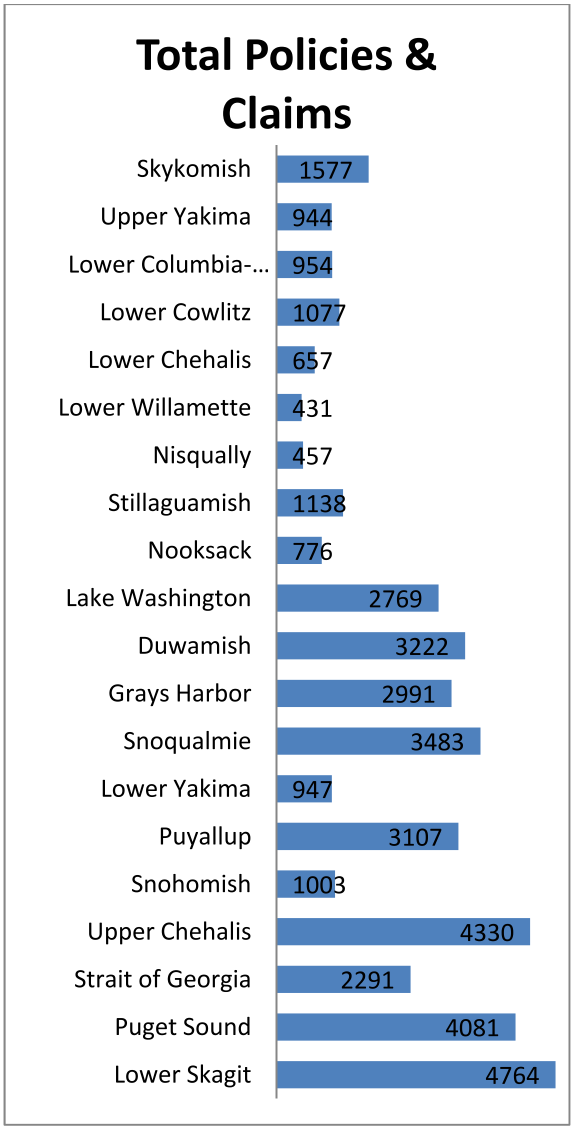
Watershed Ranking

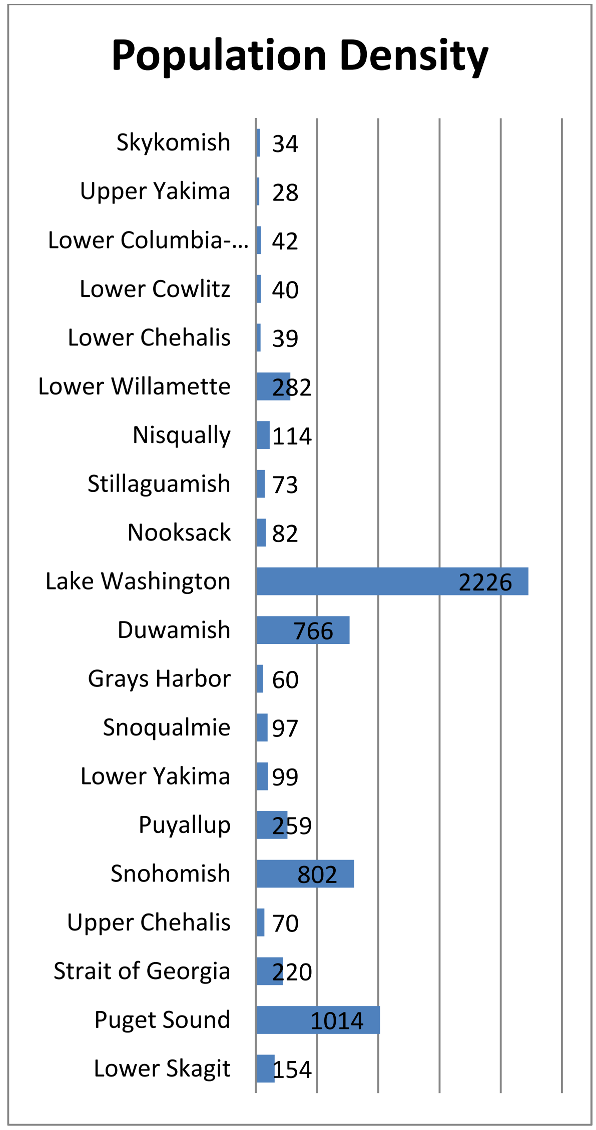
Total numbers and areas were avoided and a weighted scheme was developed to emphasize risk factors with greater influence on risk concentrations. Population density was assigned a sixty percent weight as the predominate risk factor. NFIP policies and claims were allocated thirty percent weighted value and floodplain area given ten percent of the scheme.

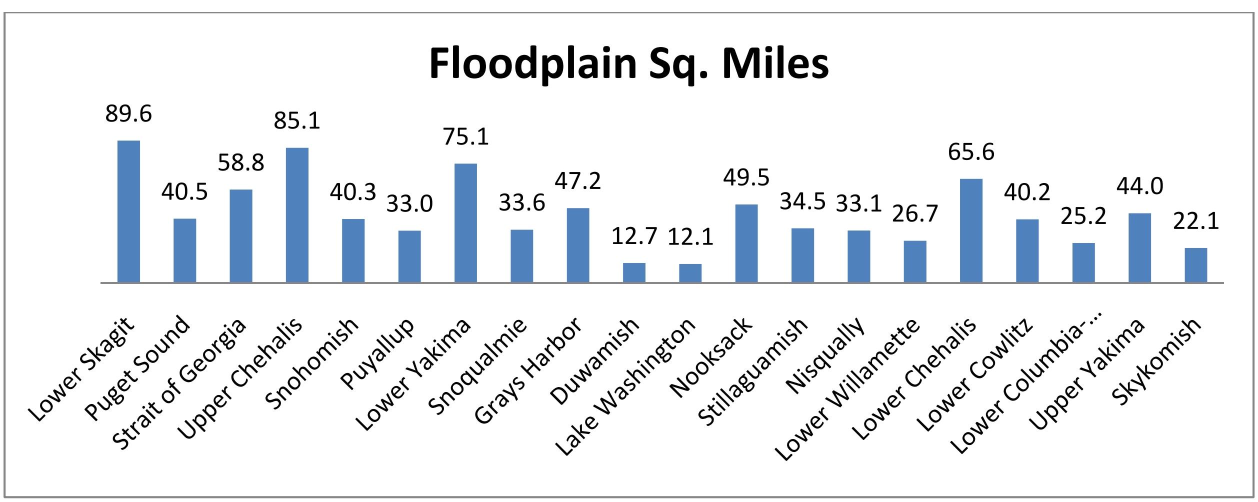
The weighted method was removed and equal quantities were ranked to evaluate the sensitivity if the weighted approach. All top twenty watersheds remained in the top twenty with emphasis given to large unpopulated floodplain deltas and understated the value of population density as a predominate risk factor.

All three weighted factors were sorted in ascending order and assigned a value from one to seventy one with the highest risk watersheds assigned the lowest values. The three rankings were summed equally and again assigned a rank value with the highest risk watersheds assigned the lowest values. The resulting assessment assigned a value to all seventy one watersheds. The top twenty at-risk watersheds are detailed and mapped below:

HUC8 Name	FEMA Trifecta Rank	Floodplain Area Rank	Population Density Rank	Policies & Claims Rank	ESA	LiDAR	Final Risk Rank	Map Page
Lower Skagit	30	2	11	1	present	yes	1	6
Puget Sound	4	17	3	3	present	yes	2	8
Strait of Georgia	22	7	9	9	present		3	10
Upper Chehalis	9	3	22	2		yes	4	12
Snohomish	23	18	4	15	present	yes	5	14
Puyallup	2	23	8	6	present	yes	6	16
Lower Yakima	7	4	14	17	present	yes	7	18
Snoqualmie	18	21	15	4	present	yes	8	20
Grays Harbor	29	13	23	7		yes	9	22
Duwamish	12	42	5	5	present		10	24
Lake Washington	6	45	1	8	present	yes	11	26
Nooksack	16	11	18	19	present	yes	12	28
Stillaguamish	21	20	21	11	present	yes	13	30
Nisqually	13	22	12	25	present	yes	14	32
Lower Willamette	99	28	7	27	present	yes	15	34
Lower Chehalis	17	6	29	21		yes	16	36
Lower Cowlitz	28	19	28	13	present	yes	17	38
Lower Columbia-Clatskanie	10	29	26	16	present	yes	18	40
Upper Yakima	11	15	36	18	present	yes	19	42
Skykomish	19	33	33	10	present	yes	20	44


Total Policies & Claims
Skykomish 1577
Upper Yakima 944
Lower Columbia-... 954
Lower Cowlitz 1077
Lower Chehalis 657
Lower Willamette 431
Nisqually 457
Stillaguamish 1138
Nooksack 776
Lake Washington 2769
Duwamish 3222
Grays Harbor 2991
Snoqualmie 3483
Lower Yakima 947
Puyallup 3107
Snohomish 1003
Upper Chehalis 4330
Strait of Georgia 2291
Puget Sound 4081
Lower Skagit 4764


Population Density
Skykomish 34
Upper Yakima 28
Lower Columbia-... 42
Lower Cowlitz 40
Lower Chehalis 39
Lower Willamette 282
Nisqually 114
Stillaguamish 73
Nooksack 82
Lake Washington 2226
Duwamish 766
Grays Harbor 60
Snoqualmie 97
Lower Yakima 99
Puyallup 259
Snohomish 802
Upper Chehalis 70
Strait of Georgia 220
Puget Sound 1014
Lower Skagit 154


Floodplain Sq. Miles
Lower Skagit 89.6
Puget Sound 40.5
Strait of Georgia 58.8
Upper Chehalis 85.1
Snohomish 40.3
Puyallup 33.0
Lower Yakima 75.1
Snoqualmie 33.6
Grays Harbor 47.2
Duwamish 12.7
Lake Washington 12.1
Nooksack 49.5
Stillaguamish 34.5
Nisqually 33.1
Lower Willamette 26.7
Lower Chehalis 65.6
Lower Cowlitz 40.2
Lower Columbia-... 25.2
Upper Yakima 44.0
Skykomish 22.1

Lower Skagit Watershed

RiskMAP Rank: 1 of 67

HUC8 Name	Sq miles	Trifecta Rank	Floodplain SQ Miles	Floodplain area Rank	Pop density Rank	Policies & Claims Rank	RiskMAP Rank
Lower Skagit	454	30	89	2	11	1	1

Communities:
Burlington, Concrete, Hamilton, La Conner, Lyman, Mount Vernon, Sedro-Woolley, Stanwood

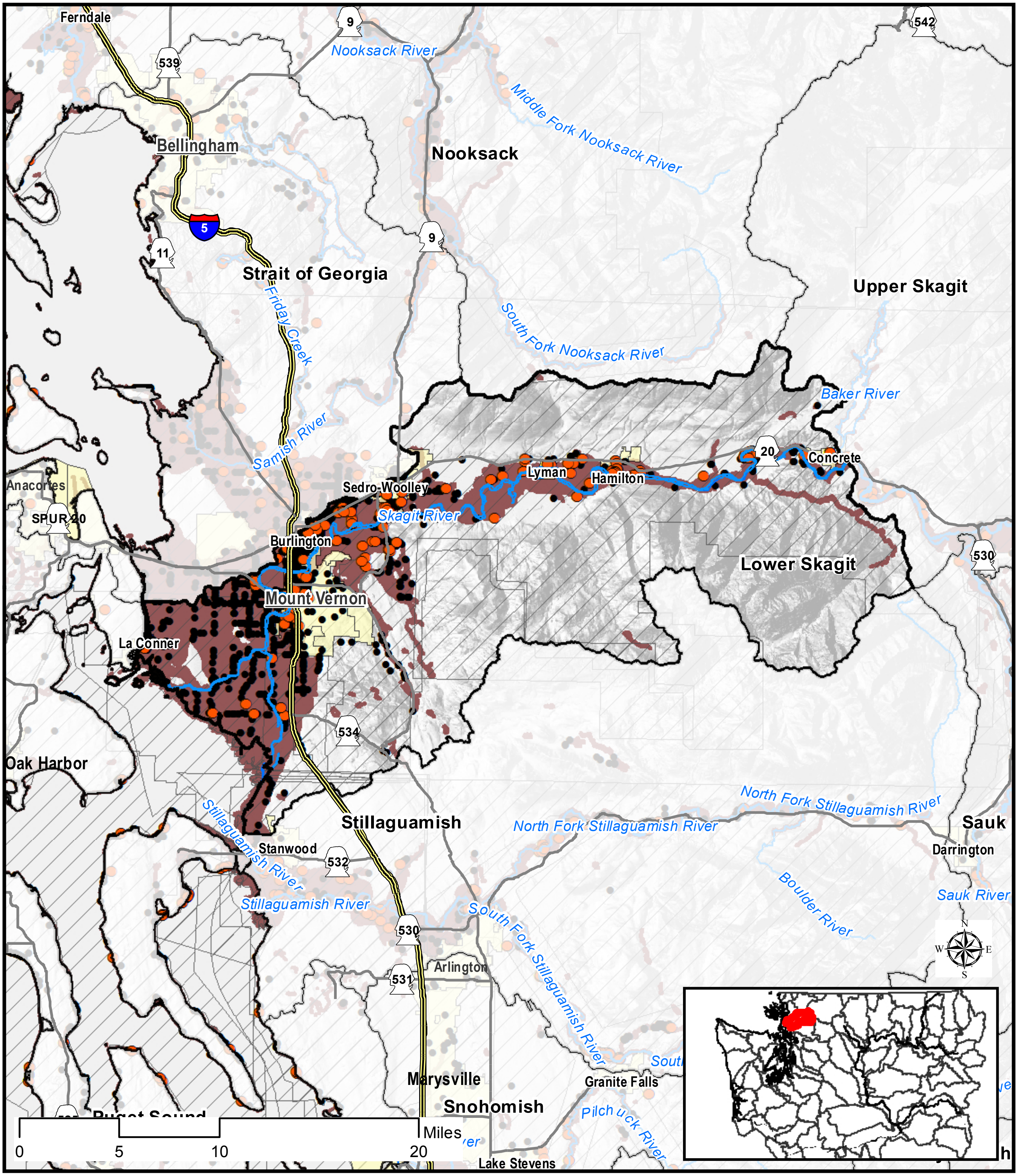
Principal Flood Problems: Skagit River

Flooding from the Skagit River affects the cities of Burlington, Mount Vernon and Sedro Woolley, the Towns of Hamilton, Lyman, La Conner and the unincorporated areas of Skagit County.

Flooding problems occur from high-tide levels in Skagit Bay or from major floods on the Skagit River and its tributaries. Tidal flooding can occur when a high astronomical tide is heightened by a large storm surge. Wave run-up is a significant factor in areas where the shorelines are not sheltered from local wind effects.

Major floods of the Skagit River and its tributaries are caused by winter rainstorms. The Skagit basin, lying directly in the storm path of cyclonic disturbances from the Pacific Ocean, is subject to numerous storms, which are frequently quite severe. Not uncommon are two or more storms in rapid succession, sometimes less than 24 hours apart. Rain-type floods usually occur in November or December, but may occur as early as October or as late as February. These floods are characterized by sharply rising river flows, high magnitude peaks, and flood durations of several days. Often, heavy rainfall is accompanied by snowmelt which increases the runoff. On the mountain slopes, storm precipitation is heavy and almost continuous as a result of combined frontal and orographic effects.

Earlier levee construction was to provide protection from spring floods which permit ted farmers to plant earlier. These levees were subsequently improved to also provide more winter protection.
The Skagit River represents the major flooding source of the delta area. Flooding occurs from multiple levee failures and bank and levee overtopping during a 100-year flood. Downstream of Sedro Woolley, the Skagit River flows through a large delta area that fronts Samish, Padilla, and Skagit Bays. Within this area, the floodplain forms a large alluvial fan with an east-west width of approximately 11 miles and a north-south width of 19 miles. The most severe floods and the corresponding peak discharges since 1908, when stream gauging in the Skagit River Basin began.



Rank 1 of 67 **Washington State Watershed Risk Assessment: Lower Skagit**

Incorporated City
1% Annual Chance Flood
NFIP Claims
NFIP Policies
Interstate Fwy
State & US Routes
Available LiDAR

Puget Sound Watershed

WA RiskMAP Rank: 2 of 67

HUC8_Name	Sq miles	Trifecta Rank	Floodplain SQ_Miles	Foodplain Area Rank	Pop density Rank	Policies & Claims Rank	Risk Rank
Puget Sound	1492	4	40.5	17	3	3	2

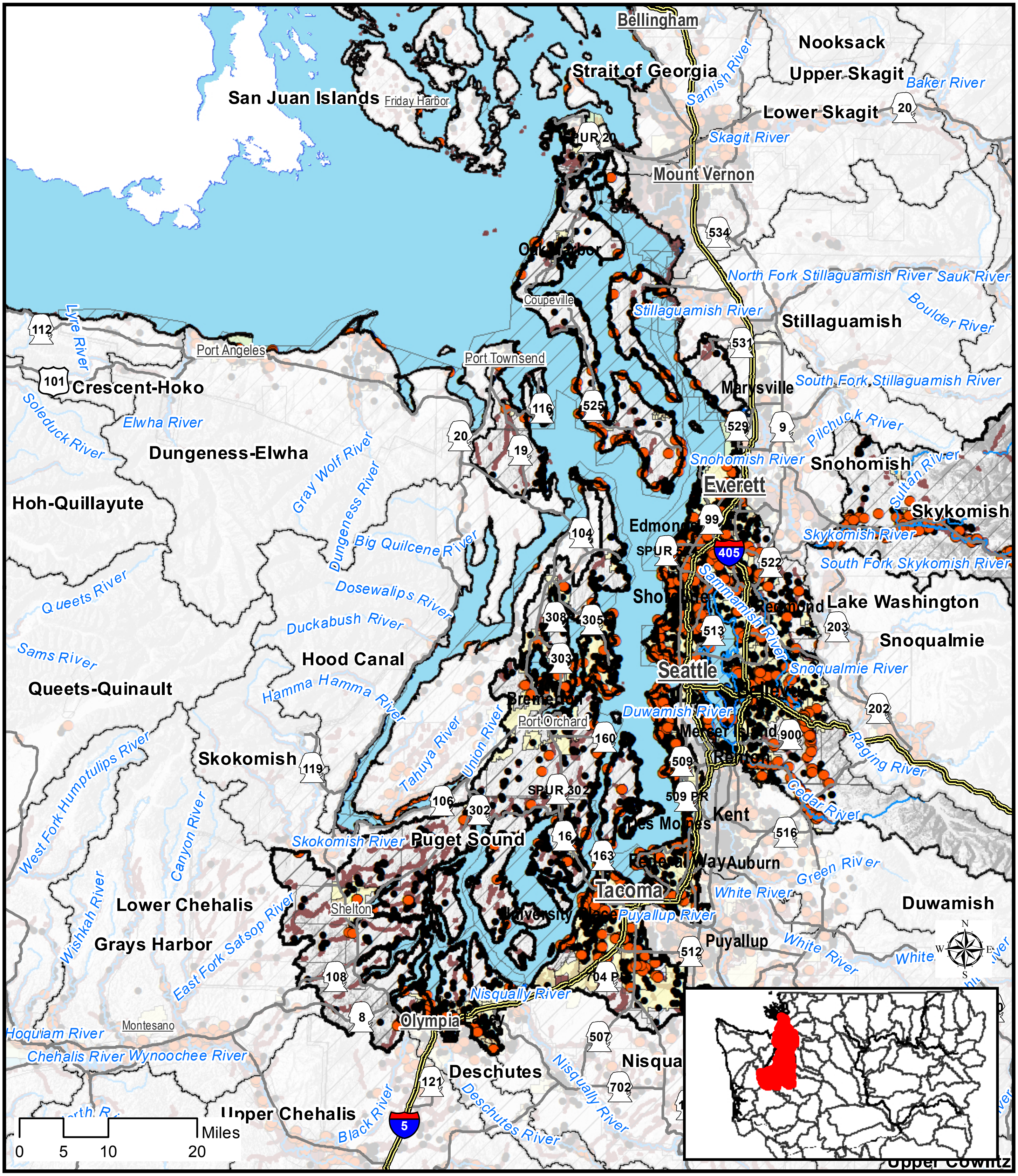
Communities:
Anacortes, Bainbridge Island, Bremerton, Burien, Coupeville, Des Moines, DuPont, Edgewood, Edmonds, Everett, Federal Way, Fife, Fircrest, Gig Harbor, Kent, Lacey, Lakewood, Langley, Lynnwood, Marysville, Milton, Milton, Mukilteo, Normandy Park, Oak Harbor, Olympia, Olympia, Olympia, Port Orchard, Port Townsend, Poulsbo, Puyallup, Ruston, SeaTac, Seattle, Shelton, Shoreline, Steilacoom, Tacoma, Tumwater, University Place, Woodway

Principal Flood Problems
Population is the biggest risk factor in the Puget Sound Basin. Coastal flooding rarely causes damages without riverine influences. Flooding problems occur from high-tide levels in Puget Sound combined with high flows from riverine systems and concentrated low pressure storms. Low lying populated areas of Puget Sound, sloughs, and areas exposed to westward wind fetch experience the highest flood risk. Typical examples are the cities of Olympia and La Connor, the Skokomish and Skagit deltas, and coastal areas of Island and San Juan Counties.

Groundwater Flooding
The unique geomorphic history of Puget Sound, Washington, leads to the unusual phenomenon of ground-water flooding when wet conditions persist for much more than a year. In the central Pierce County area of Southern Puget Sound, some relic drainage channels — legacies of melting glaciers at the conclusion of the last Ice Age — now convey only ground water. When wet conditions prevail, ground-water flooding can be observed moving progressively "downstream" in these channels.

Cost of Flooding in Western Washington
More than 28,000 structures have been built in floodplains since the National Flood Insurance Program's inception. Since 1990, the costs of flooding in Western Washington have been have been disastrous and costly for all of us:

- Puget Sound has experienced 16 federally declared flood disasters.
- 58 lives have been lost due to floods.
- More than $1.4 billion in flood damages have been paid by taxpayers.
- Levees failed or overtopped in ten of the past 16 flood disasters, costing $125 million in repairs to more than 200 sites.
- 833 homes in the Puget Sound Area have flooded repeatedly (three times or more), and cost taxpayers $71 million in insurance claims.
- Interstate 5 has been closed four times costing more than $181 million in losses.
- In a single 1990 flood, more than 600 cattle died in Snohomish and King Counties. In a 2003 flood, more than 300 farm animals perished.



Rank 2 of 67 **Washington State Watershed Risk Assessment: Puget Sound**

Incorporated City
1% Annual Chance Flood
NFIP Claims
NFIP Policies
Interstate Fwy
State & US Routes
Available LiDAR

DEPARTMENT OF ECOLOGY State of Washington

Straight of Georgia Watershed

WA RiskMAP Rank: 3 of 67

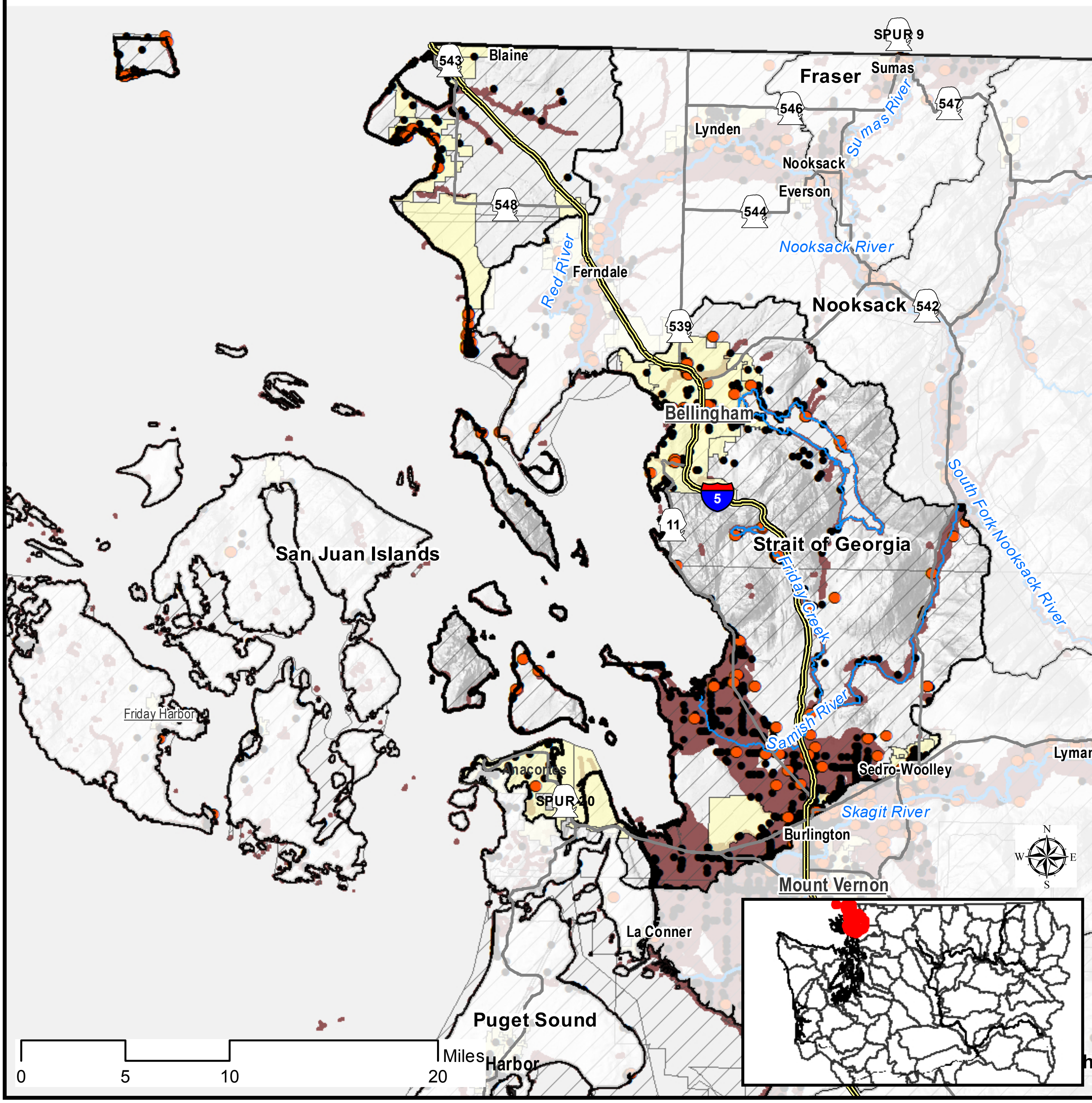
HUC8 name	Sq. miles	FEMA Trifecta Rank	Floodplain SQ_Miles	Floodplain Area Rank	Pop Density Rank	Policies & Claims Rank	Risk Rank
Strait of Georgia	440.84	22	58.8	7	9	9	3

Communities:
Blaine, Ferndale, Bellingham, Sedro-Woolley, Anacortes, Burlington

Primary Flooding Sources:
Whatcom Creek, Friday Creek, Samish River, Samish River, Straight of Georgia

Principal Flood Problems:
Flood damage in the coastal areas of Whatcom County is caused by a combination of high tide levels and wave action. The observed tide level is a result of astronomical tide (caused by gravitational effects of sun and moon) and storm surge (rise in water levels as a result of wind stress and low atmospheric pressure). Waves, breaking onto the shoreline, produce an additional water level rise at the beach (wave setup), and waves running up the beach (wave runup) can cause impact damage far above the stillwater level. Flood elevations were determined by combining the effects of tide and wave setup. When both calculated wave heights at the shoreline and wave runup exceeded 3 feet, a wave hazard area was denoted in the region between the 1-percent-annual-chance flood elevation and the estimated limits of wave runup.

Coastal Flooding in the Cities of Bellingham and Blaine Flood damage in the coastal areas of Bellingham and Blaine is caused by a combination of high tide levels and wave action. The observed tide level is a result of astronomical tide (caused by gravitational effects of the sun and moon) and storm surge (rise in water levels due to wind stress and low atmospheric pressure). Waves breaking onto the shoreline produce an additional water-level rise at the beach (wave setup), and waves running up the beach (wave runup) can cause impact damage far above the stillwater level. Flood elevations were determined by combining the effects of tide and wave setup.



Rank 3 of 67 **Washington State Watershed Risk Assessment: Strait of Georgia**

Incorporated City

1% Annual Chance Flood

NFIP Claims

NFIP Policies

Interstate Fwy

State & US Routes

Available LiDAR

Upper Chehalis Watershed

WA RiskMAP Rank: 4 of 67

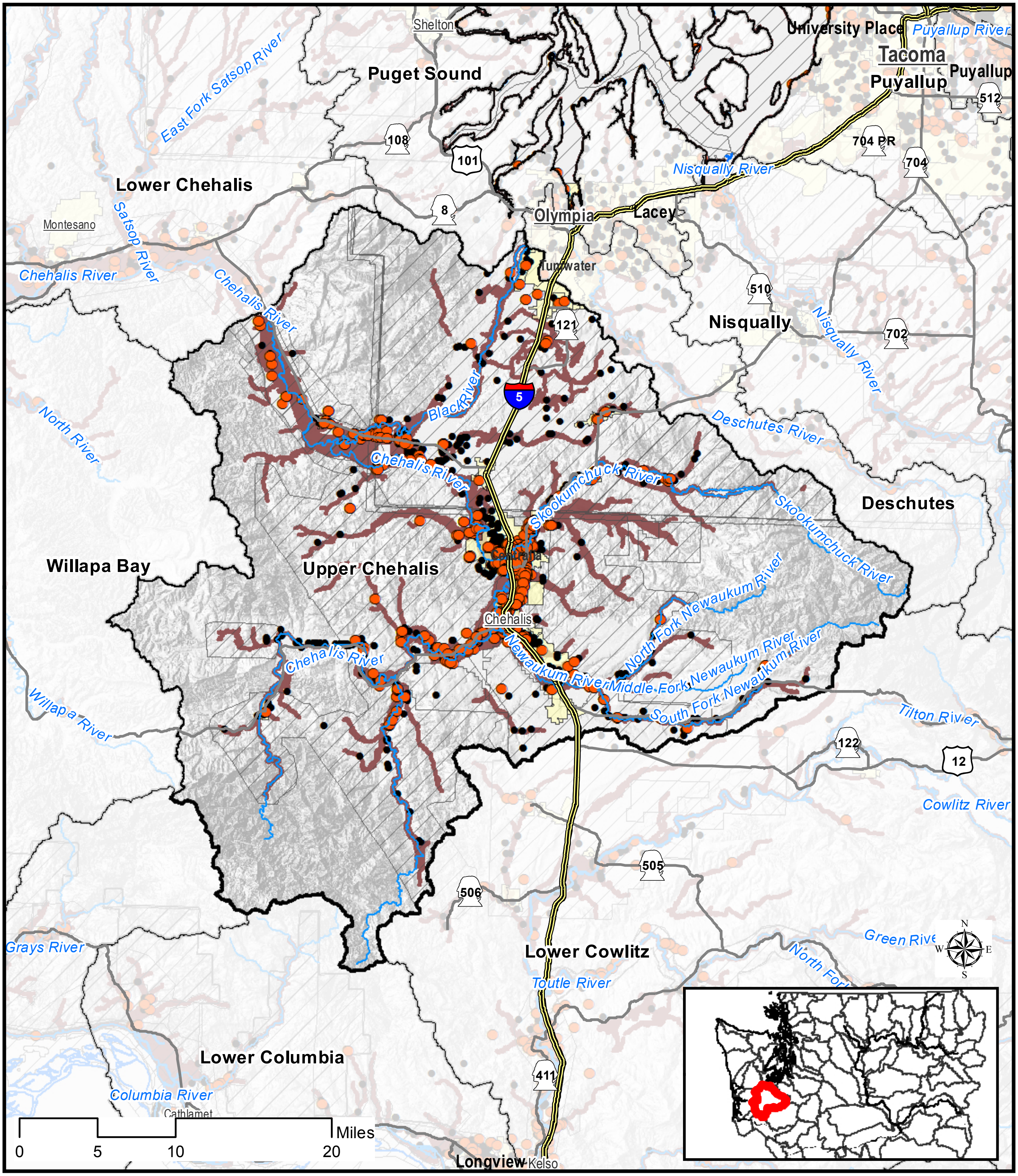
HUC8 Name	Sq Miles	FEMA Trifecta Rank	Floodplain SQ_Miles	Floodplain Density Rank	population Density Rank	Policies & Claims Rank	Risk Rank
Upper Chehalis	1299	9	85.1	3	22	2	**4**

Communities:
Bucoda, Centralia, Chehalis, Napavine, Oakville, Pe Ell, Tenino, Tumwater

Primary Flooding Sources:
Black River, Chehalis River, Middle Fork, Newaukum River, North Fork Newaukum River, Skookumchuck River, South Fork Chehalis River, South Fork Newaukum River

Principal Flood Problems:
The Chehalis River Basin of western Washington is the second largest in the state, second only to the Columbia Basin. In the last two decades, four 100-year floods have occurred there: in January and November 1990, February 1996, and December 2007. Extreme flood events along the Centralia Reach have severely impacted transportation. In 1990, I-5 was closed for one day; in 1996, four days; and in 2007, four days. In 2004 the Army Corps estimated that transportation-delay costs for the freeway were 3.4 million dollars per day of closure, and that a 100-year flood could be expected to bring 4.5 days of closure costing 15.3 million dollars.

Federal Involvement
There is a long history of government flood projects, studies, and proposals in the basin, with particular focus on the flood-prone Centralia Reach of the upper river, near the Twin Cities of Lewis County, Centralia and Chehalis. In 1931, 1935, and 1944 Army Corps reports on the basin determined that flood control was not feasible. In 1965 a federal study began that determined large-scale projects were not justified, though levees, channel modifications, and headwater dams may be. In 1972 interim reports were published, and beginning in 1974 a levee alternative was evaluated for the Centralia area. In 1982 an Army Corps feasibility study recommended increasing storage of the Skookumchuck Reservoir on the Skookumchuck River, a tributary which joins the Chehalis River near Centralia. Preconstruction engineering and design began in 1988; work was suspended in 1991, when the project was determined unfeasible; and a final report was released in 1992.



Rank 4 of 67 **Washington State Watershed Risk Assessment: Upper Chehalis**

Incorporated City
1% Annual Chance Flood
NFIP Claims
NFIP Policies
Interstate Fwy
State & US Routes
Available LiDAR

DEPARTMENT OF ECOLOGY State of Washington

Snohomish Watershed

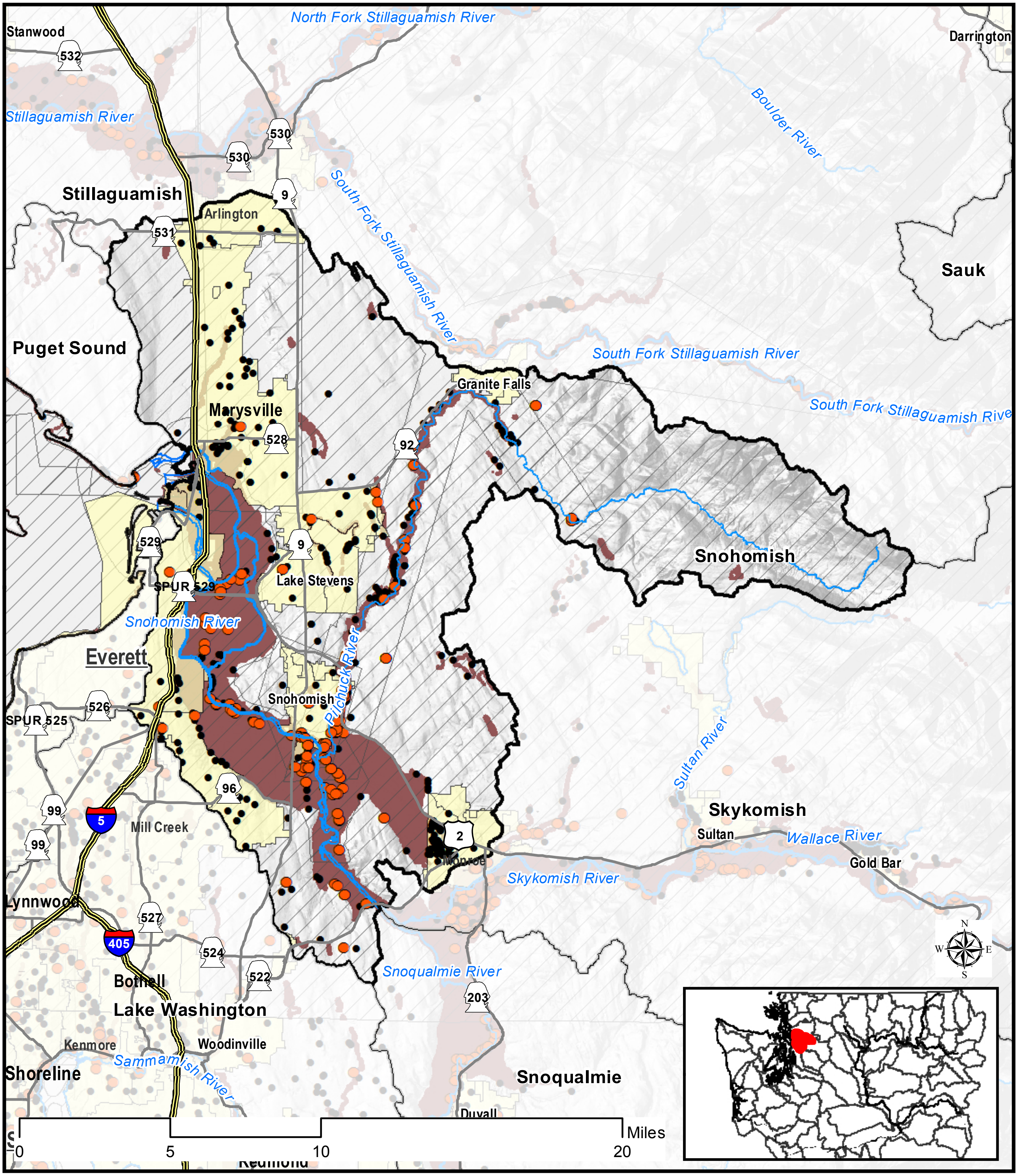
WA RiskMAP Rank: 5 of 67

HUC8 Name	HUC8 sq. mi.	FEMA Trifecta Rank	Floodplain sq. mi.	Floodplain Area Rank	Population Density Rank	Policies & Claims Rank	Risk Rank
Snohomish	291.5	23	40.3	18	4	15	5

Communities:
Arlington, Everett, Granite Falls, Lake Stevens, Marysville, Mill Creek, Monroe, Snohomish

Primary Flooding Sources:
Snohomish River, Pilchuck River, Snoqualmie River

Principal Flood Problems:
Flooding in the Snohomish watershed may occur from high tide levels in Puget Sound or from floods on the various rivers and streams in the county. Tidal flooding can occur when a high astronomical tide (gravitational effects of the sun and moon) is heightened by a large storm surge (rise in water levels due to wind stress and low atmospheric pressure). Wave runup is a significant factor when occurring during high-tide conditions in areas where the shorelines are not sheltered from local wind effects. Major floods on rivers and streams in Snohomish County are caused by rainstorms between October and March. Though floodwaters are primarily from rainfall, they are often augmented by snowmelt. Snowmelt floods in spring and summer months are usually not as severe. Rain-runoff floods in the study basins are characterized by sharply rising riverflows, with high-magnitude peaks and flood durations ranging from a few hours on small streams to several days on larger rivers. The greatest threat from flooding occurs between late November and early February, when moisture-laden storms pass through the Puget Sound region. Characteristically, these storms are 24 hours in duration, with moderate and fairly constant precipitation seldom exceeding 1 inch per hour. Not uncommon are two or more storms in rapid succession, sometimes less than 24 hours apart. The Snohomish River floodplain is subject to frequent inundation. Except for the French Creek Drainage District, existing levees provide protection only from normal spring floods that would damage crops. Overtopping maybe expected every 2 to 5 years on average, depending on height and condition of levees. Streamflow records are available from two gaging stations operated by the USGS on the Snohomish River. The gaging station on the Snohomish River near the City of Monroe is located approximately 0.1 mile downstream of the Skykomish and Snoqualmie River confluence and has operated since 1963. Records for the gage at the City of Snohomish included both stage and discharge between 1942 and 1965, but since 1965 only stages are available through the USGS.



Rank 5 of 67 **Washington State Watershed Risk Assessment: Snohomish**

Incorporated City
1% Annual Chance Flood
NFIP Claims
NFIP Policies
Interstate Fwy
State & US Routes
Available LiDAR

DEPARTMENT OF ECOLOGY State of Washington

Puyallup Watershed

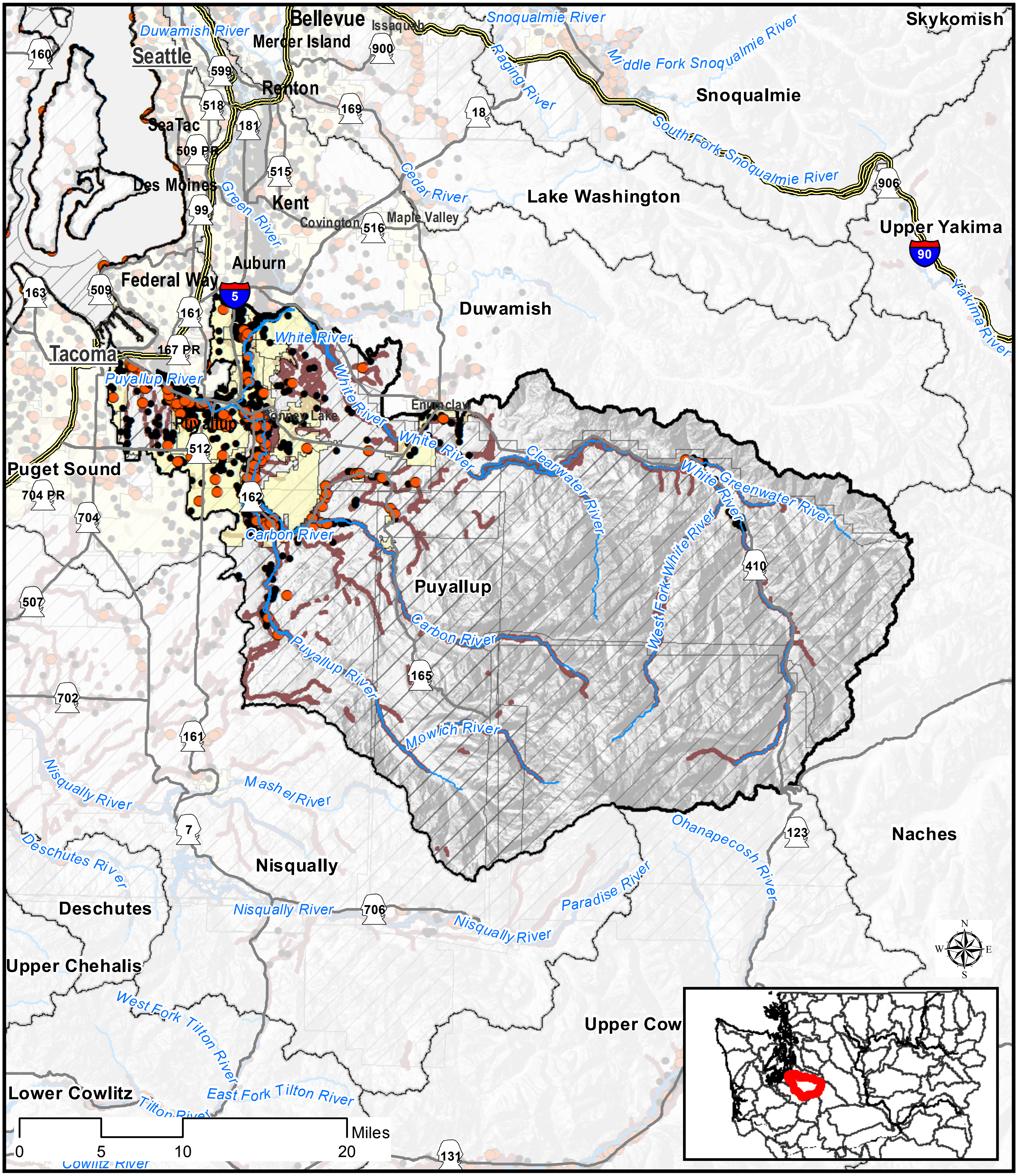
WA RiskMAP Rank: 6 of 67

HUC8 Name	HUC8 sq. mi.	FEMA Trifecta Rank	Floodplain sq. mi.	Floodplain Area Rank	Population Density Rank	Policies & Claims Rank	Risk Rank
Puyallup	984.7	2	33.0	23	8	6	6

Communities
Algona, Auburn, Bonney Lake, Buckley, Carbonado, Edgewood, Enumclaw, Fife, Orting, Pacific, Puyallup, South Prairie, Sumner, Tacoma, Wilkeson

Primary Flooding Sources
Carbon River, Carbon River, Clearwater River, Greenwater River, Mowich River, Puyallup River, South Mowich River, West Fork White River, White River

Principal Flood Problems
Major floods on the Puyallup River were recorded 18 times at the City of Puyallup between 1914 and 1943, before Mud Mountain Dam was completed. The largest flood, 57,000 cfs, occurred on December 10, 1933. The river has not exceeded zero flood damage flow (45,000 cfs at Puyallup) since the Mud Mountain Dam was completed in 1943. It is estimated that the natural peak flow of the January 1965 flood would have been 53,000 cfs, but the Mud Mountain Project reduced it to 41,500 cfs. Major flood damage still occurs in the vicinity of the Town of Orting, where the channel capacity of the Puyallup River has been exceeded frequently. The largest flood recorded at the gaging station near Orting at River Mile 26.4 was 15,300 cfs in November 1962. In December 1977, major damage occurred in the communities of Alderton and McMillin because of high flows on the Puyallup River. The only extensive flood plains on the White River are located in the Sumner area at the mouth. Mud Mountain Dam, at River Mile29.6, has regulated flood flows on the lower White River so as not to exceed 20,000 cfs and has thus limited major damage. Most of the flood damage from the Carbon River occurs in the lower4-mile reach in the vicinity of Orting. The steep gradient of the river upstream of Orting causes high velocities that erode the stream banks and result in channel changes during high flows. The channel capacity in the Orting area is estimated at 6,000 cfs. The largest flood recorded at the USGS gaging station at Fairfax (gage no. 12093900) at River Mile 17.7 was 10,000cfs in December 1977.



Rank 6 of 67 **Washington State Watershed Risk Assessment: Puyallup**

Incorporated City	NFIP Claims	Interstate Fwy
1% Annual Chance Flood	NFIP Policies	State & US Routes
Available LiDAR		

DEPARTMENT OF ECOLOGY State of Washington

Lower Yakima Watershed

WA RiskMAP Rank: 7 of 67

HUC8 Name	HUC8 sq. mi.	FEMA Trifecta Rank	Floodplain sq. mi.	Floodplain Area Rank	Population Density Rank	Policies & Claims Rank	Risk Rank
Lower Yakima	2905.4	7	75.1	4	14	17	7

Communities

Benton City, Grandview, Granger, Harrah, Kennewick, Mabton, Moxee, Prosser, Richland, Sunnyside, Toppenish, Union Gap, Wapato, West Richland, Yakima, Zillah

Primary Flooding Sources

Yakima River, Ahtanum Creek, Cowiche Creek, Wide Hollow Creek

Principal Flood Problems

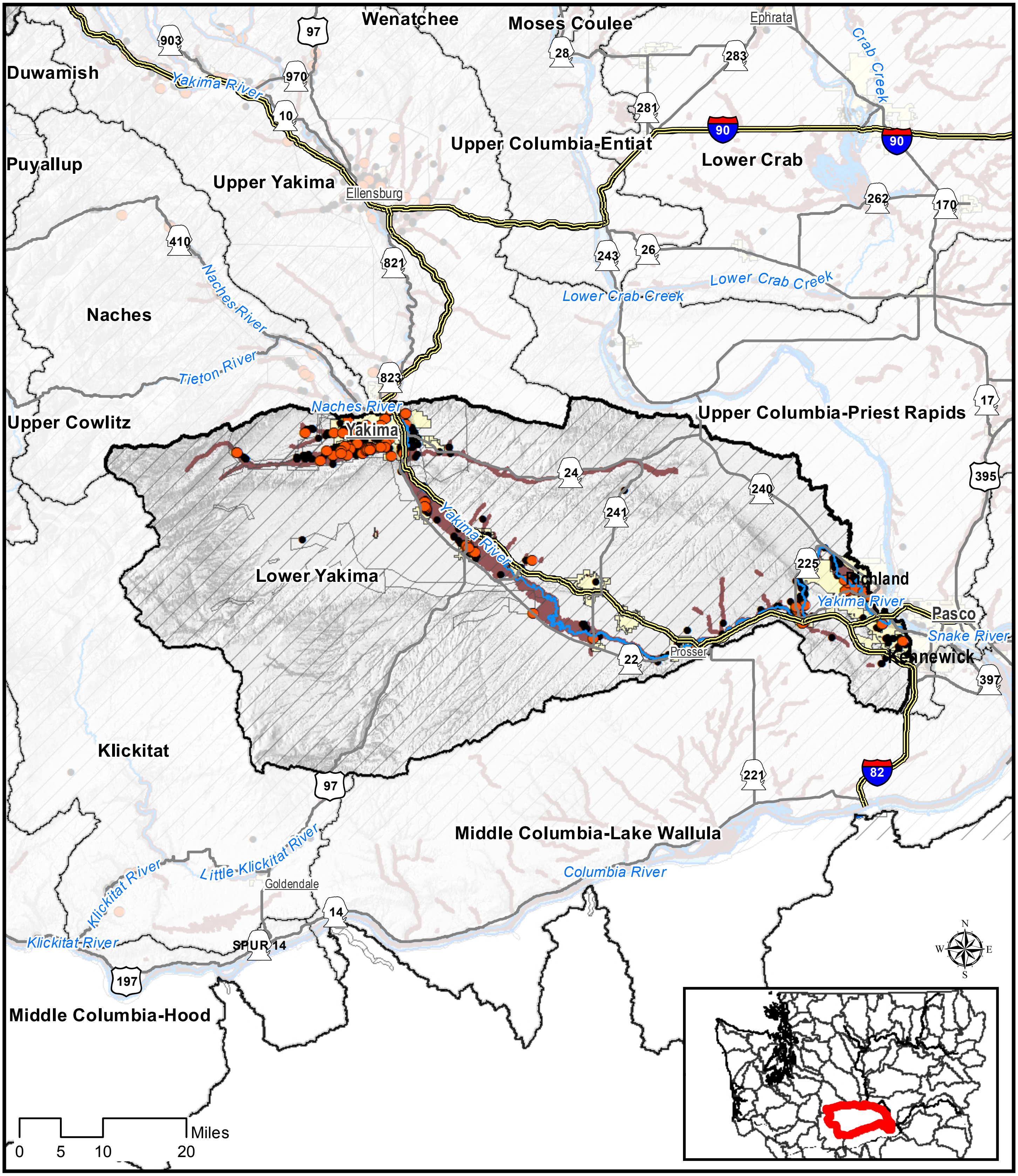
When the combined flow of the Naches and Yakima Rivers exceeds approximately 12,000 cubic feet per second (cfs), overflow occurs and innndates property in the flood"plains. In 65 years of gage records on the Yakima River, 43 occasions of overbank flows have been observed (References 5, 6, and 7). The highest recorded flows are associated with heavy winter rainfall, sometimes augmented by rising temperatures which caUSe local snowmelt. Such conditions occurred in 1896, 1906, 1917, and 1933. Peak flows observed were as follows:

November 16, 1896 45,600 cfs Union Gap
November 15, 1906 63,900 cfs Union Gap
December 30, 1917 52,900 cfs Parker
December 23, 1933 65,000 cfs Parker

After 1933, the highest winter flood flow occurred in 1974, when 28,000 cfs was recorded at Parker on January 17. Spring floods, caused by snowmelt at higher elevations in the watershed, also occur. Spring floods with flows in the range of from 12,000 to 20,000 cfs have occurred approximately 20 times during 65 years of continuous records. The three most severe spring floods recorded had peak flows as follows, measured at the Parker Gage:

June 3, 1913 22,600 cfs
June 19, 1916 24,800 cfs
May 29, 1948 37,700 cfs

The highest reported damage toll was that of the January 1974 floods, estimated at $13 million (Reference 12). The total included agricultural damage of $3 million and $4 million damage to roads, highways, and other public facilities. Seventy-seven homes were destroyed, and 383 others received major damage; 1,115 families were affected, and 2 fatalities were reported.



Rank 7 of 67 **Washington State Watershed Risk Assessment: Lower Yakima**

Incorporated City
1% Annual Chance Flood
NFIP Claims
NFIP Policies
Interstate Fwy
State & US Routes
Available LiDAR

DEPARTMENT OF ECOLOGY State of Washington

Snoqualmie Watershed

WA RiskMAP Rank: 8 of 67

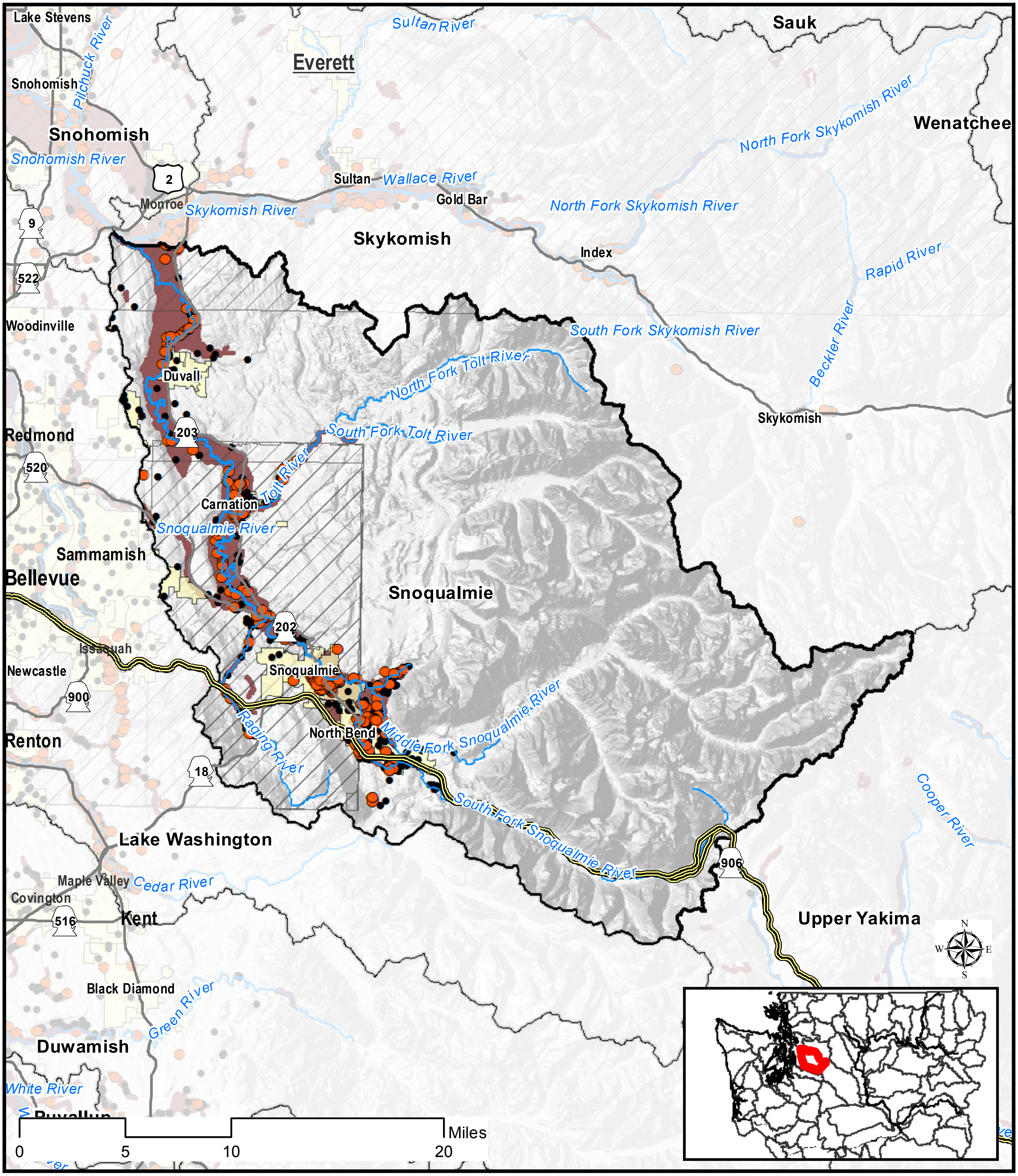
HUC8 Name	HUC8 sq. mi.	FEMA Trifecta Rank	Floodplain sq. mi.	Floodplain Area Rank	Population Density Rank	Policies & Claims Rank	Risk Rank
Snoqualmie	694.0	18	33.6	21	15	4	8

Communities
Carnation, Duvall, North Bend, Redmond, Sammamish, Snoqualmie

Primary Flooding Sources
North Fork Snoqualmie River, North Fork Tolt River, Raging River, Snoqualmie River, South Fork Snoqualmie River, South Fork Tolt River, Tolt River

Principal Flood Problems
Climatic and topographic conditions of the upper Snoqualmie Valley, create two distinct high-flow periods each year. In the spring or early, summer, the seasonal rise in temperature melts snow in the headwaters and causes increased flow. The other high-flow period, the winter flood, is the most damaging. Winter storms bring in moisture-laden air from the Pacific Ocean and mild temperatures causing snowmelt, combined to cause floods of high magnitude and short duration. Most of the major floods have occurred during November, December, January, and February. Without the protection by flood control reservoirs, the communities along the free flowing Snoqualmie River and its forks are vulnerable to severe flooding such as occurred in November 1959 and December 1975. The largest known flood in the Snoqualmie-North Bend area occurred on November 23, 1959. As the rivers in the basin swelled on that November day, there occurred a classic example of how wildly a river can change its course. About 9 miles east of the City of North Bend, the South Fork cut a new channel on the opposite side of its valley through what was a section of the main cross state arterial, the Snoqualmie Pass Highway. The largest known flood in the Carnation area occurred in December 1975. Agriculture and transportation damages constituted the principal losses. However, the lower valley is inundated to some extent almost every winter. Other major floods occurred in February 1932, December 1967, and January 1969. Storms which cause flooding in the Tolt River Watershed are usually associated with long, steady rains (i.e., winter maritime occluded frontal systems) which are typified by longer duration, more uniform intensity, and more evenly distributed precipitation than the unstable shower (convective) storms. With this type of rainstorm, the flooding in one basin, such as the Tolt, will be associated with flooding on adjacent basins; thus, the rare occurrence of a 100-year frequency flood on the Tolt would most likely be associated with high water backwater of the Snoqualmie River.

The elevation of future floods depends upon the level of the Snoqualmie River at the peak discharge of the Tolt River, the amount of landfill or diking, the physical arrangement or layout, and the hydraulic conditions of the channel.



Rank 8 of 67 **Washington State Watershed Risk Assessment: Snoqualmie**

Incorporated City	NFIP Claims	Interstate Fwy
1% Annual Chance Flood	NFIP Policies	State & US Routes
Available LiDAR		

DEPARTMENT OF ECOLOGY State of Washington

Grays Harbor Watershed

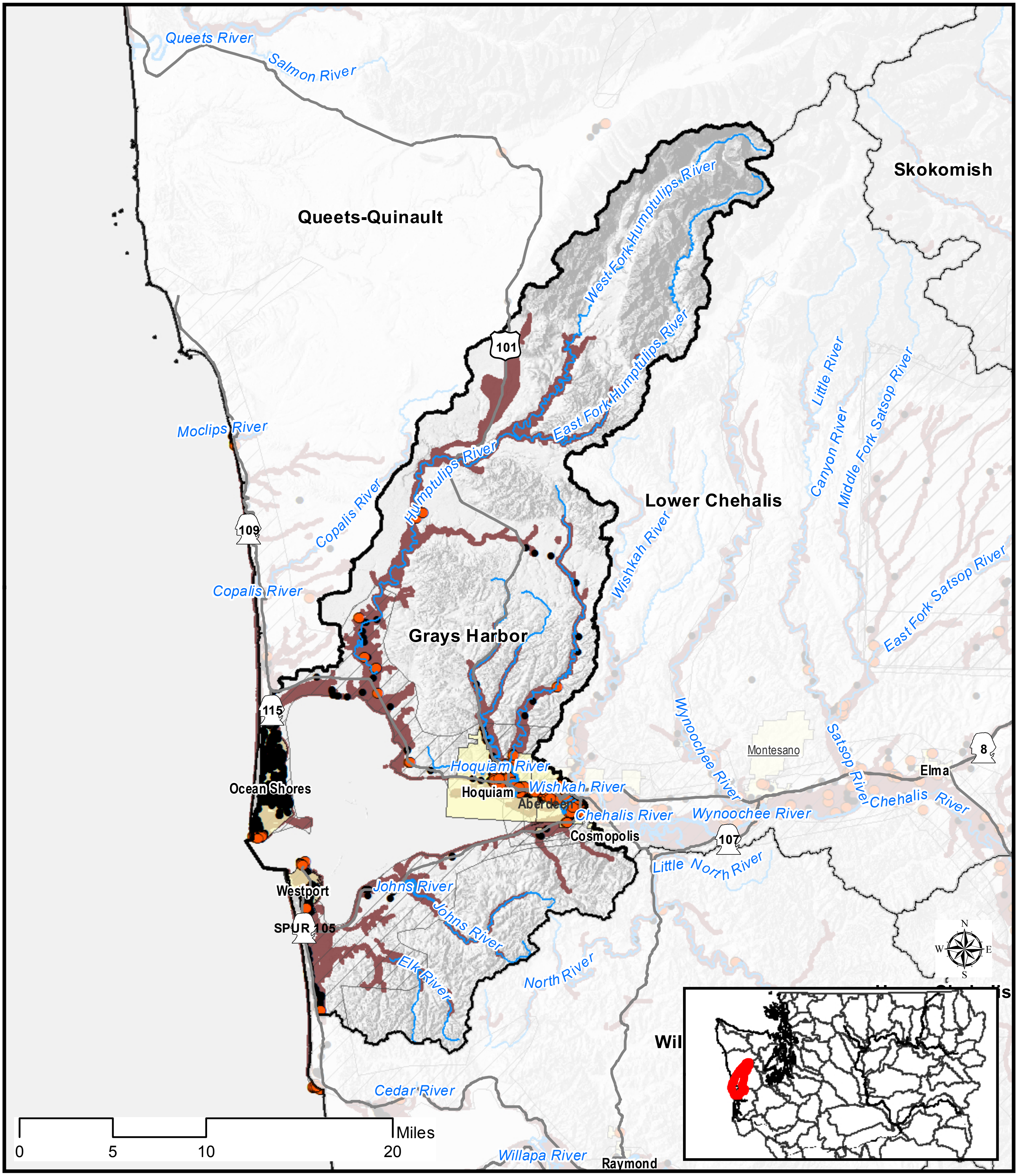
WA RiskMAP Rank: 9 of 67

HUC8 Name	HUC8 sq. mi.	FEMA Trifecta Rank	Floodplain sq. mi.	Floodplain Area Rank	Population Density Rank	Policies & Claims Rank	Risk Rank
Grays Harbor	587.1	29	47.2	13	23	7	9

Communities
Aberdeen, Cosmopolis, Hoquiam, Ocean Shores, Westport

Primary Flooding Sources
East Fork Humptulips River, Elk River, Humptulips River, Johns River, Little Hoquiam River, Middle Fork Hoquiam River, North Fork Johns River, South Fork Johns River, West Branch Elk River, West Fork Hoquiam River

Principal Flood Problems
Flooding in Grays Harbor County occurs principally in the winter. High spring tides and strong winds from winter storms produce storm surges that cause coastal flooding. Heavy rains with some snowmelt produce the highest runoff flows in the winter. The storms that produce the storm surges also bring heavy rains, therefore, the high riverflows are held back by tides, producing the greatest flooding at river mouths.



Rank 9 of 67 **Washington State Watershed Risk Assessment: Grays Harbor**

Incorporated City
1% Annual Chance Flood
NFIP Claims
NFIP Policies
Interstate Fwy
State & US Routes
Available LiDAR

DEPARTMENT OF ECOLOGY State of Washington

Duwamish Watershed

WA RiskMAP Rank: 10 of 67

HUC8 Name	HUC8 sq. mi.	FEMA Trifecta Rank	Floodplain sq. mi.	Floodplain Area Rank	Population Density Rank	Policies & Claims Rank	Risk Rank
Duwamish	495.6	12	12.7	42	5	5	10

Communities

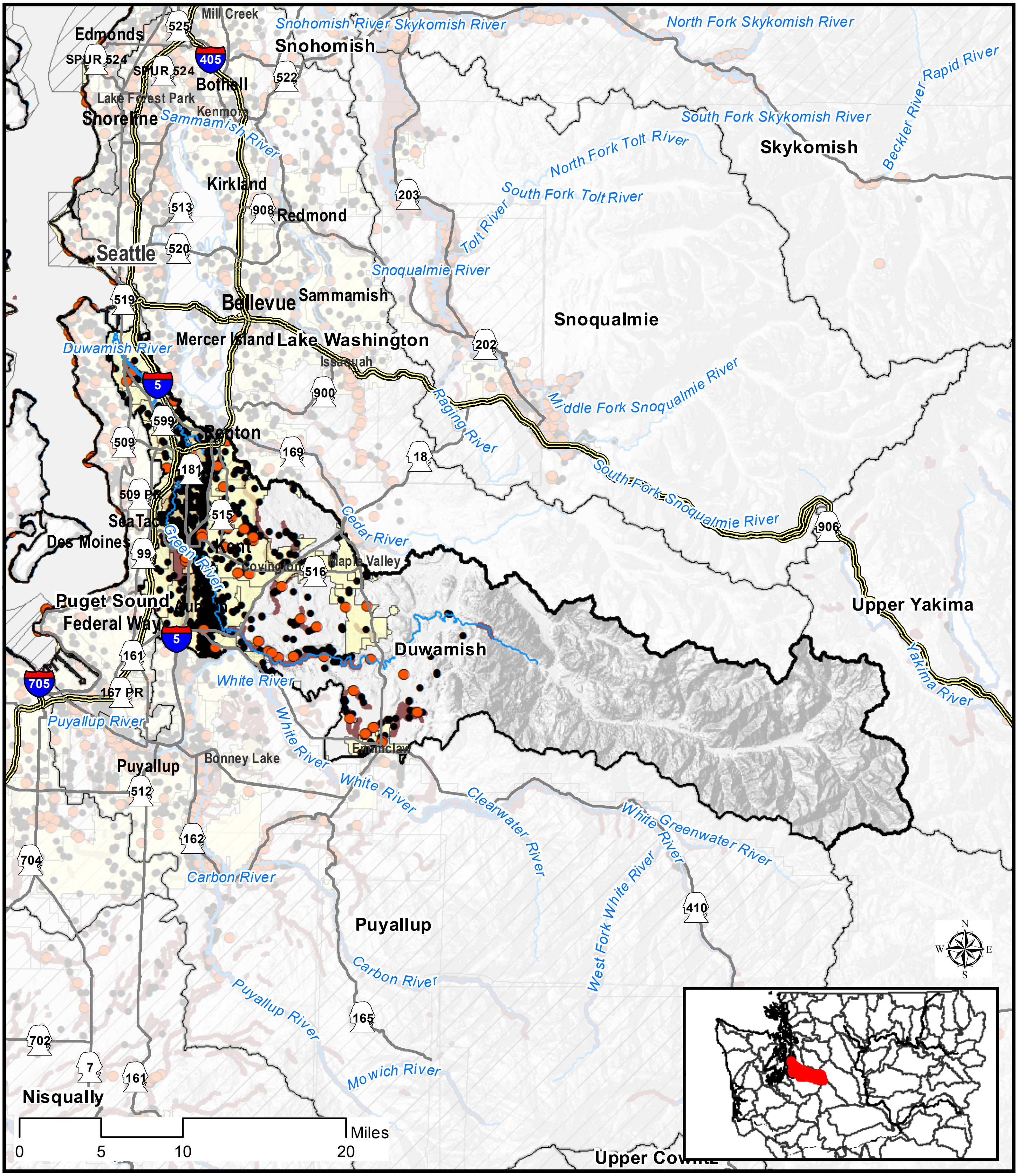
Algona, Auburn, Black Diamond, Burien, Covington, Des Moines, Enumclaw, Federal Way, Kent, Maple Valley, Renton, SeaTac, Seattle, Tukwila

Primary Flooding Sources

Black River, Duwamish River, Green River

Principal Flood Problems

Flooding damage to crops and property in the lower Green River Valley has been a problem since the earliest settlement of the area. Flooding occurred almost annually but the impact to the farmland was minimal. After urbanization, the impact of flooding became more severe. Rapid increase in construction of roads, housing, and parking lots increased the volume and rate at which runoff reached the valley floor. Commercial and industrial landfills have been typically located in the lower valley, resulting in alteration of natural drainage patterns and reduction in overbank storage. During periods of excessive precipitation, surface and subsurface runoff from the steep valley walls cause groundwater elevations in the valley floor to rise significantly. This creates open ponding in topographically depressed areas. This condition is further aggravated by flood flows and corresponding high water elevations on the Green River, resulting in a perched channel condition, which prevents natural drainage of subsurface water. In some areas, the overlying soils are generally less pervious than the deeper sands and runoff collects in pond perched above the water table. Under regulated conditions, significant flooding still does occur in areas unprotected by levee systems and from interior local drainage runoff that outlets to the Green River. High water levels in the Green River and concerns with existing levee system freeboard and structural integrity limit the discharge of runoff waters carried by Mill Creek (Auburn), the Black River, and various other tributaries. The high water levels of the Green River require that the tributary flows be stored and released by gravity or pump discharge to the river channel in a manner consistent with the requirements of the Green River Management Agreement. Under existing conditions, extensive backwater flooding occurs at the uncontrolled outlets of Mill Creek (Auburn) and Mullen Slough, south and west of State Routes 516 and 167, respectively.



Rank 10 of 67 Washington State Watershed Risk Assessment: **Duwamish**

Incorporated City
1% Annual Chance Flood
NFIP Claims
NFIP Policies
Interstate Fwy
State & US Routes
Available LiDAR

DEPARTMENT OF ECOLOGY State of Washington

Lake Washington Watershed

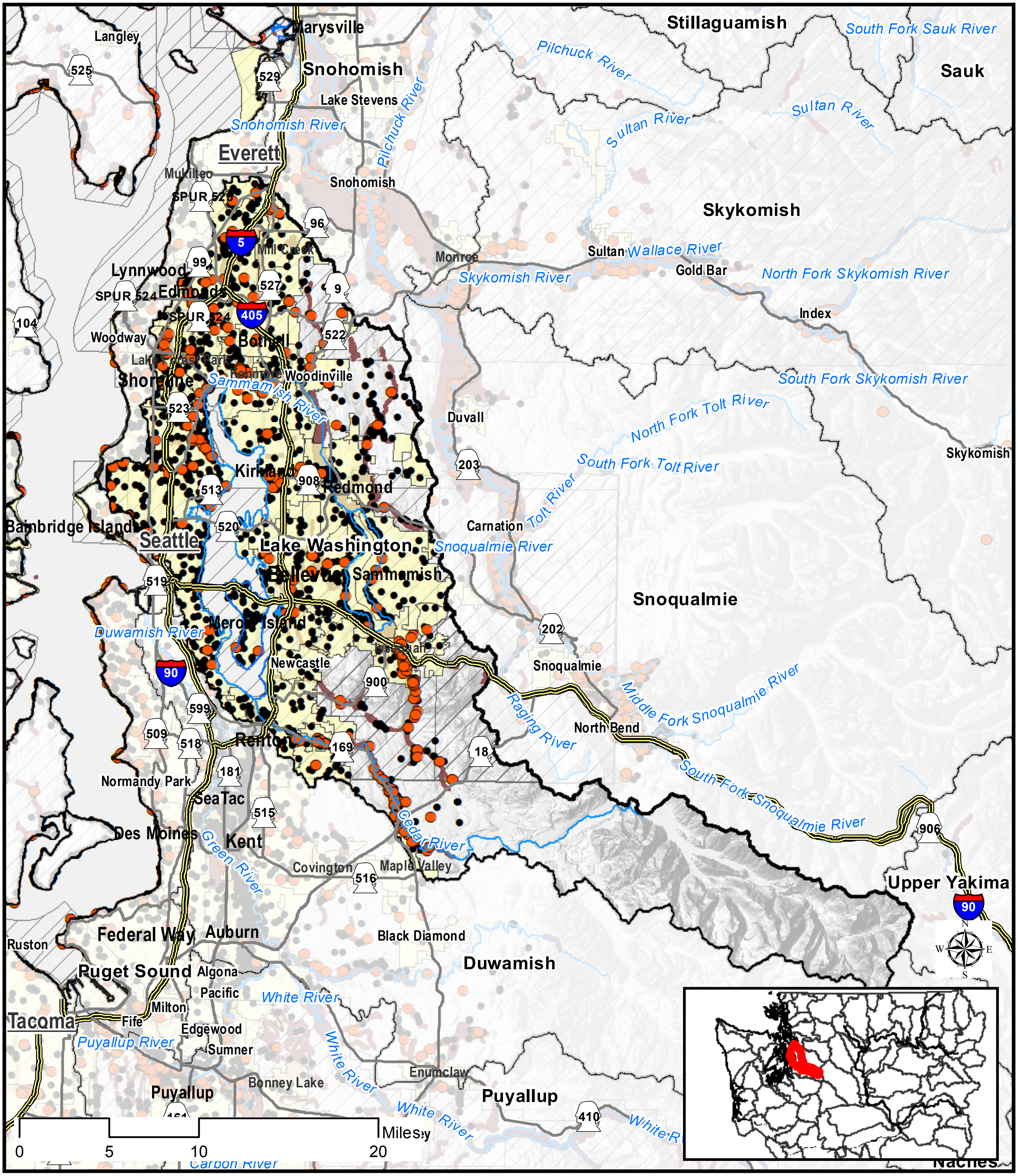
WA RiskMAP Rank: 11 of 67

HUC8 Name	HUC8 sq. mi.	FEMA Trifecta Rank	Floodplain sq. mi.	Floodplain Area Rank	Population Density Rank	Policies & Claims Rank	Risk Rank
Lake Washington	597.1	6	12.1	45	1	8	11

Communities
Beaux Arts, Bellevue, Bothell, Brier, Clyde Hill, Edmonds, Everett, Hunts Point, Issaquah, Kenmore, Kent, Kirkland, Lake Forest Park, Lynnwood, Maple Valley, Medina, Mercer Island, Mill Creek, Mountlake Terrace, Mukilteo, Newcastle, Redmond, Renton, Sammamish, Seattle, Shoreline, Tukwila, Woodinville, Yarrow Point

Primary Flooding Sources
Cedar River, Lake Washington, Sammamish River

Principal Flood Problems
Stream flow on the Cedar River has been recorded almost continuously since 1895 at the gage near Landsburg. The greatest flood which has occurred over the past 50 years took place on December 4, 1975, with a peak discharge at Landsburg of 8,800 cfs. Based on an updated frequency curve for the Renton USGS stream gage for the 40 years of record through 1985, the recurrence interval for that event exceeded 100 years. Preliminary peak flow estimates by the USGS (Reference 22) for the recent November 1986 event indicate a peak flow of approximately 5,300 cfs, with a recurrence interval of approximately 100 years. Preliminary peak flow estimates by the USGS (Reference 22) for the recent November 1986 event indicate a peak flow of approximately 5,300 cfs, with a recurrence interval of approximately 10 years. Damages in the Cedar River basin from the December 1975 flood event were estimated at $1,760,000. In the reach under study, the west bank of an improved channel at the mouth of the Cedar River was overtopped above the South Boeing Bridge and the Renton Municipal Airport experienced significant flooding and had to close down until the floodwaters receded. Extent of flooding for the November 1986 event in the lower 2-mile reach under study was mainly limited to the improved channel with the exception of some overbank flooding adjacent to the Renton Airfield. Upstream of the improved channel, portions of the Maplewood Additions and other scattered residential developments have been inundated by past flooding events. Log and debris jams have been experienced on the lower river channel, especially during the 1933 and 1975 floods. The lower reach of the river channel, through the City of Renton, has been aggrading in recent years based on comparison of current and previous cross section data. This may result in increases in flood levels and potential overflows.



Rank 11 of 67 **Washington State Watershed Risk Assessment: Lake Washington**

- Incorporated City
- 1% Annual Chance Flood
- NFIP Claims
- NFIP Policies
- Interstate Fwy
- State & US Routes
- Available LiDAR

DEPARTMENT OF ECOLOGY State of Washington

Nooksack Watershed

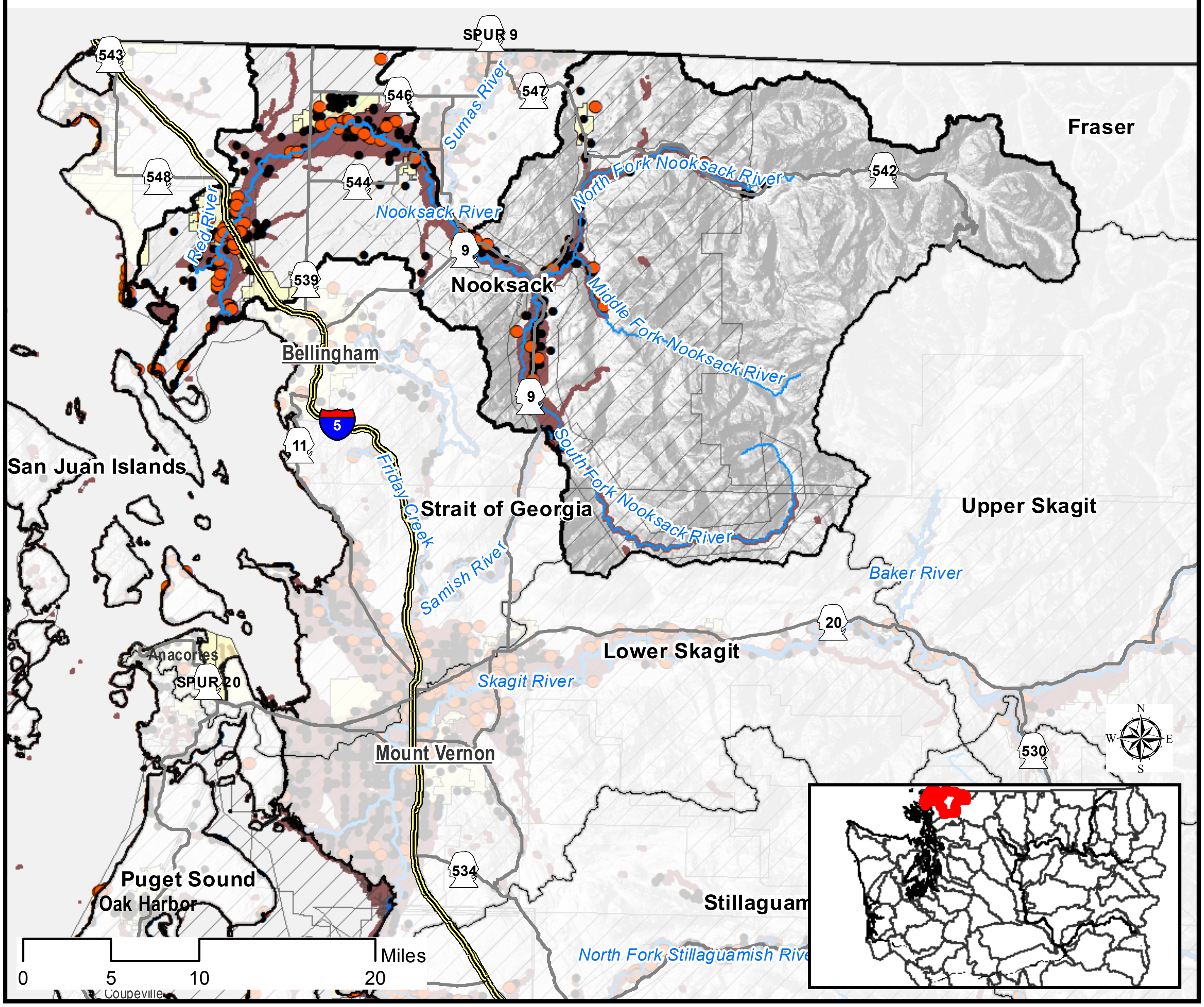
WA RiskMAP Rank: 12 of 67

HUC8 Name	HUC8 sq. mi.	FEMA Trifecta Rank	Floodplain sq. mi.	Floodplain Area Rank	Population Density Rank	Policies & Claims Rank	Risk Rank
Nooksack	790.1	16	49.5	11	18	19	12

Communities
Bellingham, Everson, Ferndale, Lynden

Primary Flooding Sources
Lummi River, Middle Fork Nooksack River, Nooksack River, North Fork Nooksack River, Red River, Samish River, South Fork Nooksack River

Principal Flood Problems
Large, scattered areas of the Nooksack River Valley are annually subject to local flooding. The remainder of the floodplain is subject to flooding approximately once in 2 to 5 years, affecting areas utilized almost entirely for agriculture and containing both farm and residential buildings. Maximum known flow was 49,300 cubic feet per second (cfs) at Deming in 1932 as computed from high-water marks. At this discharge, most of the floodplain is inundated. Along the South Fork and downstream near Everson, the flooded area is an irregular strip approximately 0.5 mile wide. Between the constrictions at Everson and Ferndale, the floodwater surface varies from 1 to 2 miles in width, and downstream of Ferndale, the delta is covered for a width of 3 to 4 miles. In the agricultural setting of the Nooksack Valley, the greater part of flood damage occurs to land and crops. This results from drowning of grasses and other plants; loss of livestock; erosion of banks and fallow ground; leaching of fertilizer; infestations by weed seed; carrying away of fences; deposition of sand, gravel, and driftwood; and temporary loss of pasture use because of ground saturation. A special situation occurs in the delta when tidal dikes are breached by impounding river waters. The resulting saltwater intrusion may reduce productivity for several years. Next in order of importance are damages to buildings, particularly in the low-lying areas of populated areas and to a lesser extent on farms. Damage to levees by erosion and overtopping is a significant problem, recurring during most large floods. Floods in 1951, 1975, 1989, 1990, 1999, and 2002 caused levees to fail along both banks of the Nooksack River. Roadways suffer erosion of embankments and shoulders, undermining of pavement, and a temporary weakening because of subgrade saturation. Restriction of travel may cause financial losses.
In the upper portions of the valley above Everson, flood damages consist chiefly of bank erosion and the deposition of sand and gravel on farmlands.



Rank 12 of 67 **Washington State Watershed Risk Assessment: Nooksack**

Incorporated City
1% Annual Chance Flood
NFIP Claims
NFIP Policies
Interstate Fwy
State & US Routes
Available LiDAR

Stillaguamish Watershed

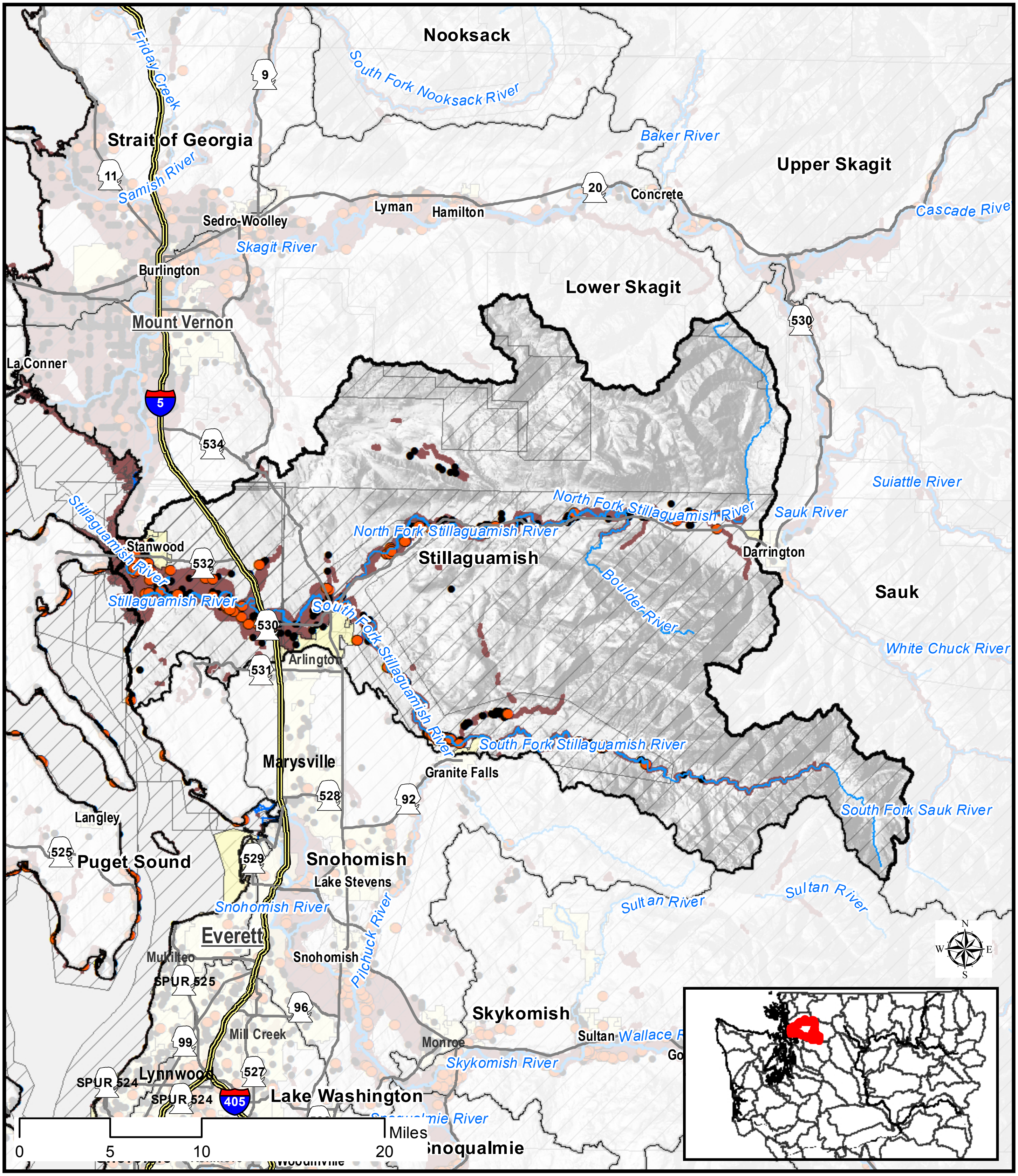
WA RiskMAP Rank: 13 of 67

HUC8 Name	HUC8 sq. mi.	FEMA Trifecta Rank	Floodplain sq. mi.	Floodplain Area Rank	Population Density Rank	Policies & Claims Rank	Risk Rank
Stillaguamish	702.6	21	34.5	20	21	11	13

Communities
Arlington, Granite Falls, Marysville, Stanwood

Primary Flooding Sources
Boulder River, North Fork Stillaguamish River, South Fork Stillaguamish River, Stillaguamish River

Principal Flood Problems
Streamflow records for the Stillaguamish River have been reported at USGS stream-gaging stations on the South Fork Stillaguamish River near the City of Granite Falls and North Fork Stillaguamish River near the City of Arlington since 1928. Streamflow records are not available for the main stem, but river stages are reported from a National Weather Service (NWS) non-recording gage on the Stillaguamish River at the City of Arlington. All major floods of record on the Stillaguamish River have occurred between November and February and were caused by high rates of precipitation with accompanying snowmelt. Discharges usually rise and fall rapidly, and two or more crests may occur in rapid succession as a series of storms move across the basin. The Stillaguamish River basin suffers damaging floods approximately every 3 to 5 years. From the confluence of the North and South Fork Stillaguamish Rivers at the City of Arlington, the Stillaguamish River meanders westerly 23 miles through a fertile floodplain. In the vicinity of the community of Silvana, the stream flows through two channels, Cook Slough and the Stillaguamish River. The channels recombine near River Mile (RM) 11 and then divide again near RM 8. From this point, the main stream flows approximately 2 miles through Hat Slough and discharges into Port Susan. Below the head ofHat Slough, the old Stillaguamish River channel, via the City of Stanwood, has become aggraded to the extent that it carries little or no river flow during the dry season. Below the City of Stanwood, flows in the old channel discharge into Port Susan through South Pass and into Skagit Bay through West Pass. The Stillaguamish River system is tidal for approximately 11.5 miles upstream from its mouth. The total range between mean higher-high water and mean lower-low water is approximately 11 feet.



Rank 13 of 67 **Washington State Watershed Risk Assessment: Stillaguamish**

Incorporated City
1% Annual Chance Flood
NFIP Claims
NFIP Policies
Interstate Fwy
State & US Routes
Available LiDAR

DEPARTMENT OF ECOLOGY State of Washington

Nisqually Watershed

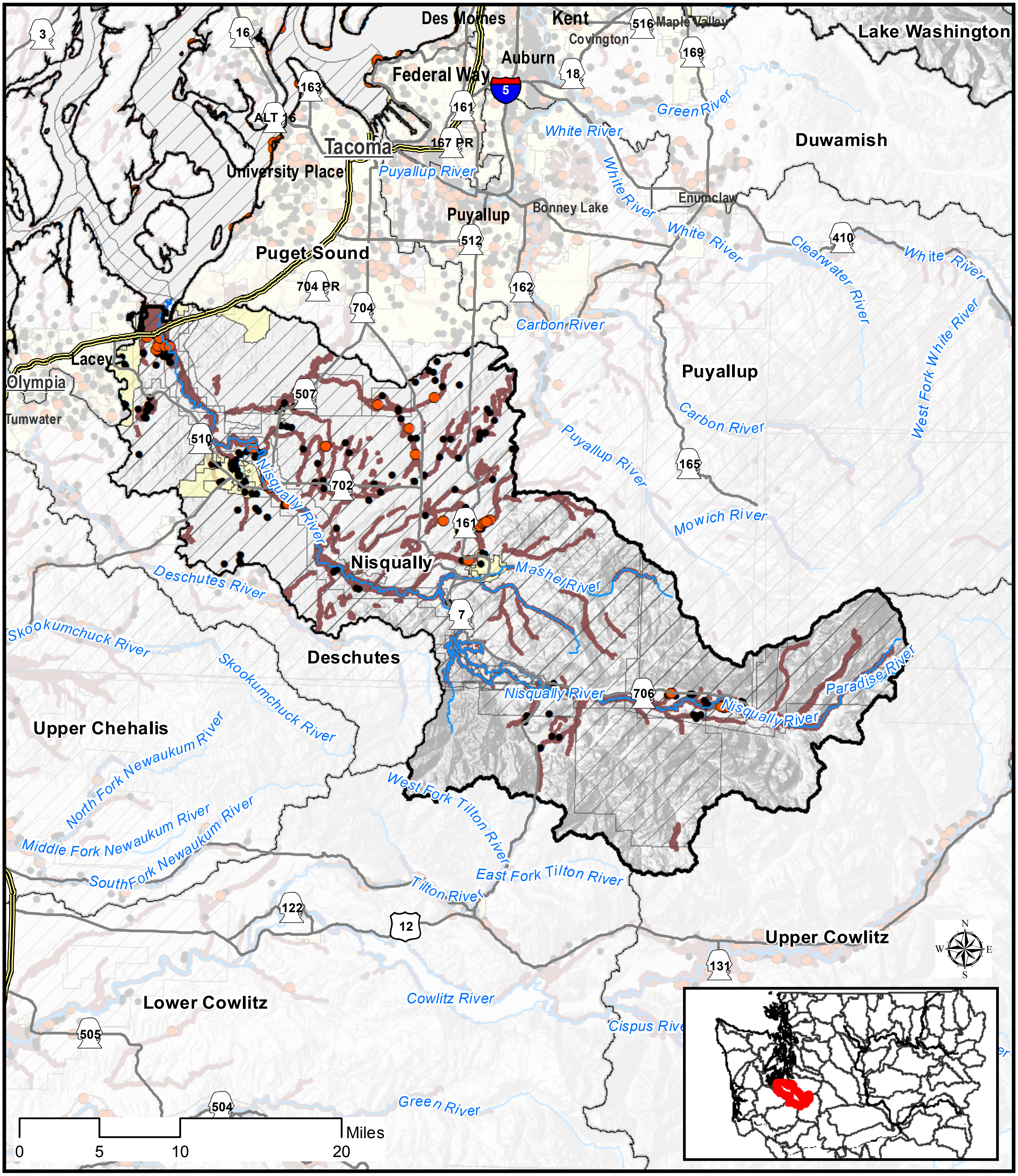
WA RiskMAP Rank: 14 of 67

HUC8 Name	HUC8 sq. mi.	FEMA Trifecta Rank	Floodplain sq. mi.	Floodplain Area Rank	Population Density Rank	Policies & Claims Rank	Risk Rank
Nisqually	769.8	13	33.1	22	12	25	14

Communities
DuPont, Eatonville, Lacey, McKenna, Roy, Yelm

Primary Flooding Sources
Little Mashel River, Little Nisqually River, Mashel River, Nisqually River, Paradise River

Principal Flood Problems
Flood damage along the Nisqually River is generally limited to an area near the community of McKenna at River Mile 21.8 and to the Nisqually Delta, which is a wide 3-mile-long flood plain at the mouth of the river. The land from McKenna to LaGrande Dam has a narrow flood plain with limited access. Approximately 18,000 cfs in the Nisqually River at McKenna is considered to represent the upper limit of zero flood damage. This flow has been exceeded six times during the period of record (1947-78) at the USGS gaging station on the Nisqually River below Powell Creek near McKenna (gage no. 12088400) at River Mile 31.6. At this station, the three most severe floods occurred in December 1975 (30,700 cfs), January 1965 (25,700 cfs), and January 1974 (23,200 cfs). An estimated flood of 42,000 cfs at the same site occurred in December 1933, inundating most of the delta.



Rank 14 of 67 **Washington State Watershed Risk Assessment: Nisqually**

Incorporated City	NFIP Claims	Interstate Fwy
1% Annual Chance Flood	NFIP Policies	State & US Routes
Available LiDAR		

DEPARTMENT OF ECOLOGY State of Washington

Lower Willamette Watershed

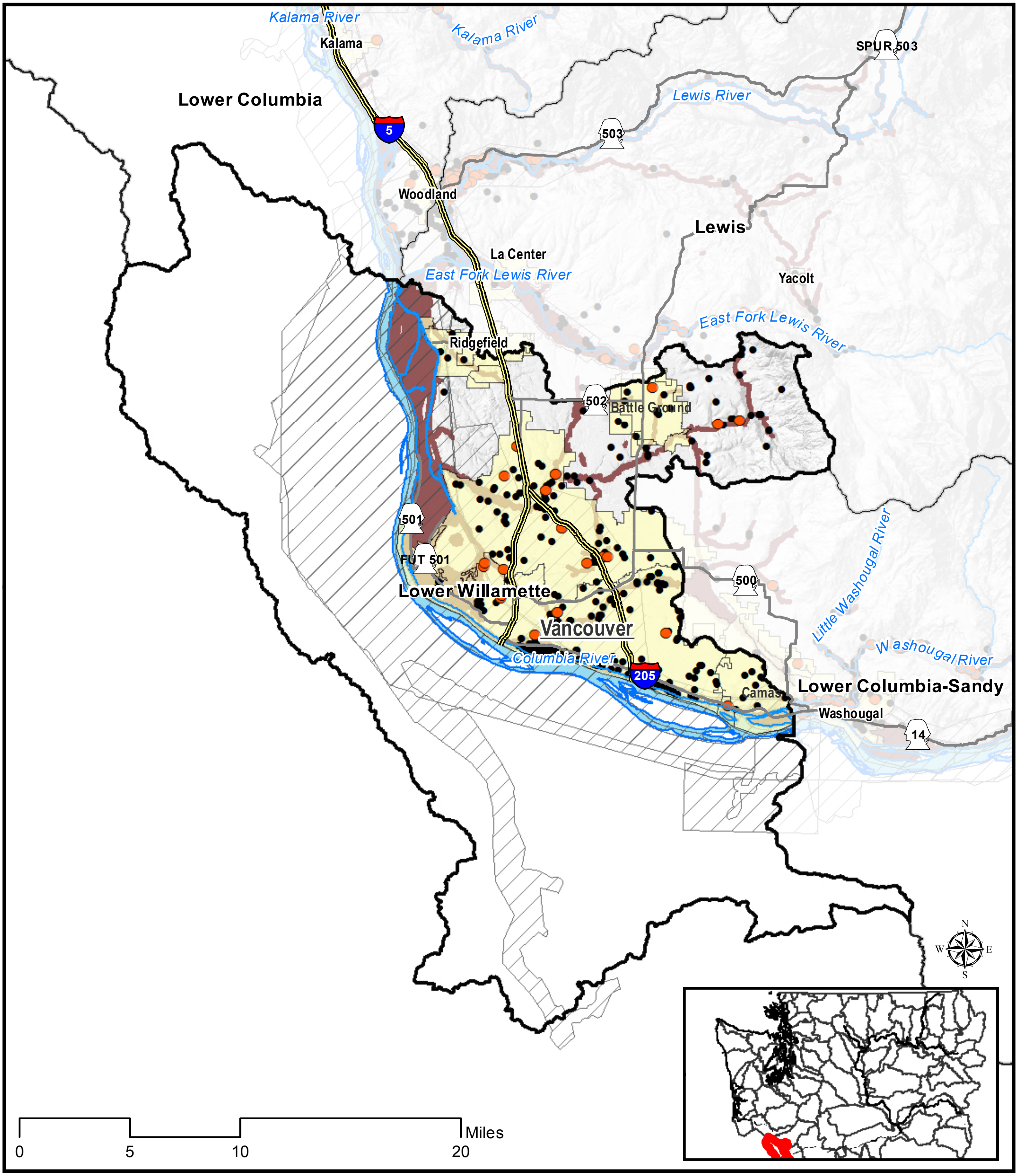
WA RiskMAP Rank: 15 of 67

HUC8 Name	HUC8 sq. mi.	FEMA Trifecta Rank	Floodplain sq. mi.	Floodplain Area Rank	Population Density Rank	Policies & Claims Rank	Risk Rank
Lower Willamette	644.1	99	26.7	28	7	27	15

Communities
Battle Ground, Camas, Ridgefield, Vancouver

Primary Flooding Sources
Columbia River

Principal Flood Problems
Although many large Columbia River floods have occurred in Clark County, existing flood control storage will reduce the severity of future floods. The June 1948 and June 1956 floods were typical spring-summer floods caused by snowmelt runoff. Although less significant than the aforementioned floods, the December 1964 flood is noteworthy because it was an unusually large winter flood resulting primarily from rainfall. Peak discharges at the U.S. Geological Survey (USGS) gage at The Dalles, Oregon, for the June 1948 and June 1956 floods were 1,010,000 and 823,000 cubic feet per second (cfs), respectively. Discharges are given for The Dalles (approximately 55 miles upstream of Vancouver) rather than at Clark County because The Dalles is the first gage upstream of the mouth of the Columbia River with a reliable stage- discharge relationship. The discharge of the December 1964 flood is not comparable to the floods of 1948 and 1956 because large inflows occurred downstream of The Dalles. The estimated return periods for the 1948 and 1956 floods were 48 years and 18 years, respectively. The Columbia River floods of 1948 and 1956 caused light damage to residential areas of Clark County. Most of the damage in the unincorporated areas occurred in low lying farm and industrial areas. Emergency flood fighting measures along the Columbia River and temporary evacuation reduced damage.



Rank 15 of 67 **Washington State Watershed Risk Assessment: Lower Willamette**

Incorporated City
1% Annual Chance Flood
NFIP Claims
NFIP Policies
Interstate Fwy
State & US Routes
Available LiDAR

DEPARTMENT OF ECOLOGY State of Washington

Lower Chehalis Watershed

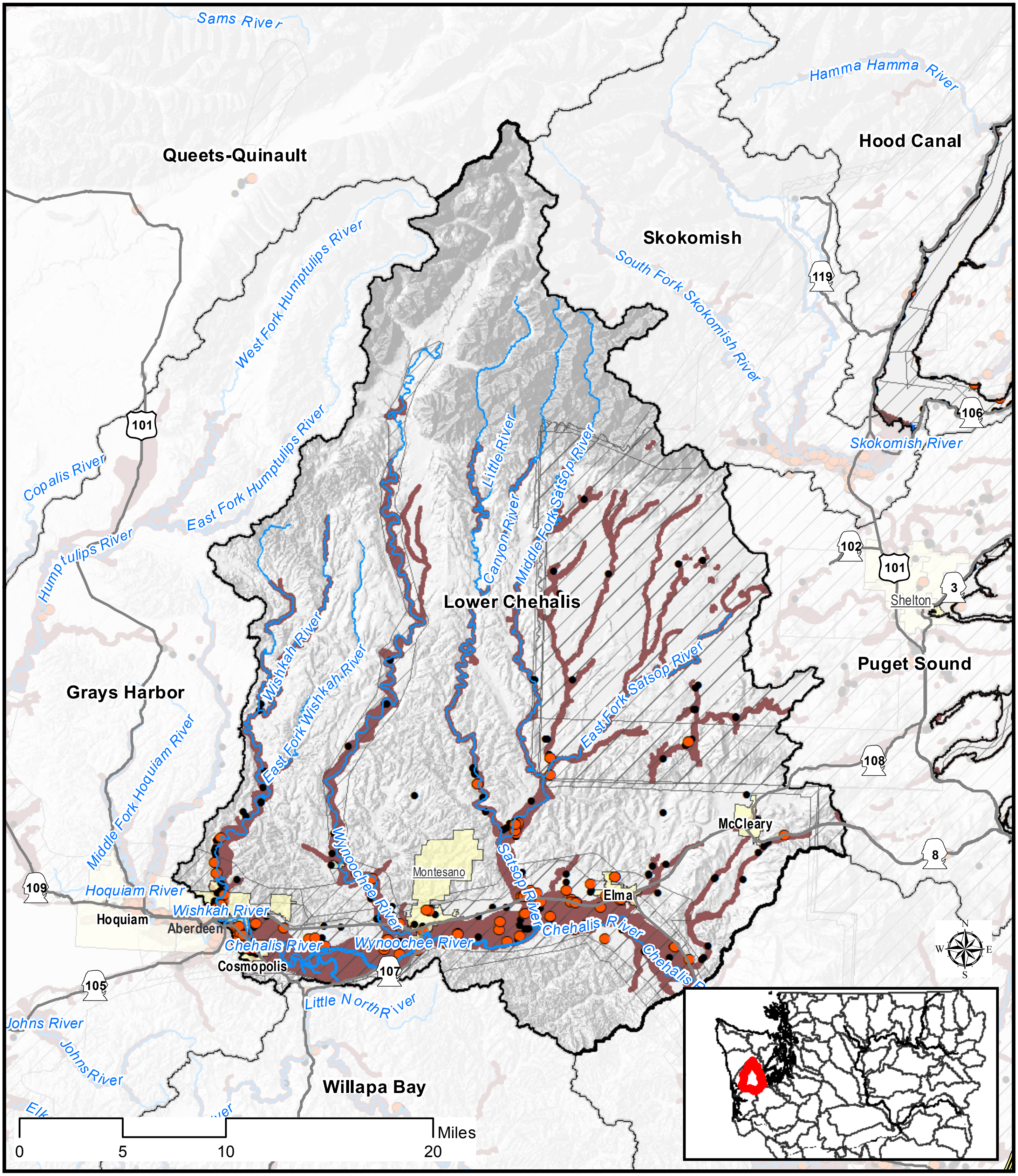
WA RiskMAP Rank: 16 of 67

HUC8 Name	HUC8 sq. mi.	FEMA Trifecta Rank	Floodplain sq. mi.	Floodplain Area Rank	Population Density Rank	Policies & Claims Rank	Risk Rank
Lower Chehalis	817.9	17	65.6	6	29	21	16

Communities
Aberdeen, Cosmopolis, Elma, McCleary, Montesano

Primary Flooding Sources
Canyon River, Chehalis River, East Fork Satsop River, East Fork Wishkah River, Little River, Middle Fork Satsop River, Satsop River, West Fork Satsop River ,West Fork Wishkah River, Wishkah River, Wynoochee River

Principal Flood Problems
Flooding in Grays Harbor County occurs principally in the winter. High spring tides, and strong winds from winter storms produce storm surges that cause coastal flooding. Heavy rains with some snowmelt produce the highest runoff flows in the winter. The storms that produce the storm surges also bring heavy rains, therefore, the high riverflows are held back by tides, producing the greatest flooding at river mouths. Flows have been recorded, on the Chehalis River at Porter since January 1952. The two largest floods on record at this station had discharges of 55,660 cubic feet per second (cfs) (January 1972) and 49,600 cfs (January 1971). The COE estimates the recurrence intervals for these floods are once in 75 years and once in 60 years, respectively (Reference 1). The COE completed construction of a dam on the Wynoochee River at RM 51.8 in August 1972. Until January 1982, the highest flow recorded at the gage located just above Black Creek was 18,100 cfs in December 1972. Based on the exceedence-frequency curve developed by the USGS for this gaging site, this discharge has a recurrence interval of approximately once in 2 years. There is a gage on the Satsop River at RM 2.3. This gage has been in operation since March 1929. The highest discharge recorded at the gage has been 46,600 cfs in January 1935. Based on the exceedence-frequency curve developed by the USGS for this gaging site, this discharge has a recurrence interval of approximately once in 50 years.



Rank 16 of 67 **Washington State Watershed Risk Assessment: Lower Chehalis**

Incorporated City
1% Annual Chance Flood
NFIP Claims
NFIP Policies
Interstate Fwy
State & US Routes
Available LiDAR

DEPARTMENT OF ECOLOGY State of Washington

Lower Cowlitz Watershed

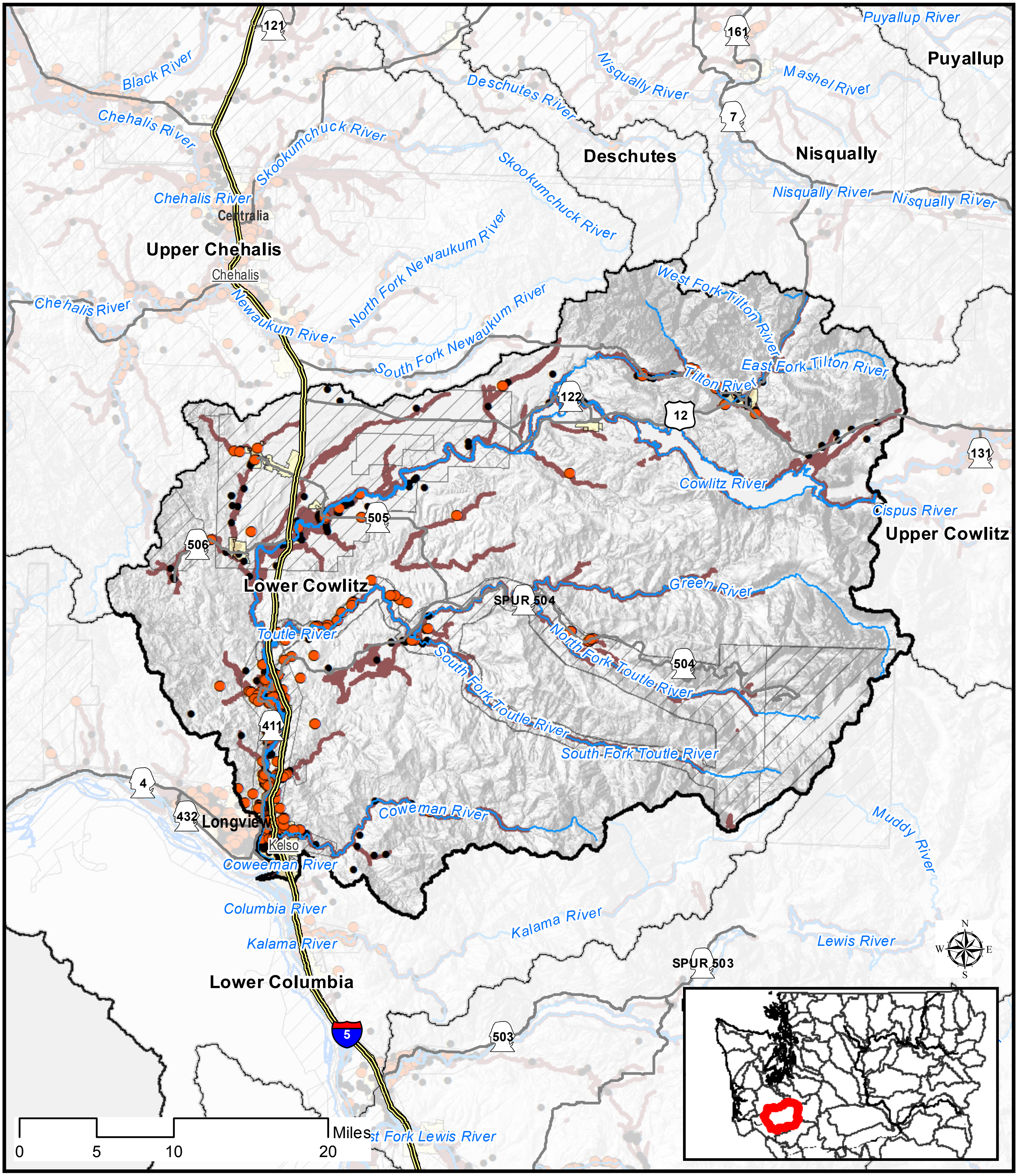
WA RiskMAP Rank: 17 of 67

HUC8 Name	HUC8 sq. mi.	FEMA Trifecta Rank	Floodplain sq. mi.	Floodplain Area Rank	Population Density Rank	Policies & Claims Rank	Risk Rank
Lower Cowlitz	1451.1	28	40.2	19	28	13	17

Communities
Castle Rock, Kelso, Longview, Morton, Mossyrock, Toledo, Vader, Winlock

Primary Flooding Sources
Coweman River, Cowlitz River, East Fork Tilton River, Green River, North Fork Tilton River, North Fork Toutle River, South Fork Toutle River, Tilton River, Toutle River, West Fork Tilton River

Principal Flood Problems
Major floods usually result from a combination of intense rainfall and snowmelt after the watershed has been saturated from prior rainfall. Columbia River floods generally are an annual event which occurs in the spring when the snow melts in the mountains. However, there has been winter flooding through the study reach of magnitudes comparable with the larger spring freshets. Flooding from rivers and smaller creeks within the Cowlitz, Kalama, and Lewis River basins generally occurs during the winter months of November through January. The historical record of flooding in Cowlitz County is available only for the period since substantial population centers became established. In December 1933, the county experienced one of the worst and most extensive floods in memory when Cowlitz, Coweman, Kalama, and Lewis Rivers Peaked well in excess of their current estimated 100-year discharge. Damage to the area was estimated at more than $3 million, occurring mainly within the populated urban centers of Kelso, Castle Rock, and Woodland when protective dikes were washed out and nearly 3000 people were forced to evacuate their homes because of the high water. Several major ridges were destroyed, and considerable damage to rural highways and farmland was incurred. In June 1948, Columbia River swelled to a Peak discharge of more than 1 million cubic feet Per second and caused an estimated $7.2 million damage, $6 million of which was to farm proPerty, in the region from Woodland to Willow Grove. Flooding was intensified by high tides which affected Columbia River elevations within Cowlitz County.



Rank 17 of 67 **Washington State Watershed Risk Assessment: Lower Cowlitz**

Incorporated City	NFIP Claims	Interstate Fwy
1% Annual Chance Flood	NFIP Policies	State & US Routes
Available LiDAR		

DEPARTMENT OF ECOLOGY State of Washington

Lower Columbia-Clatskanie Watershed

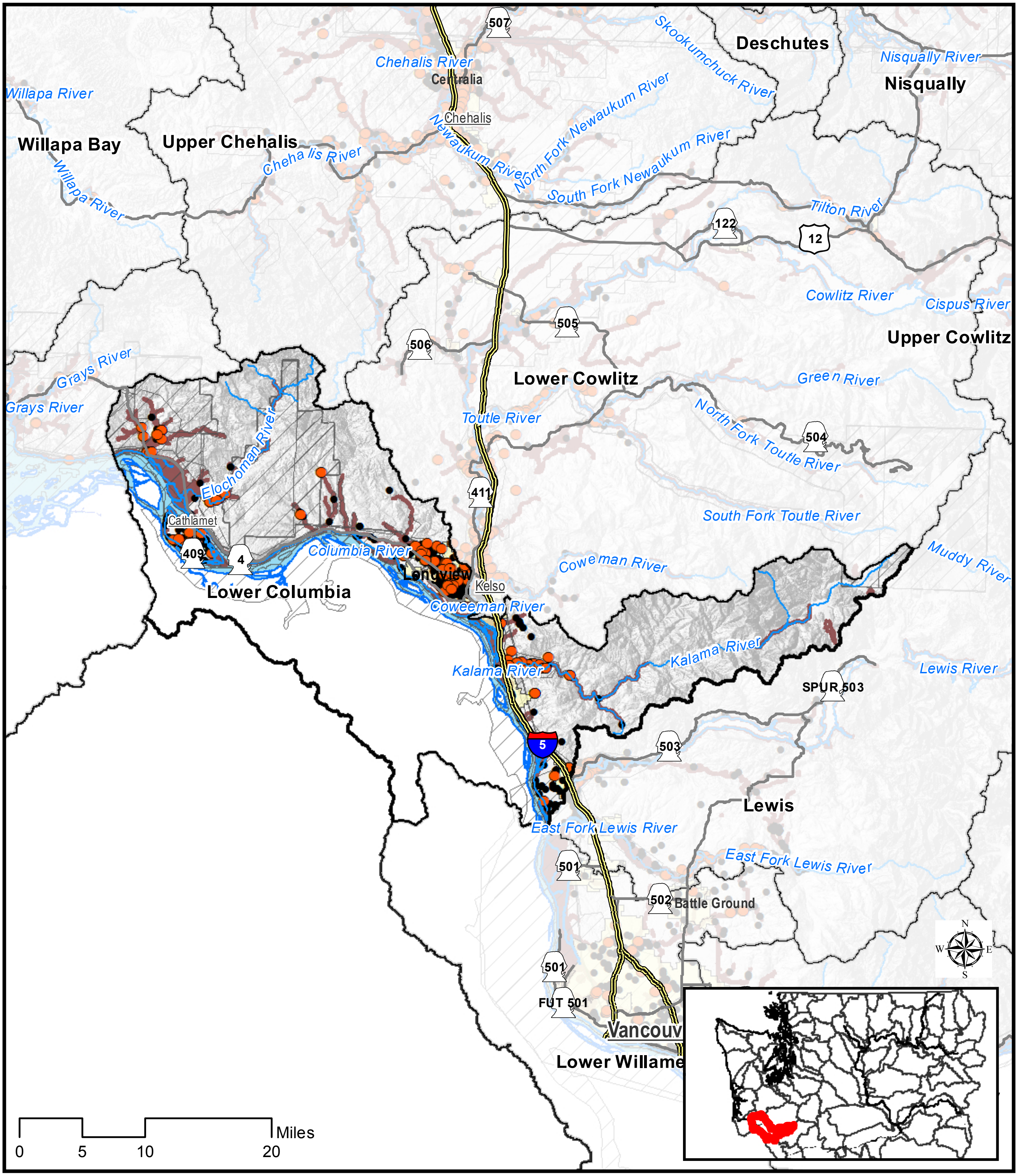
WA RiskMAP Rank: 18 of 67

HUC8 Name	HUC8 sq. mi.	FEMA Trifecta Rank	Floodplain sq. mi.	Floodplain Area Rank	Population Density Rank	Policies & Claims Rank	Risk Rank
Lower Columbia-Clatskanie	907.0	10	25.2	29	26	16	18

Communities
Cathlamet, Kalama, Kelso, Longview, Woodland

Primary Flooding Sources
Columbia River

Principal Flood Problems
Although many large Columbia River floods have occurred in Clark County, existing flood control storage will reduce the severity of future floods. The June 1948 and June 1956 floods were typical spring-summer floods caused by snowmelt runoff. Although less significant than the aforementioned floods, the December 1964 flood is noteworthy because it was an unusually large winter flood resulting primarily from rainfall. Peak discharges at the U.S. Geological Survey (USGS) gage at The Dalles, Oregon, for the June 1948 and June 1956 floods were 1,010,000 and 823,000 cubic feet per second (cfs), respectively. Discharges are given for The Dalles (approximately 55 miles upstream of Vancouver) rather than at Clark County because The Dalles is the first gage upstream of the mouth of the Columbia River with a reliable stage- discharge relationship. The discharge of the December 1964 flood is not comparable to the floods of 1948 and 1956 because large inflows occurred downstream of The Dalles. The estimated return periods for the 1948 and 1956 floods were 48 years and 18 years, respectively. The Columbia River floods of 1948 and 1956 caused light damage to residential areas of Clark County. Most of the damage in the unincorporated areas occurred in low lying farm and industrial areas. Emergency flood fighting measures along the Columbia River and temporary evacuation reduced damage.



Rank 18 of 67 **Washington State Watershed Risk Assessment: Lower Columbia-Clatskanie**

Incorporated City
1% Annual Chance Flood
NFIP Claims
NFIP Policies
Interstate Fwy
State & US Routes
Available LiDAR

DEPARTMENT OF ECOLOGY State of Washington

Upper Yakima Watershed

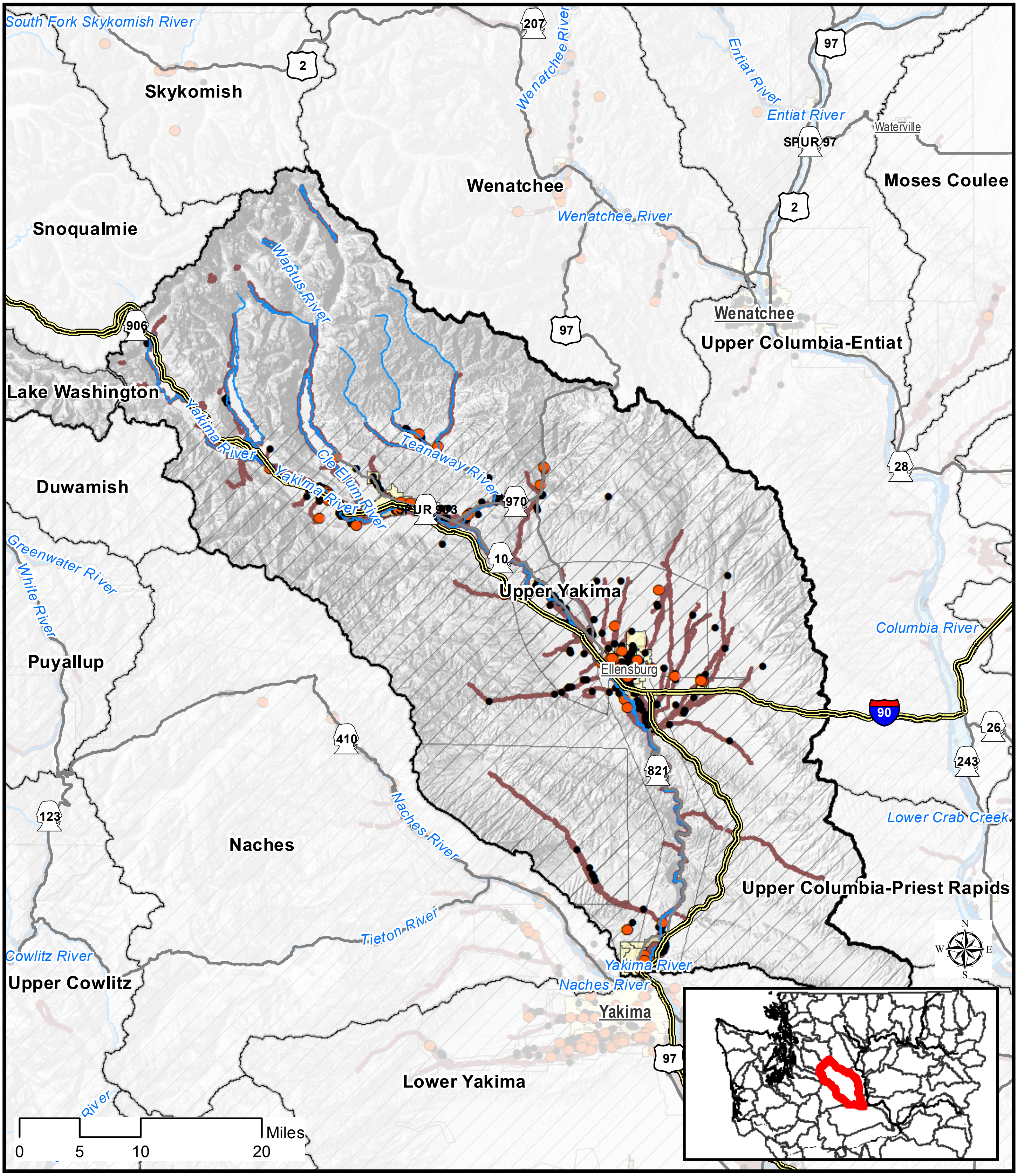
WA RiskMAP Rank: 19 of 67

HUC8 Name	HUC8 sq. mi.	FEMA Trifecta Rank	Floodplain sq. mi.	Floodplain Area Rank	Population Density Rank	Policies & Claims Rank	Risk Rank
Upper Yakima	2138.8	11	44.0	15	36	18	19

Communities
Cle Elum, Ellensburg, Kittitas, Roslyn, Selah, South Cle Elum

Primary Flooding Sources
Cle Elum River, Cooper River, Kachess River, Middle Fork Teanaway River, North Fork Teanaway River, Teanaway River, West Fork Teanaway River, Yakima River

Principal Flood Problems
Floods on the Yakima, Teanaway, and Cle Elum Rivers occur as the result of snowmelt in spring and early summer, and occur after heavy rains in November and December. The snowmelt floods are characterized by slow rise and long duration of flow; river stages may be increased by ice and debris jams. The winter flood crests are reduced because of Kachess, Keechelus, and Cle Elum Lakes' reservoir storage as flooding occurs after the irrigation season when storage is available. However, these reservoirs control only a small part of the runoff, and storage may not be available if a second winter flood occurs. Since 1862, 18 floods have occurred on the Yakima River and its tributaries. Five of the most severe floods occurred in November 1906 (41,000 cubic feet per second (cfs)), December 1933 (32,200 cfs), May 1948 (27,700 cfs), December 1975 (16,600 cfs), and December 1977 (21,500 cfs). These peak discharges were recorded at the u.s. Geological Survey gaging station on the Yakima River at Umtanum, Washington, Station No. 12484500. This site is 10 miles south of Ellensburg. Ellensburg and Kittitas are surrounded by a complex irrigation system consisting of the North Branch, Town, and Cascade Canals; Whipple Wasteway; and Reecer, Currier, Whiskey, Mercer, Wilson, Cooke, and Caribou Creeks. This system has a decreasing capacity downstream, and, if used to route floodwaters, may be overtaxed. In the 1948 flood, floodwaters diverted from one basin caused problems in another. Ice and debris have an impact on flood stages when culverts and bridges are obstructed. Historic high-water elevations and streamflow information were obtained from U.S. Geological Survey publications. Other high-water marks were obtained from records of the floods of December 1975 and December 1977 by the study contractor.



Rank 19 of 67 **Washington State Watershed Risk Assessment: Upper Yakima**

Incorporated City
1% Annual Chance Flood
NFIP Claims
NFIP Policies
Interstate Fwy
State & US Routes
Available LiDAR

DEPARTMENT OF ECOLOGY State of Washington

Skykomish Watershed

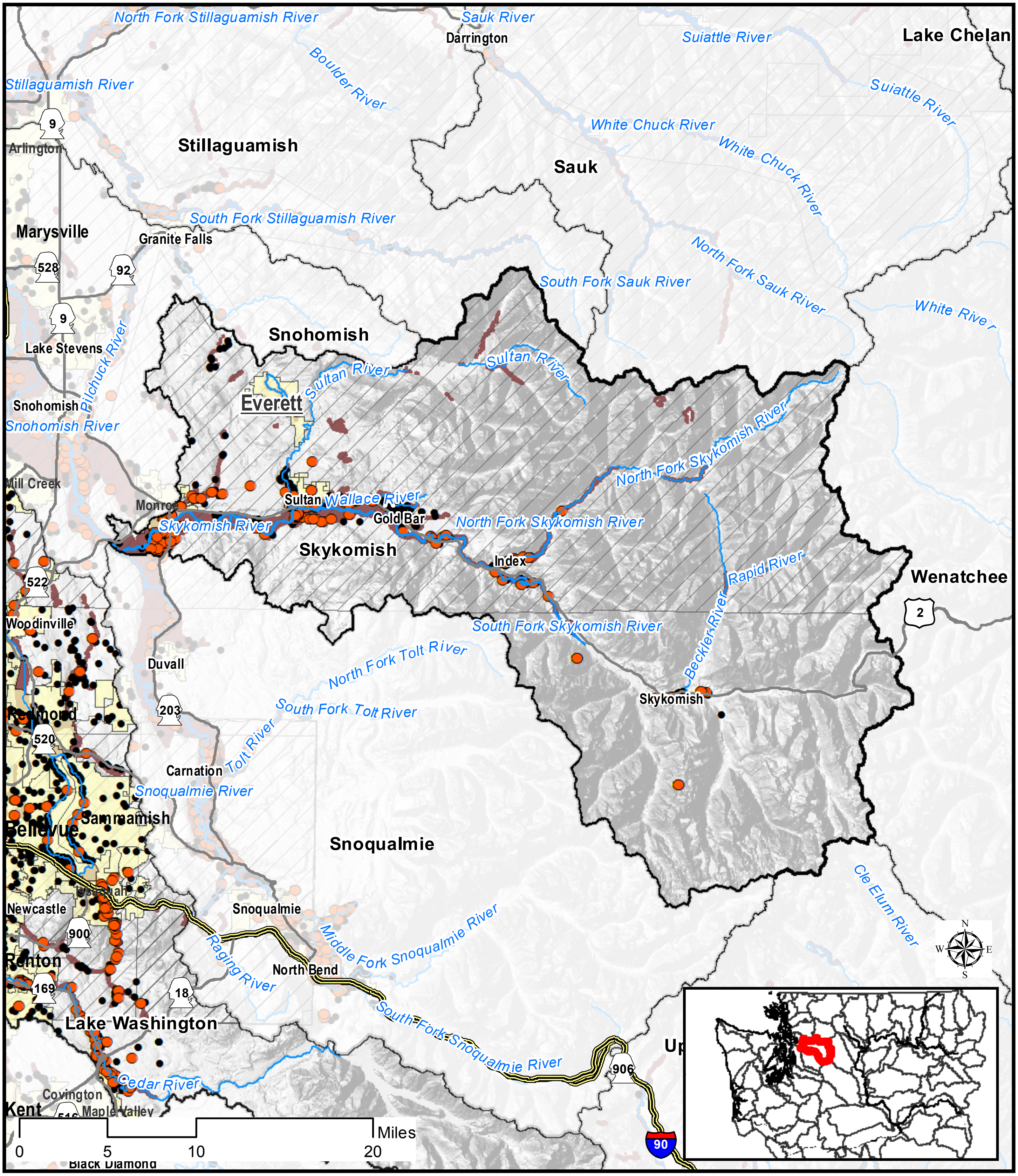
WA RiskMAP Rank: 20 of 67

HUC8 Name	HUC8 sq. mi.	FEMA Trifecta Rank	Floodplain sq. mi.	Floodplain Area Rank	Population Density Rank	Policies & Claims Rank	Risk Rank
Skykomish	834.8	19	22.1	33	33	10	20

Communities
Everett, Gold Bar, Index, Monroe, Skykomish, Sultan

Primary Flooding Sources
Beckler River, North Fork Skykomish River, Rapid River, Skykomish River, South Fork Skykomish River, Sultan River, Wallace River

Principal Flood Problems
Flooding of the City of Everett may occur from high tide levels in Puget Sound or from floods on the various rivers and streams in the county. High tides alone do not usually cause flooding but, when combined with high winds, can cause flooding along the coastline. Tidal flooding within the City of Everett along the coastal industrial area has occurred three times in the last 25 years, as reported by local residents. Coincidence of the annual highest tide level with a river peak can enlarge the extent of river flooding, but over the 30 years during which records have been kept, the magnitude of such coincident tides has not exceeded that having a 3-year recurrence interval. The major problem associated with floods within the City of Everett has been inundation of the low-lying agricultural lands, resulting in loss of crops and, in some cases, failure of dikes and blocked roads. Within the City of Monroe, the estimated 100-year flood from the Skykomish River will inundate approximately 80 acres of undeveloped land in the south and southeastern parts of the city. The estimated 100-year flood from the Snohomish River will inundate approximately 100 acres of developed agricultural land in the extreme northwestern part of the city. The Woods Creek floodplain in the City of Monroe is dominated by floodwaters backing up from the Skykomish River. Flooding in the City of Mukilteo may occur from high-tide levels and storm surge accompanied by winds in Possession Sound. Very little flood-damage potential exists in the City of Mukilteo area. Flooding in the City of Snohomish by the Snohomish and Pilchuck Rivers is confined primarily to the southeastern part of the City where there are scattered residences and undeveloped land. Photographs of the 1951 flood and the 1979 flood on the Snohomish River at the City of Snohomish are shown in Figures 3, 14, and 15. Flooding in the City of Sultan is caused by major floods on the Sultan and Skykomish Rivers. The Wallace River is not a major flooding factor because areas subject to flooding from the Wallace River are more significantly affected by backwater from the Skykomish River. Flooding occurs in the City of Sultan when high flows on the Sultan and Skykomish Rivers go over the banks on the western and southern sides of the city. Floodwaters also enter the City of Sultan when high flows on the Skykomish River back up into the Sultan River and go over banks on both sides of the lower Sultan River.



Rank 20 of 67 **Washington State Watershed Risk Assessment: Skykomish**

Incorporated City	NFIP Claims	Interstate Fwy	Available LiDAR
1% Annual Chance Flood	NFIP Policies	State & US Routes	

DEPARTMENT OF ECOLOGY State of Washington