# Natural Hazards Mitigation Plan

## for the Thurston Region

**The Emergency Management Council of Thurston County**

**Prepared by Thurston Regional Planning Council**
**September, 2009**

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# Executive Summary

## Introduction

This plan is the second edition of the *Natural Hazards Mitigation Plan for the Thurston Region.* It is a multi-jurisdictional plan that addresses the most destructive natural hazards that threaten Thurston County and its communities.

**The primary function of this plan is to explain the risks posed by natural hazards and to identify actions that can create more disaster resilient communities in Thurston County.**

The Thurston region frequently experiences destruction from natural hazard events such as earthquakes, landslides, severe storms, flooding, wildland fires, and to a lesser extent, volcanic eruptions. Natural disasters only occur when people, property, and infrastructure are vulnerable or directly exposed to the destructive effects of natural hazards.

**Did you know** that since 1962, Thurston County has received 23 Federal Disaster Declarations? That is almost one natural disaster every two years. Six Disaster Declarations have occurred since this plan was first adopted in 2003.

Hazard mitigation planning identifies and prioritizes sustained measures that if enacted, will reduce or eliminate long-term risk to people and property from natural hazards and their effects. In the long term, mitigation measures reduce personal loss, save lives, and reduce the cost to local, state, and federal governments for responding to and recovering from recurrent or unusual natural hazard events.

In an effort to manage risk, contain costs, and promote sustainable communities, the federal government outlined new hazard mitigation planning requirements for states, tribes, and local governments in the Disaster Mitigation Act of 2000 (44 CFR part 201.6). The act established the requirement for local governments to adopt a federally approved hazard mitigation plan in order to be eligible to apply for and/or to receive federal mitigation assistance program grants. Local hazard mitigation plans must be updated and resubmitted to the Federal Emergency Management Agency (FEMA) for approval every five years. This plan complies with all of the federal hazard mitigation planning requirements.

*More information about how hazard mitigation planning can benefit the Thurston Region and its communities can be found in Chapter 1: Introduction.*

## Plan Process and Partners

Thurston County Emergency Management played a leadership role by providing the planning funds to update the plan for the entire region. A multi-jurisdictional plan requires coordination and collaboration among its partners. The Emergency Management Council (EMC) of Thurston County, a formally organized intergovernmental board of emergency managers, served as the lead advisory committee in the update to this plan. The EMC is familiar with a variety of key community

stakeholders involved with disaster preparedness, response, recovery, and hazard mitigation. Thurston Regional Planning Council provided staff on contract to support the plan partners and write the plan.

Hazard Mitigation Plans must be updated every five years. In May 2008, the EMC invited 39 jurisdictions and organizations to participate in the update to the plan. Twenty-six jurisdictions responded. The following communities chose to participate as partners in the plan update process:

**Municipalities and Tribes**

Thurston County
Town of Bucoda
City of Lacey
City of Olympia
City of Tumwater
City of Rainier
City of Tenino
City of Yelm
Nisqually Tribe

**School Districts**

Olympia School District
North Thurston Public Schools
Rainier School District
Tumwater School District
Yelm Community Schools

**Fire Districts**

Thurston County FD 3
Thurston County FD 2 & 4
Thurston County FD 8
Thurston County FD 9 & 5
Thurston County FD 17

**Service Providers and Non-Profits**

Intercity Transit
LOTT Alliance
Thurston PUD
Timberland Regional Library
Providence Saint Peter Hospital

**Colleges**

The Evergreen State College
South Puget Sound Community College

One or more individuals served as a representative for their jurisdiction and served on the Hazard Mitigation Planning Workgroup. The composition of the workgroup was diverse and included city mayors, fire chiefs, police chiefs, planners, school district superintendents, construction managers, emergency managers, and public works directors. The Workgroup functioned as the primary working body. The Workgroup met and convened multiple work sessions from May 2008 through August 2009.

## Guiding Principles

The development of this plan was guided by six principles:

1. **Provide a Methodical Approach to Mitigation Planning**
2. **Enhance Public Awareness and Understanding of Natural Hazards**
3. **Create a Decision-Making Tool for Policy and Decision Makers**
4. **Promote Compliance with State and Federal Program Requirements**

5. **Assure Inter-Jurisdictional Coordination of Mitigation-Related Programming**
6. **Create Jurisdiction Specific Hazard Mitigation Plans for Implementation**

## Public Participation

A variety of materials and methods were used to encourage public participation in the planning process, educate community members about the effects of natural hazards, and describe methods to mitigate losses. Materials included internet postings, news releases, announcement flyers, brochures, comment forms, and posters. Staff attended several community events to promote the visibility of the hazard mitigation planning process. Three open house meetings were hosted by TRPC staff and Workgroup members early in the process to seek public input before the plan was drafted.

**Open House Meetings Scheduled before the Plan was Drafted**

| Date | Location |
|---|---|
| June 25, 2008 | Thurston Regional Planning Council, Conference Room A, 2424 Heritage Court S.W., Olympia |
| June 26, 2008 | Tenino Elementary School, multipurpose room, 301 Old Highway 99 North, Tenino |
| June 30, 2008 | Rochester Community Center, multipurpose room, 10140 Highway 12 S.W., Rochester |

Towards the end of the planning process, two additional open house meetings were held to seek community input on the draft plan before it was submitted for its regulatory review and subsequent adoption by the plan partners.

**Open House Meetings Scheduled before the Plan was Adopted**

| Date | Location |
|---|---|
| August 26, 2009 | Thurston Regional Planning Council, Conference Room A, 2424 Heritage Court S.W., Olympia |
| September 2, 2009 | Tenino Quarry House, 199 Park Avenue W, Tenino |

*More information about the plan process and development can be found in Chapter 2: Plan Process and Development. Samples of public outreach materials used during the plan update process are located in Appendix B.*

# Risk Assessment

Risk assessments for the major natural hazards that threaten the Thurston Region are included in this plan. The risk assessment provides the factual basis for the region's partners to develop effective mitigation strategies. Chapter 4: Risk Assessment, includes six comprehensive profiles of the most destructive natural hazards that threaten people, property, government services, and businesses in Thurston County.

The hazard profiles for earthquake, severe storm, flood, and landslide were updated. Two new hazard profiles, wildland fire and volcanic event were developed during the plan update process. In addition, a new section titled "Climate Change Projections" provides a summary of current literature and scientific findings of the effects of climate change on the Pacific Northwest.

## Hazard Profile Content

Each profile in the risk assessment is consistently formatted and includes the following hazard information:

- Definition
- Severity
- Impacts
- Probability of Occurrence
- Historical Occurrences and Impacts
- Delineation of Hazard Area (including maps)
- Population and Employment in the Hazard Area
- Inventory of Assets and Dollar Values in the Hazard Area
- Critical Facilities and Infrastructure in Hazard Area
- Summary Assessment

## Risk Rating

An overall risk rating is assigned for each hazard profiled in this plan. The risk rating is an adjective description (high, moderate, or low) of the overall threat posed by a hazard to the region or for a particular jurisdiction. Risk is the subjective estimate of the combination of any given hazard's probability of occurrence combined with a community's vulnerability to the hazard.

**Probability, Vulnerability, and Risk of the Major Natural Hazards in Thurston County**

| Hazard | Probability of Occurrence | Vulnerability | Risk |
|---|---|---|---|
| Earthquake | High | High | High |
| Storm | High | High | High |
| Flood | High | Moderate | High |
| Landslide | Moderate | Low | Moderate |
| Wildland Fire | High | Moderate | Moderate |
| Volcanic Event | Low | High | Moderate |

The regional risk assessment describes the risks posed to Thurston County, the entire planning area addressed in this plan. In addition, a local risk assessment was developed by each participating jurisdiction to describe where their risks vary from the entire planning area. The local risk assessment is included in each jurisdiction's annex.

*More information about the destructive effects of natural hazards and their impacts on this region's communities can be found in Chapter 4: Risk Assessment, Sections 4.1 to 4.6. More information about the hazard data sources and methods used to prepare the vulnerability assessments is located in Section 4.8: Risk Assessment Methodology.*

## Mitigation Goals

The goals identify what the Thurston Region's hazard mitigation planning partners intend to achieve in order to reduce the impacts of natural hazards on people and property and reduce potential losses. The goals also guided the development of mitigation actions or initiatives contained in this plan.

The goals are adopted by all of the region's planning partners. The goals are not prioritized in terms of their significance or the order in which they will be fulfilled. Their numbers serve as reference link between the mitigation initiatives and the goals and objectives they support. The following are the goals for mitigating the effects of natural disasters in the Thurston Region:

1. **All sectors of the community work together to create a disaster resistant community.**
2. **Local and state government entities have the capabilities to develop, implement, and maintain effective natural hazards mitigation programs in the Thurston region.**
3. **Collectively the communities in the Thurston region have the capacity to initiate and sustain emergency operations during and after a disaster.**
4. **Local government operations are not significantly disrupted by disasters from natural hazards.**
5. **Reduce the vulnerability to natural hazards in order to protect the life, health, safety and welfare of the community's residents and visitors.**
6. **Local governments will support natural hazards mitigation planning, and implement the mitigation initiatives for their jurisdiction.**
7. **The local infrastructure of communities in the Thurston region is not significantly affected by a disaster from a natural hazard.**
8. **Residents understand the natural hazards of the Thurston region and are aware of ways to reduce their personal vulnerability to those hazards.**

*More information about the plan's goals and objectives can be found in Chapter 5: Mitigation Goals and Initiatives.*

## Regulatory Review Process

### State and Federal Review

On August 20, 2009, the Emergency Management Council approved the release the final draft plan for public review. Following the public review process of the draft plan and prior to local adoption, the plan is submitted to Washington State Emergency Management Division. The state

reviews the plan to ensure that it meets all of the federal hazard mitigation planning requirements and also determines if the plan is consistent with the goals of the *Washington State Natural Hazards Mitigation Plan*. The state then forwards the plan to FEMA for its review.

FEMA reviews all natural hazard mitigation plans to determine if they satisfactorily meet all of the federal planning requirements. Once this review is complete and the plan is deemed satisfactory, FEMA notifies each participating jurisdiction that their plan is *approvable pending adoption*. This notice allows jurisdictions to begin the plan adoption process.

*More information about the regulatory review process can be found in Chapter 2: Plan Process and Development.*

### Community Rating System

Thurston County is enrolled in the Community Rating System (CRS), a program for communities that demonstrate flood hazard management and mitigation practices above and beyond the minimum National Flood Insurance Program standards for flood plain regulation. Thurston County was accepted into the CRS program in 2000. It attained a rating of Class 5, which provides for a 25 percent reduction for flood insurance policies for properties in Thurston County. A higher CRS rating results in a greater flood insurance premium discount for policy holders. To maintain this rating, the County must recertify its CRS participation every three years.

There are many similarities in federal planning requirements between natural hazards mitigation plans and community rating system plans. The Natural Hazards Mitigation Plan for the Thurston Region will eventually become Thurston County's comprehensive Flood Hazard Management Plan. As a separate plan review process, Thurston County will submit this plan to the Insurance Services Office (ISO). The ISO reviews plans and awards points on various elements including public involvement process and the development and implementation of flood hazard mitigation initiatives. Future updates to this plan will be made to improve Thurston County's CRS classification.

*More information about the National Flood Insurance Program in Thurston County can be found on pages 4.3-24 through 25 and in Thurston County's Annex.*

## Plan Adoption, Implementation, Monitoring, and Maintenance

### Adoption

Jurisdictions must formally adopt their plans for FEMA to issue a final letter of approval. Once a jurisdiction receives notification from FEMA that their plan is *approvable pending adoption*, it has one year to adopt the plan. Each jurisdiction or entity seeking approval of its plan must have its governing body (Board of County Commissioners, City Council, Board of Directors, etc.) adopt the entire plan and their jurisdiction's annex. Each jurisdiction/entity will ensure that proper process is followed according to the laws or rules of their organization including adequate public notice and public hearings.

Once a jurisdiction adopts the plan and provides FEMA evidence of adoption, FEMA sends the agency a letter which includes the approval and expiration dates of the plan. The first jurisdiction to formally adopt the plan initiates the five-year plan cycle and sets the expiration date for the plan for all the region's plan partners, regardless of when they adopt their plan.

## Implementation

Each governmental entity will be responsible for implementation of their individual mitigation initiatives based on funding availability and entity priorities. This implementation may include incorporating mitigation initiatives and activities into existing planning programs and activities. This would include amending the local governments' comprehensive plans for policies and programs, development regulations for building, zoning and subdivision code standards.

In addition to plans, programs, and regulations, the entities may also incorporate the mitigation measures into their capital facilities plans (CFP's). The CFP identifies those major infrastructure developments or facilities which the entity has planned for a six, ten, or twenty year time frame.

Some of the jurisdictions have comprehensive emergency management plans (CEMP's). It is likely that when the CEMP's are updated, they will include parts of this plan, or be linked back to this document by reference.

As this is the second edition of the Natural Hazards Mitigation Plan for the Thurston Region, jurisdictions with adopted mitigation strategies are required to report on the progress they have made towards implementing their adopted initiatives. This information is located in the section titled, "Initiative and Implementation Status" for each initiative located in this plan.

## Monitoring

The Thurston County Emergency Management Council (EMC) will be responsible for over-all plan monitoring and maintenance for the next five years. The plan will be reviewed on an annual basis during the October meeting of the EMC. All regional hazard mitigation plan partners will be invited to assess the plan with the following criteria:

1. Progress towards the plan's goals and objectives
2. Progress towards county wide and jurisdiction specific mitigation initiatives
3. Implementation problems such as technical, legal, or coordination issues among local agencies, the State, or FEMA
4. Public involvement activities.
5. General information sharing (best practices) related to mitigation planning among the plan Partners.
6. Financing the multi-jurisdiction plan update

As is routine, the EMC will conduct an after action review following a significant disaster event to document lessons learned during the response and recovery phases. As part of this review process, the EMC will assess:

1. The characteristics and severity of the hazard to determine if the region's risks have changed
2. Direct and indirect damage as well as any response and recovery costs.
3. The type and extent of the damages to determine any new mitigation initiatives that should be incorporated into the plan to avoid similar losses due to future hazard events.

The results of the assessment will be shared with all of the region's hazard mitigation planning stakeholders.

### Maintenance

The plan must be updated at a minimum of every five years. Plan maintenance should be an ongoing task. If done properly, it is executed throughout the plan's five year cycle. Plan maintenance ensures that information is current and accurate. Furthermore, by revising the plan on a periodic basis to reflect current conditions, the five year plan update process is simplified for all involved in a routine maintenance cycle.

The plan describes the process for minor, technical, and substantive revisions, and a process for distributing revisions. In addition, the plan describes procedures for adding new communities to the regional plan.

### Continued Public Involvement

The Emergency Management Council, as well as all of the entities that participated in this plan, are committed to continued public involvement and education. It will be important that natural hazards mitigation becomes integrated into existing programs and becomes part of the way jurisdictions make decisions about land use and facilities planning. As mentioned in the preceding section, in the city and county jurisdictions, comprehensive plan amendment processes as well as capital facilities planning both have elements of public notification and involvement. These local plans require updating every six to seven years but are often amended yearly with an associated public process. These processes will provide a venue that promotes public dialogue regarding the importance of hazard mitigation.

More Information about the plan's adoption, implementation, monitoring, and maintenance process can be found in Chapter 6: Adoption, Implementation, Monitoring, and Maintenance.

## Mitigation Initiatives

Mitigation initiatives are the action items in the *Natural Hazards Mitigation Plan for the*

*Thurston Region*. The term "mitigation initiative" refers to an action designed to reduce or eliminate losses resulting from natural hazards. It is through the implementation of these initiatives that the communities within Thurston County can truly become more disaster resistant. Local governments formulate their mitigation strategies by proposing actions, identifying who will implement them, estimating costs, listing potential funding sources, and developing timelines for implementation.

## Categorization

Every mitigation initiative is categorized according to its function. There are seven categories of mitigation activities. The categories and the total number of corresponding initiatives are displayed below.

| Category | Total Initiatives |
|---|---|
| **Public Outreach and Information:** Information delivered in a variety of formats intended to inform and educate community members, elected officials, and property owners about the hazards and potential ways to mitigate them. Such actions include websites, outreach projects, real estate disclosure, fairs and expos, and school-age and adult education programs. | 6 |
| **Plan Coordination and Implementation:** Activities that support a jurisdiction's natural hazards mitigation planning process and implementation strategy within their organization and in conjunction with neighboring jurisdictions and relevant stakeholders. | 13 |
| **Data Collection and Mapping:** Actions that relate to the process of gathering and analyzing new data and then mapping or utilizing the information in such a manner that it improves communities' ability to make informed decisions about increasing their disaster resilience. | 17 |
| **Development Regulations:** Government administrative or regulatory actions or processes that influence the way land and buildings are developed and built. These actions also include public activities to reduce hazard losses. Examples include planning and zoning, building codes, capital improvement programs, open space preservation, and storm water management regulations. | 6 |
| **Hazard Preparedness:** Advance actions that serve to protect people and property during and immediately after a disaster or hazard event. These could include the development or improvement of warning systems, emergency response services, and the stockpiling of supplies and materials. | 26 |
| **Hazard Damage Reduction:** Actions that involve the modification of existing buildings or structures to protect them from a hazard, or removal from the hazard area. Examples include acquisition, elevation, relocation, structural retrofits, storm shutters, and shatter-resistant glass. | 26 |
| **Critical Facilities Replacement/Retrofit:** Refers specifically to hazard damage reduction activities targeted specifically at protecting or replacing critical facilities. | 32 |
| **Total** | **126** |

## Current Adopted Mitigation Initiatives

This Executive Summary lists the current mitigation initiatives for the plan partners who submitted their annexes prior to the completion of the plan for the public and regulatory review processes. Budget constraints, staff shortages, or scheduling conflicts prevented some plan partners from completing their annex in accordance with the work schedule. This plan's framework accommodates the incorporation of additional annexes as they are completed. Several jurisdictions intend to submit their annex at a later date.

The region's partners have identified a total of 126 mitigation initiatives; nine are adopted county wide by all of the plan's partners. More details about the County Wide Mitigation Initiatives are

located in Chapter 5: Mitigation Goals and Initiatives. Jurisdiction-specific mitigation initiatives (current and completed/removed) are located in each jurisdiction's annex.

## Initiatives by Jurisdiction

I.D. Number Hazard Category Codes: EH=Earthquake Hazard; FH=Flood Hazard; LH=Landslide Hazard; MH=Multi Hazard; SH=Storm Hazard; WH=Wildland Fire Hazard; and VH=Volcanic Hazard

| Priority | I.D. Number | Category | Action |
|---|---|---|---|
| **County Wide – Adopted by all Jurisdictions** | | | |
| 1 of 9 | CW-MH 4 | Hazard Damage Reduction | Create a lifeline transportation route GIS map for the Thurston Region and integrate the data into the Thurston County Emergency Operations Plan |
| 2 of 9 | CW-MH 7 | Hazard Preparedness | Develop a system for sharing critical resources among emergency managers during disaster events |
| 3 of 9 | CW-SH 1 | Hazard Preparedness | Improve the capabilities of managing debris from severe winter storm events |
| 4 of 9 | CW-FH 1 | Data Collection and Mapping | Obtain digital data and create GIS maps of the flood inundation from possible dam failures of the Skookumchuck Dam on the Skookumchuck River, and the Alder and LaGrande Dams on the Nisqually River |
| 5 of 9 | CW-MH 6 | Public Information | Develop public information and outreach website portal and complementary printed materials to increase the awareness and participation in natural hazards mitigation planning among the region's major employers, small businesses, and residents |
| 6 of 9 | CW-WH 1 | Data Collection and Mapping | Refine methodology to assess high risk wildland fire communities in Thurston County |
| 7 of 9 | CW-MH 1 | Data Collection and Mapping | Continue to refine the list of the region's critical facilities and jurisdictional asset data, geocode these locations, and update their financial value |
| 8 of 9 | CW-EH 2 | Data Collection and Mapping | Improve the technical analysis of earthquake hazards in the county |
| 9 of 9 | CW-MH 8 | Hazard Preparedness | Strengthen the capabilities of the Disaster Medical Coordination Center (DMCC) Hospital |
| **Thurston County** | | | |
| 1 of 30 | TC-EH 1 | Critical Facilities Replacement/ Retrofit | Perform preliminary evaluations of county owned critical facilities to identify seismic vulnerabilities in those structures. Implement appropriate retrofitting/strengthening measures to improve their ability to withstand the effects of earthquakes |
| 2 of 30 | TC-MH 4 | Hazard Damage Reduction | Improve alert and warning capabilities |
| 3 of 30 | TC-MH 1 | Hazard Preparedness | Prepare a plan and subsequent mitigation initiatives for how essential functions of county government will be reestablished during or after a disaster |

| Priority | I.D. Number | Category | Action |
|---|---|---|---|
| 4 of 30 | TC-FH 25 | Hazard Damage Reduction | Develop evacuation plans for communities and residents situated downstream from the Nisqually and Skookumchuck River dams |
| 5 of 30 | TC-FH 22 | Hazard Damage Reduction | Draft a prioritized list of road segments and bridges that should be elevated above the 100 year floodplain and culverts that will fail under flood flow. Upgrade these structures if state or federal monies become available |
| 6 of 30 | TC-FH 1 | Plan Coordination and Implementation | Continue Thurston County's enrollment in the Community Rating System (CRS) program as a part of the National Flood Insurance Program |
| 7 of 30 | TC-FH 24 | Plan Coordination and Implementation | Develop a southeast flood detour plan for the Thurston County Comprehensive Emergency Management Plan |
| 8 of 30 | TC-FH 7 | Data Collection and Mapping | Remap the floodplains for all rivers, streams, and high groundwater areas and update the Flood Insurance Rate Maps (FIRMs) |
| 9 of 30 | TC-FH 23 | Data Collection and Mapping | Acquire MIKE 11, a three-dimensional hydrological modeling software package and AQUARIUS, a USGS standard streamflow modeling software package |
| 10 of 30 | TC-FH 15 | Hazard Damage Reduction | Draft a prioritized list of which floodplain residences the county would acquire (buyout) if state and federal monies are available |
| 11 of 30 | TC-FH 4 | Plan Coordination and Implementation | Continue to be actively involved in the multiple jurisdiction flood hazard reduction efforts within the Chehalis River basin |
| 12 of 30 | TC-LH 1 | Development Regulations | Limit activities in identified potential and historical landslide areas through regulation and public outreach |
| 13 of 30 | TC-FH 9 | Data Collection and Mapping | Develop mapping protocols to archive all flood maps and data sets so they can be reused at a later date |
| 14 of 30 | TC-MH 2 | Hazard Preparedness | Coordinate existing plans for post disaster inspections of critical facilities and other publicly owned buildings |
| 15 of 30 | TC-MH 7 | Hazard Preparedness | Develop plans to address the medical needs of people who rely on electrically powered medical equipment and/or do not have dependable transportation |
| 16 of 30 | TC-LH 2 | Hazard Damage Reduction | Prepare a landslide vulnerability index for county roads |
| 17 of 30 | TC-MH 3 | Hazard Preparedness | Improve the capability to identify moderate to long term road impedances, and put them into the CAD (Computer Aided Dispatch) |
| 18 of 30 | TC-FH 8 | Data Collection and Mapping | Map the channel migration zones for all rivers in the region and the extent of high quality riparian habitat |

| Priority | I.D. Number | Category | Action |
|---|---|---|---|
| 19 of 30 | TC-MH 6 | Hazard Preparedness | Conduct a study of private roads and bridges to determine their capacity to provide access to emergency vehicles |
| 20 of 30 | TC-FH 16 | Hazard Damage Reduction | Draft a prioritized list of which residences the county would help elevate above the 100-year floodplain, if state or federal monies are available |
| 21 of 30 | TC-FH 2 | Plan Coordination and Implementation | Secure funding for flood related projects within the 20-year Stormwater Capital Facilities Plan |
| 22 of 30 | TC-FH 21 | Hazard Damage Reduction | Undertake a study of repetitive public cost losses, this would include residential structures, but also include properties such as livestock, out-buildings and rescue costs not already identified by FEMA |
| 23 of 30 | TC-FH 11 | Development Regulations | Revise shoreline regulations to encourage “shoreline protective structures” to be “bioengineered” |
| 24 of 30 | TC-FH 20 | Plan Coordination and Implementation | Implement the recommendations of the adopted stormwater drainage basin plans |
| 25 of 30 | TC-FH 10 | Development Regulations | Reevaluate land uses and zoning based upon new floodplain maps |
| 26 of 30 | TC-FH 12 | Development Regulations | Work with others to determine the width and conditions of buffers along river and stream shorelines |
| 27 of 30 | TC-FH 13 | Development Regulations | Draft a Comprehensive Plan policy which encourages the creation and use of wetland mitigation bank |
| 28 of 30 | TC-FH 14 | Data Collection and Mapping | Prepare new drainage basin plans in priority areas such as Salmon and Yelm Creeks |
| 29 of 30 | TC-FH 17 | Hazard Damage Reduction | Work with landowners and others to establish reforested corridors along river and stream shorelines |
| 30 of 30 | TC-FH 18 | Hazard Damage Reduction | Encourage research into bioengineering and other techniques which provide streambank protection and improve fisheries through the use of large woody debris. Support local demonstration projects which could provide such research |
| **Town of Bucoda** | | | |
| 1 of 5 | B-MH 2 | Hazard Preparedness | Prepare an addendum to the Town’s Comprehensive Emergency Management Plan |
| 2 of 5 | B-MH 1 | Critical Facilities Replacement/ Retrofit | Purchase and install a 30kW propane generator at the Bucoda Fire Department |
| 3 of 5 | B-MH 4 | Hazard Damage Reduction | Perform analysis of the Town’s three critical facilities to identify the most efficient method of maintaining seat of government, emergency operations, and sheltering needs during a flood or earthquake |

| Priority | I.D. Number | Category | Action |
|---|---|---|---|
| 4 of 5 | B-FH 1 | Hazard Damage Reduction | Stormwater management engineering and design for city streets |
| 5 of 5 | B-MH 3 | Hazard Damage Reduction | Establish an alternate well site for the Town. |
| **City of Lacey** | | | |
| 1 of 15 | L-EH 2 | Critical Facilities Replacement/ Retrofit | Pursue seismic upgrades to water facilities that do not meet current seismic codes |
| 2 of 15 | L-EH 4 | Hazard Damage Reduction | Replace the shut off valve at the Union Mills Reservoir that will enable the water storage facility to be isolated in the case of a water line break or other damage |
| 3 of 15 | L-MH 8 | Hazard Damage Reduction | Retrofit the City's alarm system for wastewater lift station facilities and convert them from older, analog technology to modern digital components |
| 4 of 15 | L-EH 1 | Plan Coordination and Implementation | Continue funding the water line replacement program to ensure water supply lines are constantly being upgraded |
| 5 of 15 | L-MH 9 | Hazard Preparedness | Develop a system for secure off-site, "real-time" storage of data from City computers and networks |
| 6 of 15 | L-FH 5 | Hazard Damage Reduction | Evaluate the flood prone area of Rainier Road SE near the BNSF railroad trestle and determine solutions to prevent future flooding events |
| 7 of 15 | L-MH 7 | Hazard Preparedness | Purchase and install backup generators to provide power to the remaining sewer lift stations that do not currently have permanently mounted standby generators |
| 8 of 15 | L-MH 5 | Hazard Damage Reduction | Develop policy regarding private contractors removing debris and/or snow on public streets |
| 9 of 15 | L-EH 3 | Hazard Damage Reduction | Reduce hazards inside the City of Lacey facilities to prevent property damage and enhance ability to recover and respond after an earthquake |
| 10 of 15 | L-MH 3 | Hazard Preparedness | Develop public and private partnerships to foster natural hazard mitigation program coordination and collaboration |
| 11 of 15 | L-FH 2 | Plan Coordination and Implementation | Encourage and educate the public on the purchase of flood insurance |
| 12 of 15 | L-FH 1 | Data Collection and Mapping | Identify and map public and private properties in the 100-year floodplain |

| Priority | I.D. Number | Category | Action |
|---|---|---|---|
| 13 of 15 | L-FH 4 | Hazard Damage Reduction | Establish a program whereby sand and sandbags are stored by the City and made available to the public in anticipation of minor flooding during the winter. The bags would be made available to the general public if their property was in danger of being flooded |
| 14 of 15 | L-MH 6 | Public Information | Purchase communications system that will enable the City to broadcast information to a very localized and specific geographical area, such as road closures, water outages, and other utility information |
| 15 of 15 | L-MH 10 | Hazard Damage Reduction | Evaluate and purchase an internet based communications system that will enable City resources to be called-out in response to disasters or emergencies as well as send out announcements and warnings to the public |
| **City of Olympia** | | | |
| 1 of 9 | OLY-FH 1 | Hazard Preparedness | Place flood elevation poles and staff gauges along Capitol Lake |
| 2 of 9 | OLY-MH 1 | Hazard Preparedness | Upgrade Olympia's VHF radio system |
| 3 of 9 | OLY-MH 3 | Critical Facilities Replacement/ Retrofit | Add a backup generator to Olympia Center |
| 4 of 9 | OLY-SH 2 | Plan Coordination and Implementation | Improve the capabilities of managing debris from severe winter storm events |
| 5 of 9 | OLY-MH 4 | Data Collection and Mapping | Continue to refine the list of the region's critical facilities and jurisdictional asset data, geocode these locations, and update their financial value |
| 6 of 9 | OLY-VH 1 | Plan Coordination and Implementation | Develop a volcano hazard plan for the City of Olympia |
| 7 of 9 | OLY-FL 4 | Plan Coordination and Implementation | Plan and identify strategies to mitigate the adverse effects of sea level rise |
| 8 of 9 | OLY-EH 1 | Critical Facilities Replacement/ Retrofit | Undertake seismic retrofit of critical facilities and infrastructure in the city |
| 9 of 9 | OLY-SH 1 | Critical Facilities Replacement/ Retrofit | Replace the existing overhead utility lines throughout the City of Olympia |

| Priority | I.D. Number | Category | Action |
|---|---|---|---|
| **City of Rainier** | | | |
| 1 or 3 | R-SH 1 | Critical Facilities Replacement/ Retrofit | Install City-owned natural gas generator at City Hall |
| 2 or 3 | R-FH 1 | Hazard Damage Reduction | Stormwater management engineering and design for City streets |
| 3 or 3 | R-FH 02 | Public Information | Flood Hazard Education and Community Outreach |
| **City of Tenino** | | | |
| 1 of 10 | TEN-MH 3 | Critical Facilities Replacement/ Retrofit | Retrofit Tenino High School for generator hookpu capability |
| 2 of 10 | TEN-MH 1 | Critical Facilities Replacement/ Retrofit | Purchase and install a 20KW generator at the Tenino Police Building |
| 3 of 10 | TEN-FH 1 | Public Information | Flood Hazard Education and Community Outreach |
| 4 of 10 | TEN-FH 2 | Data Collection and Mapping | Scatter Creek Stream Gage Installation and Data Monitoring |
| 5 of 10 | TEN-FH 4 | Data Collection and Mapping | Flood Hazard Analysis and Project Prioritization |
| 6 of 10 | TEN-FH 3 | Data Collection and Mapping | Flood Hazard Mitigation Review of City Ordinances and Best Practice Amendments |
| 7 of 10 | TEN-MH 2 | Critical Facilities Replacement/ Retrofit | Retrofit the Tenino City Fire Hall building and set up an altermate disaster command center |
| 8 of 10 | TEN-MH 5 | Hazard Preparedness | Construct third well and redundant reservoir above City Park |
| 9 of 10 | TEN-MH 4 | Hazard Preparedness | Purchase a 26 foot semi-trailer and stock it with emergency supplies to be used in hazard response |
| 10 of 10 | TEN-EH 1 | Data Collection and Mapping | Fund engineer study of potential seismic retrofits for historical buildings |
| **City of Tumwater** | | | |
| 1 of 8 | TUM-EH 1 | Critical Facilities Replacement/ Retrofit | Conduct a voluntary non-structural earthquake readiness inspection for all critical facilities on an annual basis |

| Priority | I.D. Number | Category | Action |
|---|---|---|---|
| 2 of 8 | TUM-SH 1 | Critical Facilities Replacement/ Retrofit | Inspect all trees within falling distance of critical facilities, related equipment such as generators, and utilities such as power and communication lines within the immediate vicinity to determine if they pose a hazard to the facility or operation of the facility during a storm |
| 3 of 8 | TUM-FH 15 | Hazard Damage Reduction | Consider the construction of a short floodwall around the Tumwater Valley golf course clubhouse to stop the infiltration of floodwaters during a flood event |
| 4 of 8 | TUM-FH 14 | Data Collection and Mapping | Install flood elevation gauges on the Deschutes River |
| 5 of 8 | TUM-VH 1 | Hazard Preparedness | Keep a supply of air filters on hand for critical equipment, generators and vehicles in case of ash fall from a volcanic eruption |
| 6 of 8 | TUM-FH 6 | Hazard Damage Reduction | Work with landowners to reforest corridors along river and stream shorelines |
| 7 of 8 | TUM-FH 3 | Development Regulations | Reevaluate land uses and zoning based upon new floodplain maps |
| 8 of 8 | TUM-FH 12 | Plan Coordination and Implementation | Continue to be actively involved in inter-jurisdictional flood hazard reduction efforts where Tumwater and other jurisdictions are located within the same basin |
| **City of Yelm** | | | |
| 1 of 2 | Y-EH 3 | Hazard Damage Reduction | Seismically retrofit the downtown water tower, located at Washington and 2nd Street |
| 2 of 2 | Y-EH 2 | Hazard Damage Reduction | Identify funding sources for structural and nonstructural retrofitting of publicly owned critical facilities listed in the City of Yelm's Emergency Disaster Plan that are identified as seismically vulnerable |
| **South Puget Sound Community College** | | | |
| 1 of 7 | SPSCC-MH 1 | Hazard Preparedness | Training for college staff |
| 2 of 7 | SPSCC-MH 2 | Hazard Preparedness | Upgrade campus two-way radio communication system |
| 3 of 7 | SPSCC-SH 2 | Hazard Damage Reduction | Retrofit existing roofs with specialized gutters and snow blocks |
| 4 of 7 | SPSCC-MH 3 | Hazard Preparedness | Retrofit existing leased Hawks Prairie campus with emergency lighting |
| 5 of 7 | SPSCC-MH 5 | Public Information | Provide training and information for college community on emergency preparedness |
| 6 of 7 | SPSCC-MH 6 | Hazard Damage Reduction | Implement redundant critical IT infrastructure |
| 7 of 7 | SPSCC-MH 7 | Data Collection and Mapping | Develop campus GIS database |

| Priority | I.D. Number | Category | Action |
|---|---|---|---|
| **The Evergreen State College** | | | |
| 1 of 16 | TESC-EH 3 | Critical Facilities Replacement/ Retrofit | Undertake a seismic retrofit in Clock tower on The Evergreen State College campus |
| 2 of 16 | TESC-EH 13 | Critical Facilities Replacement/ Retrofit | Undertake a seismic retrofit of Dorm A on The Evergreen State College campus |
| 3 of 16 | TESC-EH 20 | Hazard Preparedness | Install an outdoor PA system on the lower campus |
| 4 of 16 | TESC-EH 6 | Hazard Preparedness | Update Emergency Preparedness Plan for The Evergreen State College |
| 5 of 16 | TESC-EH 7 | Critical Facilities Replacement/ Retrofit | Undertake a seismic upgrade of the Lab Annex on The Evergreen State College campus |
| 6 of 16 | TESC-EH 8 | Critical Facilities Replacement/ Retrofit | Undertake a seismic upgrade of the College Activities Building on The Evergreen State College campus |
| 7 of 16 | TESC-EH 9 | Critical Facilities Replacement/ Retrofit | Undertake a seismic study of the Communications Building on The Evergreen State College campus |
| 8 of 16 | TESC-EH 10 | Critical Facilities Replacement/ Retrofit | Undertake a seismic retrofit of Lab II on The Evergreen State College campus |
| 9 of 16 | TESC-EH 11 | Critical Facilities Replacement/ Retrofit | Undertake a seismic retrofit of Lab I on The Evergreen State College campus |
| 10 of 16 | TESC-EH 12 | Critical Facilities Replacement/ Retrofit | Undertake a seismic study and upgrade of the Seminar Building on The Evergreen State College campus |
| 11 of 16 | TESC-EH 14 | Critical Facilities Replacement/ Retrofit | Undertake a seismic retrofit of the College Recreation Center on The Evergreen State College campus |

| Priority | I.D. Number | Category | Action |
|---|---|---|---|
| 12 of 16 | TESC-EH 18 | Critical Facilities Replacement/ Retrofit | Undertake a seismic retrofit of the Campus Building Connecting Bridges on The Evergreen State College campus |
| 13 of 16 | TESC-EH 15 | Critical Facilities Replacement/ Retrofit | Undertake a seismic retrofit of the Central Utility Plant on The Evergreen State College campus |
| 14 of 16 | TESC-EH 16 | Critical Facilities Replacement/ Retrofit | Undertake a seismic retrofit of the Shop Complex on The Evergreen State College campus |
| 15 of 16 | TESC-EH 17 | Critical Facilities Replacement/ Retrofit | Undertake a seismic retrofit of the Geoduck House on The Evergreen State College Campus |
| 16 of 16 | TESC-EH 19 | Critical Facilities Replacement/ Retrofit | Undertake a seismic retrofit of the Organic Farmhouse on The Evergreen State College Campus |
| **Thurston County Fire Protection Districts 2 and 4 (SE Thurston Fire and EMS)** | | | |
| 1 of 1 | TCFD2&4-EH 1 | Critical Facilities Replacement/ Retrofit | Replace Headquarters Station 41 (now 24) with a seismically safe structure |
| **Thurston County Fire Protection District 8 (South Bay Fire District)** | | | |
| 1 of 2 | TCFD8-EH 1 | Hazard Preparedness | Establish a designated Emergency Coordination Center (ECC) at Station 8-2 |
| 2 of 2 | TCFD8-SH 1 | Public Information | Develop and deliver public outreach program for storm preparedness |
| **North Thurston Public Schools** | | | |
| 1 of 2 | NTPS-EH 1 | Critical Facilities Replacement/ Retrofit | Perform seismic evaluations on all district buildings and correct if needed… |
| 2 of 2 | NTPS-MH 2 | Critical Facilities Replacement/ Retrofit | Develop a comprehensive operations response plan to include hazard preparation planning with outside agencies… |
| **Tumwater School District** | | | |
| 1 of 2 | TUMSD-EH 1 | Critical Facilities Replacement/ Retrofit | Identify seismic requirements and bring buildings up to current adopted building codes at the time school buildings are remodeled |

| Priority | I.D. Number | Category | Action |
|---|---|---|---|
| 2 of 2 | TUMSD-MH 2 | Hazard Preparedness | Adopt procedures for reporting and responding to road closures |
| **Yelm Community Schools** | | | |
| 1 of 3 | YCS-EH 1 | Critical Facilities Replacement/ Retrofit | Identify seismic requirements and bring buildings up to current adopted building codes at the time buildings are remodeled |
| 2 of 3 | YCS-MH 1 | Plan Coordination and Implementation | Develop emergency preparedness policy and procedures to coordinate with local governments and integrate with the Capital Facilities Plan |
| 2 of 3 | YCS-MH 2 | Plan Coordination and Implementation | Purchase computerized bus routing system and incorporate with emergency road closure policies |
| **Providence Saint Peter Hospital** | | | |
| 1 of 1 | PSPH-EH 1 | Critical Facilities Replacement/ Retrofit | Emergency Water Source Well. Develop an emergency water source capable of producing water for emergency use. Design pumping and pipe construction system to include backflow protection, construct pumping and piping system and connect to hospital water network |
| **Intercity Transit** | | | |
| 1 of 1 | IT-MH 2 | Hazard Preparedness | Develop Emergency Preparedness and Continuity of Operations Plan |
| **Total Initiatives** | | | **126** |

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# Chapter 1: Introduction

## Natural Hazards will Persist, but Disasters can be Avoided

*The Natural Hazards Mitigation Plan for the Thurston Region* is a multi-jurisdictional plan that addresses the most destructive natural hazards that threaten Thurston County and its communities.

**The primary function of this plan is to explain the risks posed by natural hazards and to identify actions that can create more disaster resilient communities in Thurston County**.

The Thurston region frequently endures natural hazard events such as earthquakes, landslides, severe storms, flooding, wildland fires, and to a lesser extent, volcanic eruptions. When natural hazard events take place in undeveloped and unpopulated areas, no disaster occurs. Natural disasters only occur when people, property, and infrastructure are vulnerable or directly exposed to the destructive effects of natural hazards. Natural disasters can grow larger over time as more people and property locate in areas that are predisposed to the effects of natural hazards.

**Natural Disasters Are Costly**

Disaster aid for Washington homeowners, renters, business owners, state and local governments and certain private nonprofit organizations affected by the severe flooding between Jan. 6 and 16, 2009 reached **$17,017,439** thus far, according to officials of the Federal Emergency Management Agency (FEMA), Washington Division of Emergency Management (WA-EMD) and the U.S. Small Business Administration (SBA).

- Since 1962, Thurston County has received 23 Federal Disaster Declarations; every one of them attributed to natural hazards that are inherent to the Pacific Northwest.
- In 2007, Thurston County was one of 29 counties or U.S. Census designated places nationwide that received more than 20 Federal Disaster Declarations (less than one percent).

## Hazards in the Pacific Northwest

Thurston County is located near the middle of western Washington at the Southern end of the Puget Sound. It is home to the State Capital and 245,300 people.[1] People are drawn to live and work in Thurston County for its quality of life and its natural beauty. The region is surrounded with marine shorelines, rivers, lakes, tree-covered hills, prairies, and views of snow-capped mountains. Proximity to beauty however, comes with a price. Thurston County is located in a region that is disposed to recurrent natural hazards.

Washington State is one of the most geologically active regions of North America. The Puget Sound region's geologic past was dominated by a prolonged period of glacial activity. Massive glaciers over 3,000 feet tall expanded and retreated across the landscape carving and crushing the earth's surface in the South Sound region. This process left behind a variety of sediment deposits and land forms that are extremely vulnerable to the effects of ground shaking, liquefaction, and landslides.

The state sits directly above the Cascadia Subduction Zone, a major boundary of colliding tectonic plates and source of earthquake activity. There are multiple major fault lines throughout the state. The region has experienced major earthquakes in 1949, 1965, and in 2001. The 2001 Nisqually Earthquake caused region wide destruction and was particularly damaging to older buildings and infrastructure in the state's Capital City.

There are five active volcanoes in Washington State. The May 18, 1980 eruption of Mount St. Helens killed 57 people, destroyed hundreds of miles of roadways, blanketed several eastern Washington communities with ash, and destroyed tens of thousands of acres of prime forest.

The state's pronounced mountainous terrain and its immediacy to the vast Pacific Ocean strongly influences the dynamics of the region's weather and the region's hydrologic cycle. The Pacific Northwest frequently experiences intense seasonal precipitation events that result in major lowland flooding, mudslides, and landslides in heavily developed and populated areas. In addition, high speed windstorms frequently buffet western Washington resulting in region wide power outages, structural damage, and tons of debris.

*Information about the hazards that threaten the Thurston Region is located in Chapter 4: Risk Assessment.*

## The Challenge of Building Safe Communities

### Population Growth

As the region's communities grow, local governments are challenged with managing growth and providing public services in a safe and efficient fashion. Local governments response to and recovery from natural disasters pulls valuable resources and personnel away from the normal business of governance. Population growth can have a negative effect on government resources if growth takes place in areas vulnerable to hazards like liquefaction, flooding, or landslides. Thurston County's population is estimated to reach nearly 373,000 by the year 2030[4], it is important for community planners and elected officials to consider where this growth will take place. Natural hazards mitigation planning provides a process for local governments to consider future populations and consider actions to reduce peoples' exposure to the effects of natural hazards.

### Aging and Vulnerable Infrastructure

Many of Thurston County's cities, towns, and unincorporated rural places are some of the oldest communities in the state. Jurisdictions have aging infrastructure including office buildings, roads, bridges, water storage systems, sewers, and stormwater conveyance systems. This older infrastructure is deteriorating and vulnerable to the effects of natural hazards.

Historic community development also took place in areas prone to natural hazards such as flood plains. Not all construction in hazard prone areas was the result of poor planning, but rather the lack of familiarity and knowledge about the region's hazards. Each earthquake, flood, or other natural hazard event reveals the vulnerability of older infrastructure. Neighborhoods and commercial areas

located in areas prone to flooding or landslides experience additional or repetitive losses with each new hazard event. In these instances, homes and businesses can be mitigated through seismic retrofits, elevation, relocation, or acquisition.

School districts, fire districts, and other special purpose districts also have aging infrastructure. They have unique, but no less significant challenges to provide safe and effective services to the public both during and after natural hazard events.

**How can local governments mitigate vulnerable properties in high risk hazards zones?**

**Acquisition and demolition:** Under this approach, the community purchases the flood-damaged property and demolishes the structure. The property owner uses the proceeds of the sale to purchase replacement housing on the open market. The local government assumes title to the acquired property and maintains the land as open space in perpetuity.

**Relocation:** In some cases, it may be viable to physically move a structure to a new location. Relocated structures must be placed on a site located outside of the 100-year floodplain, outside of any regulatory erosion zones, and in conformance with any other applicable State or local land use regulations.

**Elevation/Floodproofing:** Depending upon the nature of the flood threat, elevating a structure or incorporating other floodproofing techniques to meet National Flood Insurance Program criteria may be the most practical approach to flood damage reduction. Floodproofing techniques may be applied to commercial properties only; residential structures must be elevated. Communities can apply for funding to provide grants to property owners to cover the increased construction costs incurred in elevating or floodproofing the structure.

### Information Gaps

Thurston County communities continue to invest in studies that increase their understanding of natural hazards. More research, data, and forecasting tools are needed at the local level to more accurately map local hazard zones, further protect the public's health, and protect the environment. Modern computer models, aerial photos, and satellite imaging technology have enabled significant advances in mapping geologic and hydrologic hazard zones. But the availability of local data, though improving, remains limited.

### Mitigation through Regulation

Municipalities can ensure that new construction will be able to withstand the destructive forces of earthquakes, wind storms, and other hazards by maintaining and enforcing the most current building codes. An effective approach to mitigating natural disasters is preventing new development from occurring in hazard prone areas. Local land use authority, the Shoreline Management Act, the Washington State Growth Management Act, and Critical Area Ordinances provide local communities essential regulatory mechanisms to restrict new development in areas that have a high risk associated with a natural hazard.

*More information about Washington State's and local governments' hazard mitigation capabilities hazard mitigation is in Appendix C.*

## The Disaster Declaration Process

Local and State governments share the responsibility for protecting their citizens from disasters, and for helping them to recover when disaster strikes. Local government's capacity to respond to natural disasters is often overwhelmed when a significant portion of the population or infrastructure is impacted by a natural disaster. When a state's capacity to respond to disasters is exceeded, the

Governor can request federal assistance. The Stafford Disaster Relief and Emergency Assistance Act (§401) requires that "All requests for a declaration by the President that a major disaster exists shall be made by the Governor of the affected State." The Governor's request is made through the regional Federal Emergency Management Agency (FEMA) office. If the President declares that a major disaster or emergency exists, an array of federal programs to assist in the response and recovery effort is activated. There are three general categories of assistance:

- Individual Assistance – aid to individuals and households;
- Public Assistance – aid to public (and certain private non-profit) entities for certain emergency services and the repair or replacement of disaster damaged public facilities;
- Hazard Mitigation Assistance – funding for measures designed to reduce future losses to public and private property.

## Hazard Mitigation

Of the four stages of disaster response – mitigation, preparedness, response, and recovery – mitigation is the only response that serves to directly eliminate losses from the effects of natural hazards. The other stages all occur in reaction to or anticipation of impacts from disaster events. Hazard mitigation planning identifies and prioritizes sustained measures that if enacted, will reduce or eliminate long-term risk to people and property from natural hazards and their effects. In the long term, mitigation measures reduce personal loss, save lives, and reduce the cost to local, state, and federal governments for responding to and recovering from recurrent or unusual natural hazard events.

FEMA identifies six broad categories of actions that constitute natural hazards mitigation[2]:

1. **Prevention** - Government administrative or regulatory actions or processes that influence the way land and buildings are developed and built. These actions also include public activities to reduce hazard losses. Examples include planning and zoning, building codes, capital improvement programs, open space preservation, and storm water management regulations.
2. **Property Protection** - Actions that involve the modification of existing buildings or structures to protect them from a hazard, or removal from the hazard area. Examples include acquisition, elevation, relocation, structural retrofits, storm shutters, and shatter-resistant glass.
3. **Public Education and Awareness** - Actions to inform and educate citizens, elected officials, and property owners about the hazards and potential ways to mitigate them. Such actions include outreach projects, real estate disclosure, hazard information centers, and school-age and adult education programs.
4. **Natural Resource Protection** - Actions that, in addition to minimizing hazard losses preserve or restore the functions of natural systems. These actions include sediment and erosion control, stream corridor restoration, watershed management, forest and vegetation management, and wetland restoration and preservation.
5. **Emergency Services** - Actions that protect people and property during and immediately after a disaster or hazard event. Services include warning systems, emergency response services, and protection of critical facilities.

6. **Structural Projects** - Actions that involve the construction of structures to reduce the impact of a hazard. Such structures include dams, levees, floodwalls, seawalls, retaining walls, and safe rooms.

## The Disaster Mitigation Act of 2000

In an effort to manage risk, contain costs, and promote sustainable communities, the federal government outlined new hazard mitigation planning requirements for states, tribes, and local governments in the Disaster Mitigation Act of 2000. Local governments must adopt a federally approved hazard mitigation plan to apply for or to receive federal mitigation assistance program grants.

Hazard mitigation plans must demonstrate that a community's proposed mitigation measures are based on a sound planning process that accounts for the risk to and the capabilities of the individual jurisdiction. The Code of Federal Regulations (CFR), Title 44, Part 201.6 addresses local government mitigation plans. Part 201.7 addresses tribal mitigation plans.

FEMA published "Local Multi-Hazard Mitigation Planning Guidance," on July 1, 2008. This guidance provides interpretation and explanations for the local mitigation plan regulations. The individual regulatory requirements (highlighted with a black background) are located throughout this plan. For example, Chapter 4: Risk Assessment lists the federal local mitigation planning requirements found in Section 201.6(c)(2) that pertain to the identification of hazards and the development of a risk assessment.

**Authorities**[3]

Section 322 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act (Stafford Act), 42 U.S.C. 5165, as amended by the Disaster Mitigation Act of 2000 (DMA) (P.L. 106-390), provides for States, Tribes, and local governments to undertake a risk-based approach to reducing risks to natural hazards through mitigation planning. The National Flood Insurance Act of 1968, as amended, 42 U.S.C. 4001 et seq, reinforced the need and requirement for mitigation plans, linking flood mitigation assistance programs to State, Tribal and Local Mitigation Plans.

FEMA has implemented the various hazard mitigation planning provisions through regulations at 44 CFR Part 201. These reflect the need for States, Tribal, and local governments to closely coordinate mitigation planning and implementation efforts, and describes the requirement for a State Mitigation Plan as a condition of pre- and post-disaster assistance, as well as the mitigation plan requirement for local and Tribal governments as a condition of receiving FEMA hazard mitigation assistance.

The regulations governing the mitigation planning requirements for local mitigation plans are published under 44 CFR §201.6. Under 44 CFR §201.6, local governments must have a FEMA-approved Local Mitigation Plan in order to apply for and/or receive project grants under the following hazard mitigation assistance programs:

- Hazard Mitigation Grant Program (HMGP)
- Pre-Disaster Mitigation (PDM)
- Flood Mitigation Assistance (FMA)
- Severe Repetitive Loss (SRL)

## Federal Hazard Mitigation Assistance

Local governments simply lack sufficient personnel and the funds necessary to respond to and to recover from recurrent natural disasters, mitigate hazard prone private properties, and reinforce or replace all aging public infrastructure. The Stafford Act can provide local governments some disaster proofing assistance through hazard mitigation funds. Pre-Disaster Mitigation grants are offered on an annual basis and Hazard Mitigation Grant Program funds are available to states only after a federal disaster has been declared.

Local governments with an adopted and federally approved hazard mitigation plan are eligible to apply for mitigation funds through the State. In Washington State, the Emergency Management Division is responsible for fulfilling the state's role as grantee. It is responsible for notifying potential applicants of the availability of funding, defining the project selection process, ranking and prioritizing projects, and forwarding the projects to FEMA for funding. The applicant or sub-grantee carries out approved projects. The federal government will provide up to 75 percent of the cost of a mitigation project with both programs, with some restrictions. The remaining 25 percent must be matched by the local government or in some instances, the State. Other federal revenue sources cannot be used as match.

*More information about federal mitigation assistance programs can be found in Appendix D and on the Washington State Emergency Management Division's website:*

http://www.emd.wa.gov/grants/grants_hazard_mitigation.shtml

## Natural Hazards Mitigation Planning in the Thurston Region

In 2003, fifteen communities and local governments in Thurston County convened to collaborate on the development of the region's first Natural Hazards Mitigation Plan for the Thurston Region. All fifteen jurisdictions adopted the plan. FEMA approved the plan on October 6, 2003.

Since the plan's approval, five additional jurisdictions adopted local plans under the framework of the region's multi-jurisdictional plan. 44 CFR §201.6(d)(3) requires that local mitigation plans be updated and reapproved every five years in order for local governments to maintain eligibility for federal mitigation assistance program funds. For local plans that were adopted after the regional plan was approved, their plans also expire at the same time the multi-jurisdictional plan expires. Each local jurisdiction must review and revise its plan to reflect changes in development, progress in local mitigation efforts, and changes in priorities.

**In this multi-jurisdictional plan, the terms local government, local agency, jurisdiction, and community often refers to:**

Tribe, county, municipality, city, town, school district, fire district, other special purpose district, multi-county district, or other form of local government

**Thurston Region**

The terms *Thurston Region* and *Thurston County* are sometimes used interchangeably in this plan. Thurston County is both the municipal government of the county as well as the geographic area within the county's borders. Region is a collective term that refers to more than one or all of the local governments, communities, places, as well as the physical geography within the borders of Thurston County.

This plan is the culmination of the update process for planning partners that have an adopted hazard mitigation plan. It also serves as a first local hazard mitigation plan for several new planning partners within the region.

*Information about the planning partners and the process used to develop this plan is located in Chapter 2: Plan Process and Development.*

## Plan Structure

The plan in its entirety meets Federal Disaster Mitigation Act hazard mitigation planning requirements for both the multi-jurisdictional planning element requirements and each individual participating jurisdiction's planning element requirements. The core plan is divided into six chapters plus appendices. A plan annex was also prepared by each participating jurisdiction. The contents of the plan are structured as follows:

| | Chapters | Contents |
|---|---|---|
| Multi-Jurisdiction Core Plan | 1. Introduction | An overview of the Disaster Mitigation Act, the role of hazard mitigation planning, and federal mitigation assistance grant programs. |
| | 2. Plan Process and Development | A description of the planning process and documentation of the plan's development. |
| | 3. Thurston County Community Profile | A narrative and tabular summary of Thurston County's environment, demographics, development trends, and community services. |
| | 4. Risk Assessment | A comprehensive risk assessment of the natural hazards that threaten Thurston County and its communities. It is divided into six hazard profiles for earthquake, storm, flood, landslide, wildland fire, and volcanic events. This chapter also includes a discussion on climate change projections. |
| | 5. Mitigation Goals and Initiatives | Mitigation goals and objectives, and county wide descriptions of planned actions and projects to reduce or prevent impacts from natural disasters. |
| | 6. Adoption, Implementation, Monitoring, and Maintenance | A description of how the plan will be monitored, implemented, and maintained. |
| | 7. Appendices | Supporting documentation and reference material. |
| Local Plan | Annex | The annex is an addition to the plan that contains informaiton that is specific to a single jurisdiction. |

## Introduction Endnotes

[1]Thurston Regional Planning Council. 2008. The Profile. 26th Edition.

[2]Federal Emergency Management Agency. 2003. State and Local Mitigation Planning How-To Guide Developing the Plan: Identifying Mitigation Actions and Implementation Strategies. Department of Homeland Security. FEMA 386-3, April, 2003.

[3]Federal Emergency Management Agency. 2008. Local Multi-Hazard Mitigation Planning Guidance. U.S.

[4]Department of Homeland Security, July 1, 2008.

[5]Ibid

# Chapter 2: Plan Process and Development

## Introduction

This chapter describes how the plan was prepared, who was involved in the process, and how the public was involved.

The first *Natural Hazards Mitigation Plan for the Thurston Region* established multi-jurisdictional hazards mitigation planning for the region's communities. The previous planning process and the people who participated in the development of the first plan were successful with their endeavor. This plan's update followed the path of the first edition, but made substantial changes to document current hazard knowledge, and to comply with current federal planning requirements. Therefore this chapter documents and explains any differences between the original plan and this plan update. In order to maintain continuity between the past and present planning processes, the documentation for the first plan's development process (Chapter II) is included in Appendix A.

Each participating jurisdiction also documented their jurisdiction's planning process. The jurisdiction-specific planning process documentation is located in each jurisdiction's annex to this plan.

## Federal Requirements

44 CFR Section 201.6(b) and Section 201.6(c)(1) specifies the requirements necessary to document the planning process. The following requirements must be satisfactorily fulfilled in order for the Federal Emergency Management Agency (FEMA) to approve this plan:

**Requirements §201.6(b) and §201.6(c)(1):** An open public involvement process is essential to the development of an effective plan. In order to develop a more comprehensive approach to reducing the effects of natural disasters, the planning process **shall** include:

(1) An opportunity for the public to comment on the plan during the drafting stage and prior to plan approval;

(2) An opportunity for neighboring communities, local and regional agencies involved in hazard mitigation activities, and agencies that have the authority to regulate development, as well as businesses, academia and other private and non-profit interests to be involved in the planning process; and

(3) Review and incorporation, if appropriate, of existing plans, studies, reports, and technical information.

[The plan **shall** document] the planning process used to develop the plan, including how it was prepared, who was involved in the process, and how the public was involved.

Note: In general, the federal planning requirements with the words "**shall**" and "**must**" indicate that the item is mandatory and must be included in the plan, otherwise it will not be approved by FEMA. Regulations with the word "**should**" indicate that the item is strongly recommended to be included in the plan, but its absence will not cause FEMA to disapprove the plan.

All jurisdictions with adopted plans are required by 44 CFR Section 201.6(d)(3) to review and revise their plans and resubmit them for approval within five years in order to continue to be eligible for federal mitigation assistance grant funding. Therefore, the updated plan shall also describe the process used to review and analyze each section of the plan (plan process, risk assessment, mitigation strategy, and plan maintenance).

## Guiding Principles

When the *Natural Hazards Mitigation Plan for the Thurston Region* was created in 2003, the planning partners identified six guiding principles that served to influence the first plan's development process. These guiding principles also described the purpose of the plan and how it was to serve the region's communities. These principles remain relevant today and demonstrate the communities' commitment to natural hazard mitigation planning. These guiding principles have been slightly modified from their original form.

1. **Provide a Methodical Approach to Mitigation Planning**
   The process used by the planning partners identifies vulnerabilities to future disasters and proposes the mitigation initiatives necessary to avoid or minimize those vulnerabilities. Each step in the planning process builds upon the previous, providing a high level of assurance that the mitigation initiatives proposed by the participants have a valid basis for both their justification and priority for implementation.
2. **Enhance Public Awareness and Understanding of Natural Hazards**
   This plan contains data and information that can be used in a variety of ways to enhance public awareness about the most destructive natural hazards that threaten the region. This information gives members of the community a better understanding of what the most prevalent hazards have been historically, and how hazards are likely to impact or threaten the public health, safety, economic vitality of businesses, and the operational capability of important institutions in the future.

   The planning partners have provided opportunities for public involvement and information. This multi-jurisdictional effort has reached out to stakeholders from municipalities, academia, and special purpose districts as well as county and tribal government. The planning partners have also solicited ideas and input during open house meetings before and after the plan was drafted.
3. **Create a Decision-Making Tool for Policy and Decision Makers**
   This document provides basic information needed by managers and leaders of local government, business and industry, community associations, and other key institutions and organizations to take actions to address vulnerabilities to future natural disasters. It also provides proposals for specific projects and programs that are needed to eliminate or minimize those vulnerabilities.

   The mitigation actions in this plan have been reviewed to assess their benefits and costs, and have been prioritized for implementation. This approach is intended to provide a decision-making tool for the management of participating organizations and agencies regarding why the

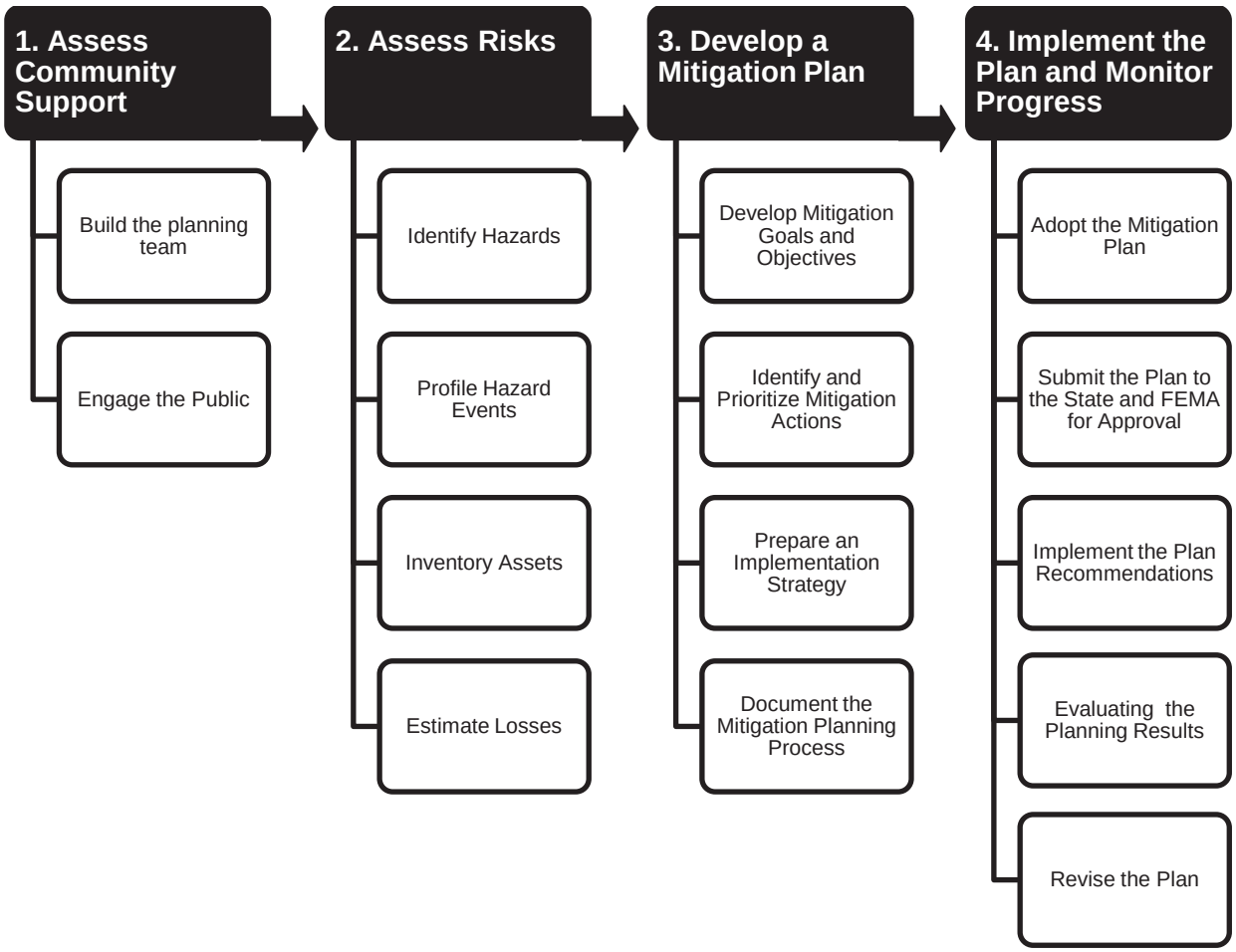
proposed mitigation initiatives should be implemented, which should be implemented first, and the social, technical, administrative, political, economic, and environmental benefits of doing so.

4. **Promote Compliance with State and Federal Program Requirements**
   At a minimum, local hazard mitigation plans must satisfactorily comply with the federal requirements in 44 CFR Section 201.6 in order to receive federal mitigation assistance program grants. This plan exceeds them. It is crucial for local government decision-makers to take an active role in preparing their communities for future disasters - because the effects of natural hazards are unique to each local community, understood best by the local community, and felt by the local community. Developing flexible plans to factor for the unknown is a good practice in risk management.
5. **Assure Inter-Jurisdictional Coordination of Mitigation-Related Programming**
   A key purpose of the planning process is to ensure that proposals for mitigation initiatives are reviewed and coordinated among the participating jurisdictions within the county. In this way, there is a high level of confidence that mitigation initiatives proposed by one jurisdiction or participating organization, when implemented, will be compatible with the interests of adjacent jurisdictions and unlikely to duplicate or interfere with mitigation initiatives proposed by others.
6. **Create Jurisdiction Specific Hazard Mitigation Plans for Implementation**
   A key purpose of the plan is to provide each participating local jurisdiction with a specific plan of action that can be adopted and implemented pursuant to its own authorities and responsibilities. Each participating jurisdiction developed an annex that is adopted as part of this plan with jurisdiction-specific information, including their mitigation initiatives. The jurisdictions and organizations can then adopt and implement the plan and the corresponding mitigation initiatives for their organization according to their individual needs and schedule. In this way, the plan format and the operational concept of the planning process ensures that proposed mitigation initiatives are coordinated and prioritized effectively among jurisdictions and organizations, while allowing each jurisdiction to adopt only the proposed mitigation initiatives that it actually has the authority or responsibility to implement when resources are available.

## The Hazard Mitigation Planning Process

Thurston County, through its Emergency Management Division, contracted with Thurston Regional Planning Council (TRPC) in April 2008 to facilitate the plan's update. TRPC staff facilitated the multi-jurisdictional planning process, assisted local governments in developing their portions of the plan, as well as compiled and authored all sections of the core plan. The plan partners contributed in kind support through their participation in the planning process and in the development of their local plan components. The plan update followed a basic four step hazard mitigation planning process as shown in Figure 2-1.

**Figure 2.1: Basic Four Step Hazard Mitigation Planning Process**




## Community Support

Communities across Thurston County have demonstrated their commitment to natural hazards mitigation planning. Twenty jurisdictions involving the County, seven municipalities, one tribe, five school districts, three fire districts, one transit agency, one college, and a regional medical center submitted and received federal approval of their adopted plans. In fact, on October 6, 2003, the *Natural Hazards Mitigation Plan for the Thurston Region* was the first multi-jurisdictional plan approved by FEMA in the State of Washington. The Disaster Mitigation Act of 2000 established a requirement that for all disasters declared on or after November 1, 2004, applicants for grants for disaster mitigation funds must have an approved local mitigation plan. Sixteen jurisdictions adopted plans prior to November 2004. Table 2.1 shows the local adoption and federal approval dates for local hazard mitigation plans in the region.

**Table 2.1: Jurisdiction Adoption and Approval Dates of the 2003-2008 Natural Hazards Mitigation Plan for the Thurston Region**

| Jurisdiction | Adoption | Approval |
|---|---|---|
| Thurston County | August 4, 2003 | October 6, 2003 |
| Town of Bucoda | May 24, 2005 | August 17, 2005 |
| City of Lacey | September 11, 2003 | October 6, 2003 |
| City of Olympia | December 9, 2003 | October 6, 2003 |
| City of Rainier | March 2, 2005 | April 6, 2005 |
| City of Tenino | July 22, 2003 | October 6, 2003 |
| City of Tumwater | July 15, 2003 | October 6, 2003 |
| City of Yelm | August 13, 2003 | October 6, 2003 |
| Confederated Tribes of the Chehalis Reservation | July 19, 2003 | October 6, 2003 |
| Fire District 4 - Rainier | August 12, 2003 | October 6, 2003 |
| Fire District 9 - McLane | August 14, 2003 | October 6, 2003 |
| Fire District 13 - Griffin | August 14, 2003 | October 6, 2003 |
| Intercity Transit | June 2, 2004 | October 6, 2003 |
| Providence St. Peter Hospital | May 6, 2004 | August 25, 2004 |
| School District, North Thurston Public Schools | January 18, 2005 | February 28, 2005 |
| School District, Olympia | August 9, 2004 | October 6, 2003 |
| School District, Rainier | | October 6, 2003 |
| School District, Tumwater | June 12, 2003 | October 6, 2003 |
| School District, Yelm Community Schools | November 23, 2004 | December 23, 2004 |
| The Evergreen State College | July 9, 2003 | October 6, 2003 |

## Plan Update Participants

In May 2008, the Emergency Management Council of Thurston County sent a letter to 39 local government entities in Thurston County inviting interested stakeholders to participate in the update to the Natural Hazards Mitigation Plan. A total of 26 jurisdictions actively participated in the plan update process - including 18 of the original plan partners plus eight new participating jurisdictions. Prior to the plan update, the Confederated Tribes of the Chehalis Reservation chose to develop a plan on their own. Fire District 13 did not to participate. Table 2.2 lists the communities and organizations that participated in the plan update process.

### Planning Team

#### The Hazard Mitigation Planning Workgroup

A multi-jurisdictional plan requires the participation a variety of stakeholders. The Hazard Mitigation Planning Workgroup (here on referred to as the Workgroup) served as the primary working committee throughout the plan's development process. The Workgroup consisted of Thurston Regional Planning Council staff and staff or elected representatives from 26 jurisdictions (see Table 2.2).

The role of individual Workgroup representative was to:

1. Participate in all aspects of the plan update's process.
2. Serve as a liaison to represent their jurisdiction's hazard mitigation issues and needs, and serve as a central resource to coordinate data requests and planning support activities.
3. Meet as needed at the workgroup or at their jurisdiction to review, update, and amend sections of the plan, and coordinate follow-up planning activities with their appropriate inter-and intra-departmental co-workers, managers, and officials.
4. Review, edit, or comment on all elements of the draft and final plan.
5. Facilitate their jurisdiction's public review process and adoption of the plan through their governing body.

The collective role of the Workgroup was to facilitate the development of the plan through a consensus decision making process. Specifically, the workgroup served to:

1. Support inter-jurisdictional cooperation and increase awareness of hazard mitigation planning activities around the region.
2. Provide technical input and information to support the development of the regional risk assessment.
3. Review the plan's goals and objectives.
4. Review all multi-jurisdictional plan elements in draft and final form (Chapters 1- 6 and appendices).
5. Identify, analyze, and prioritize the county-wide mitigation initiatives.
6. Conduct a benefit/cost review of the county-wide initiatives where needed.
7. Participate in an after action review to evaluate effectiveness of the original plan's monitoring, implementation and maintenance process, and recommend a new process if necessary.
8. Identify and participate in appropriate public involvement opportunities at the regional level.

The Workgroup met on a periodic basis to accomplish the business of the plan update process. All Workgroup meetings were open to the public. In addition to scheduled meetings, a significant amount of correspondence and tasks were fulfilled via telephone conversations and email exchanges. File transfers were performed mostly by email, with some data exchanged via compact disc. The dates of the Workgroup meetings and the major tasks and activities that this group addressed are summarized in Table 2.3.

### The Hazard Mitigation Planning Workgroup Subcommittee

An ad hoc Workgroup Subcommittee was consulted to brainstorm ideas, validate the planning material and its compliance with federal requirements, and advise the project manager in order to foster effective facilitation of the hazard mitigation planning process. The Subcommittee was consulted on an as needed basis. The Subcommittee met in person on occasion, but most business

was conducted via the telephone and email correspondence. The membership of the Subcommittee is indicated by an asterisk next to the representative's name in Table 2.2. The dates of the Workgroup Subcommittee meetings and the major tasks and activities that were addressed are summarized in Table 2.4. The Subcommittee served to provide the following support functions:

1. Brainstorm ideas for the updated plan's format and content
2. Identify effective Workgroup facilitation techniques
3. Assist with scheduling hazard mitigation planning timelines
4. Identify opportunities and formats for public process
5. Conduct reviews of early draft plan chapters prior to release to the Workgroup
6. Test document forms and data templates produced by TRPC prior to their release to the Workgroup.

## Table 2.2: 2008-2009 Hazard Mitigation Planning Partners and Workgroup Representatives

| Jurisdiction/Organization | Representative(s) |
|---|---|
| Thurston Regional Planning Council | Paul Brewster*, Associate Planner, Project Manager |
| Thurston County | Sandy Johnson* and Andrew Kinney*, Emergency Management Coordinators; Kathy Estes, Emergency Management Manager; Joe Butler*, Senior Plans Examiner and Fire Marshall, Mark Swartout, Natural Resources Program Manager and CRS Coordinator |
| Town of Bucoda | Kathy Martin, Mayor and Sherry Shepard, Deputy Town Clerk |
| City of Lacey | Jared Burbidge*, Management Analyst |
| City of Olympia | Greg Wright*, Assistant Fire Chief |
| City of Tumwater | David Ginther*, Associate Planner |
| City of Rainier | Ron Gibson, Public Works Director and Andrew Deffobis, Assistant Planner (TRPC) |
| City of Tenino | Ken Jones*, Mayor and Andrew Deffobis, Assistant Planner (TRPC) |
| City of Yelm | Todd Stancil, Chief of Police and Tim Peterson, Director of Public Works |
| Intercity Transit | Jim Merrill, Operations Manager |
| Olympia School District | Timothy Byrne, Director of Facilities and Jeff Carpenter, Coordinator of Health, Fitness, and Athletic Programs |
| North Thurston Public Schools | Shawn Lewis, Assistant Superintendant |
| Rainier School District | Dennis Friedrich, Superintendant |
| Tumwater School District | Mel Murray, Capital Projects and Construction Supervisor |
| Yelm Community Schools | Erling Birkland, Director of Facilities/Capital Projects |
| Thurston County Fire District 3 | James Broman, Chief |
| Thurston County Fire District 2, 4 | Rita Hutcheson, Chief |
| Thurston County Fire District 8 | Brian VanCamp, Chief |
| Thurston County Fire District 5, 9 | Steve North, Chief |
| Thurston County Fire District 17 | Mark Gregory, Chief |
| The Evergreen State College | Bruce Sutherland, Emergency Response Planning Coordinator |
| Providence Saint Peter Hospital | Michael Presswood, Emergency Preparedness Coordinator |
| Timberland Regional Library | Mike Wessells, Community Relations Manager and Michael Crose, Manager of Administrative Services |
| South Puget Sound Community College | Lonnie Hatman, Director of Security |
| LOTT Alliance | Dennis O'Connell, Construction Manager |
| Thurston PUD | John Weidenfeller, General Manager |
| Nisqually Tribe | Curtis Stanley, Environmental Planner |

Note: An asterisk (*) next to the representative's name indicates Workgroup Subcommittee participation.

## Table 2.3: Hazard Mitigation Planning Workgroup Meetings

| Date | Location | Activity | Subject |
|---|---|---|---|
| May 14, 2008 | TRPC | Initial Meeting | Hazard Mitigation Planning Background, Scope of Work |
| June 4, 2008 | Thurston County Emergency Operations Center | Meeting | Participation Requirements, Draft Community Profile Content, Public Process Requirements |
| June 25, 2008 | TRPC | Meeting | Federal Mitigation Assistance Programs Overview (Mark Stewart, WA EMD), and Public Open House Meeting Preparation |
| July 23, 2008 | TRPC | Meeting | Risk Assessment, Selection of Hazards to Profile, Inventory of Assets for Hazard Analysis |
| May 6, 2009 | TRPC | Meeting | Regional Risk Assessment Review; Local Agency Risk Assessment |
| May 20, 2009 | TRPC | Meeting | Local Mitigation Strategy, Actions, Benefit/Cost Review and Prioritization, NFIP Requirements |
| June 17, 2009 | TRPC | Meeting | County Wide Mitigation Initiatives - Review |
| July 1, 2009 | TRPC | Meeting | Plan Goals and Objectives; Mitigation Initiative Prioritization; and Plan Implementation Review |
| August 5, 2009 | TRPC | Meeting | Review Plan Process Documentation, Preparation of Public Review Process |

## Table 2.4: Hazard Mitigation Planning Workgroup Subcommittee Meetings

| Date | Location | Activity | Subject |
|---|---|---|---|
| May 30, 2008 | TRPC | Meeting | Regional Risk Assessment Review - Data Needs |
| June 4, 2008 | Thurston County Emergency Operations Center | Meeting | Data Exchange, Facilitation Process, Public Meeting Needs |
| June 9, 2008 | City of Tumwater, Town Hall | Meeting | Public Meeting Planning |
| June 20, 2008 | TRPC | Meeting | Regional Risk Assessment Review – Data Needs part 2 |
| April 17, 2009 | TRPC | Meeting | Draft Risk Assessment Review |

## Table 2.5: TRPC Staff Hazard Mitigation Planning Technical Assistance Visits and Training

| Date | Location | Activity | Subject |
|---|---|---|---|
| July 30, 2008 | East Olympia Fire District | Meeting with Association of Thurston County Fire Chiefs | Wildland Fire High Risk Hazard Zones and Hazard Profile |
| August 14, 2008 | City of Olympia Fire Department | Meeting with Greg Wright, Assistant Fire Chief | City of Olympia Hazard Mitigation Plan |
| September 29, 2008 | City of Olympia Fire Department | Meeting with Greg Wright, Andy Haub, City of Olympia Public Works, and Dennis O'Connell, LOTT Alliance | Downtown Olympia Tidal, Riverine, and Urban Flood Hazards and Climate Change |
| December 5, 2008 | TRPC | Meeting with Mike Wessells, TRL Community Relations Manager | Timberland Regional Library Hazard Mitigation Plan – Hazards outside of Thurston County that affect TRL Assets. |
| January 21-22, 2009 | Washington Emergency Management Division, Camp Murray | TRPC Staff Training | Washington State EMD and FEMA Natural Hazards Mitigation Planning Training Workshop |
| January 21, 2009 | Town of Bucoda | Thurston County Flood Response and Community Assistance Meeting | Town of Bucoda Flood Hazard Response and Recovery |
| February 2, 2009 | Thurston County Emergency Management | Meeting | Thurston County Supplemental Justification Report Research and Historical Hazards Data Collection |
| February 4, 2009 | Thurston County Public Works, Tilley Road | Meeting with Brent Payton, Operations and Maintenance Manager, and Maintenance Division Supervisors | Thurston County Roads and Transportation Services Vulnerability and Mitigation Projects |
| April 9, 2009 | Thurston County Public Works | Meeting with Thurston County Emergency Management Staff | State EMD and FEMA Review Process and Hazard Mitigation Grant Program Requirements |
| May 14, 2009 | City of Yelm Public Safety Building | Meeting with Todd Stancil, Chief of Police and Tim Peterson Director of Public Works | City of Yelm Hazard Mitigation Plan |
| May 28, 2009 | Horizons Intermediate School, Lacey | Meeting with Erling Birkland, Yelm Community Schools, Mel Murray, Tumwater School District, and Tom Nelson, North Thurston Public Schools | School Districts' Hazards Mitigation Plans |
| May 20, 2009 | TRPC | Meeting with Andrew Deffobis, Assistant Planner | City of Rainier Hazards Mitigation Plan |

| Date | Location | Activity | Subject |
|---|---|---|---|
| June 9, 2009 | TRPC | Meeting with Andrew Deffobis, Assistant Planner | City of Tenino Hazards Mitigation Plan |
| June 9, 2009 | TRPC | Meeting with Jeff Carpenter, Olympia School District | Olympia School District Hazards Mitigation Plan |
| June 25, 2009 | TRPC | Meeting with Mayor Ken Jones, Ron Kemp, Public Works Director, and Andrew Deffobis, Assistant Planner | City of Tenino Hazards Mitigation Plan Risk Assessment, Mitigation Initiatives, and Local Annex Timeline |
| June 30, 2009 | Bucoda Town Hall | Meeting with Town of Bucoda Planning Commission | Town of Bucoda Risk Assessment and Mitigation Initiatives |
| July 7, 2009 | Nisqually Indian Reservation | Meeting with Tribal Staff | Nisqually Indian Reservation Risk Assessment and Mitigation Initiatives |

### The Emergency Management Council of Thurston County

The Emergency Management Council (EMC) of Thurston County was created via an Interlocal Agreement to coordinate the emergency management activities of the general purpose governments and tribes within Thurston County. The membership of the EMC consists of the cities of Lacey, Olympia, Tenino, Tumwater, Rainier, and Yelm, the Town of Bucoda, Thurston County, the Nisqually Tribe, and the Confederated Tribes of the Chehalis Reservation. The Council is comprised primarily of the Emergency Managers of the ten jurisdictions. The EMC meetings are frequently attended by other stakeholders in the region such as fire districts, CAPCOM (911), Thurston County Public Health and Social Services, Providence St. Peter Hospital, LOTT Alliance, the American Red Cross, and others. Table 2.6 lists the EMC representatives.

**Table 2.6: Representatives to the Emergency Management Council of Thurston County**

| Jurisdiction/Organization | Representative(s) |
|---|---|
| Town of Bucoda | Alan Carr |
| City of Lacey | John Suessman |
| City of Olympia | Greg Wright, Co Chair |
| City of Rainier | Randy Schleis |
| City of Tenino | Ken Jones |
| City of Tumwater | John Carpenter |
| City of Yelm | Todd Stancil |
| Thurston County | Steve Romines, Co Chair |
| Nisqually Tribe | Joe Kautz |
| Confederated Tribes of the Chehalis Reservation | Ralph Wyman |

During the development of the first plan, the EMC served as an advisory committee and a decision making body for the entire plan development process. During the plan update, the EMC retained their role as a key advisory committee and assisted in the identification of County Wide Mitigation Initiatives. The EMC provided input on the Plan Goals and Objectives (Chapter 5) and the long term plan implementation, monitoring, and maintenance procedures (Chapter 6). The EMC also agreed to retain its role as the overall plan steward through the next five year plan update cycle. Table 2.7 summarizes the hazard mitigation planning activities of the Emergency Management Council during the plan update cycle.

**Table 2.7: Hazard Mitigation Planning Emergency Management Council Meetings**

| Date | Location | Activity | Subject |
|---|---|---|---|
| January 17, 2008 | Thurston County Emergency Operations Center | EMC Monthly Meeting | Preliminary Discussion of Plan Update Process, Identification of New Plan Partners |
| May 15, 2008 | Thurston County Emergency Operations Center | EMC Monthly Meeting | Participation Requirements, Public Process, Plan Goals and Objectives |
| June 18, 2009 | Thurston County Emergency Operations Center | EMC Monthly Meeting | Plan Progress; County Wide Mitigation Initiatives; Plan Monitoring, Implementation, and Maintenance; Plan Goals and Objectives |
| July 16, 2009 | TRPC | EMC Monthly Meeting | Final Review of Plan Goals and Objectives; and Approval of Plan Adoption, Monitoring, Implementation, and Maintenance Process; |
| August 20, 2009 | Thurston County Emergency Operations Center | EMC Monthly Meeting | Final Draft Plan Review and approval for public, state, and federal review processes |

## Public Participation

Citizens and members of the community are responsible for their personal safety, the safety of their families, and the protection of their assets from natural disaster events. People can learn about local hazard conditions through the natural hazards mitigation planning process and identify measures that they can take, such as the purchase of flood insurance or the procurement of essential supplies in advance, to reduce the impacts from the effects of natural hazards. A variety of community members desire to be key stakeholders in the vision of building disaster resilient communities. The near- and long-term economic vitality and environmental sustainability of the Thurston Region is important to residents, employees, and business owners, so their involvement in the planning process is essential.

### Outreach and Public Review Process

A variety of outreach methods and information sharing was utilized to increase peoples' awareness of the process and attempt to solicit their input for this plan's development. Staff issued press releases to local area newspapers, maintained information on agency websites, distributed brochures, hosted open house meetings, and attended community events. Local agency staff scheduled the topic on local government meeting agendas (city council, boards of directors, commissioners, etc.), some of which are televised and or video recorded and archived for viewing on some local governments' websites.

*See Appendix B for samples of public outreach materials used during the plan update process.*

### Website

TRPC and Thurston County Emergency Management both maintained a website containing downloadable electronic versions of the original hazards mitigation plan since the plan's adoption in 2003. TRPC established and maintained a website that was prominently accessible from the agency's homepage throughout the entire plan update process. This website contained both internal and external links that provided information that served the Workgroup members, plan participants, and public stakeholders. The draft plan was available for viewing or downloading from TRPC's website during the public review process.

### Brochures, Flyers, and Community Events

A combined informational brochure and comment form was produced and distributed county wide early on in the planning process to inform the public about the natural hazards mitigation planning process and to solicit community input. Copies of the brochure were distributed to all Timberland Regional Library branches in Thurston County (Olympia, Lacey, Tumwater, Yelm, and Tenino) and the Rochester library kiosk. Copies were also distributed to town and city halls and community activity centers throughout the region. In addition, copies of the brochure were made available at some community events.

**Table 2.8: Community Events with Natural Hazard Mitigation Planning Outreach Efforts**

| Community Event | Date |
|---|---|
| Swede Day Midsommar Festival, Rochester and Grand Mound | June 21, 2008 |
| Thurston County Fair, Thurston County Fairgrounds | July 30 - August 3, 2008 |
| Thurston County Emergency Preparedness Fair, Saint Martins University, Lacey | September 27, 2008 |
| Thurston County Flood Response Meeting, Town of Bucoda | January 21, 2009 |
| Thurston County Flood Response Meeting, Rochester Community Center | January 22, 2009 |
| Thurston County Emergency Preparedness Fair, Saint Martins University, Lacey | September 26, 2009 |

Event flyers and posters for open house meetings were also posted throughout the community prior to the two series of open house meetings during the plan kick off and the draft plan public review period.

### News Releases

To kick off the planning process, a news release was distributed to 24 local area newspapers and news media organizations on June 13, 2008 announcing the update of the plan and the dates and locations of three community open house meetings to introduce the planning process. Newspaper articles announcing the meetings were published in the *Tenino Independent* on June 18, in *The Olympian* on June 23, and in the Centralia *Chronicle*, on June 24. A second announcement (legal notice) was published in *The Olympian* on August 12 and 16, 2009 to notify the public of two open house meetings to review and comment on the draft plan prior to its local adoption.

### Community Open House Meetings

Prior to the drafting of the plan update, a series of three public meetings were held at three different locations around the county to provide public stakeholders an opportunity to learn about the planning process and provide input on the plan. The meetings were hosted in an open house format, from 6 to 8 p.m. The format allowed people to attend any time during the meeting. TRPC staff and Workgroup members hosted the events and were on hand to answer questions. Printed copies of the 2003 plan were available for review, and copies of the plan on compact disk were available for people to take home. Posters describing the hazards mitigation planning process and multiple large format informational posters describing the Thurston Region's most destructive natural hazards were prominently displayed. In addition, the brochure and comment forms were available for people to complete or take home and return at a later time. The public was encouraged to comment on the plan throughout its entire development. Twenty people attend the open house meetings.

**Table 2.9: Dates and Location of Community Open House Meetings Scheduled Prior to the Development of the Draft Plan**

| Date | Location |
|---|---|
| June 25, 2008 | Thurston Regional Planning Council, Conference Room A, 2424 Heritage Court S.W., Olympia |
| June 26, 2008 | Tenino Elementary School, multipurpose room, 301 Old Highway 99 North, Tenino |
| June 30, 2008 | Rochester Community Center, multipurpose room, 10140 Highway 12 S.W., Rochester |

Community members were provided an opportunity to review and comment on the draft plan before it was adopted by the local jurisdictions. A two week public review and comment period was scheduled from August 24 to September 4, 2009. In addition TRPC staff and Workgroup members hosted two open house meetings. Copies of the draft plan were on hand for review. Staff was present to answer questions and receive comments. In addition, draft copies of the plan were distributed to all Timberland Regional Library branch locations in Thurston County.

**Table 2.10: Dates and Location of Community Open House Meetings Scheduled to Solicit Public Comment on the Draft Plan Prior to Local Adoption**

| Date | Location |
|---|---|
| August 26, 2009 | Thurston Regional Planning Council, Conference Room A, 2424 Heritage Court S.W., Olympia |
| September 2, 2009 | Tenino Quarry House, 199 Park Avenue W, Tenino |

### Local Government Meetings

As part of the initial outreach process, TRPC staff presented an overview of natural hazards mitigation plan update process to the Association of Thurston County Fire Chiefs during their regularly scheduled monthly meeting on May 28, 2008 at the Rochester Fire District 1 Headquarters. Thurston County Fire Districts were invited to participate in the plan update process.

TRPC staff also presented the plan update process to the Thurston Regional Planning Council on June 6, 2008. The Regional Planning Council is an intergovernmental board made up of local government jurisdictions within Thurston County. The role of the Council is to develop regional plans and policies for transportation, growth management, environmental quality, and other topics. Many of the hazard mitigation planning partners that participated in the plan update process are members of the Regional Council.

The Workgroup members were responsible for informing their governing bodies and facilitating local review of the plan. More information about each jurisdiction's local public meetings can be found in their respective annex.

## Plan Revisions

### Addenda, 2003 to 2007

The hazards mitigation planning process continued in a limited fashion at the regional and local levels between 2003 and 2007. Chapter VI, Monitoring, Implementation, and Maintenance described a process as to how additions and revisions to the plan could be made, reviewed, and approved.

New content was created and appended to the end of the plan in the form of addenda. The addenda consisted of five adopted local agency hazards mitigation plans, two draft risk assessments, and an updated county wide liquefaction susceptibility map. The additions kept the plan current and were incorporated into the plan during the update process. Table 2.11 lists the plan addenda.

**Table 2.11: Natural Hazards Mitigation Plan Additions and Revisions, 2003 to 2007**

| Addendum | Content | Date Added |
|---|---|---|
| 1 | Town of Bucoda Plan | August 17, 2005 |
| 2 | City of Rainier Plan | April 6, 2005 |
| 3 | Providence St. Peter Hospital Plan | July 17, 2005 |
| 4 | North Thurston Public Schools Plan | February 28, 2005 |
| 5 | Yelm Community Schools Plan | December 23, 2004 |
| 6 | Draft Wildfire Hazard Profile to Chapter IV | January 2006 |
| 7 | Draft Volcanic Lahar Hazard Profile to Chapter IV | May 2007 |
| 8 | Draft Earthquake Liquefaction Map (County wide data) Update for Chapter IV | August 2006 |

The draft versions of the wildfire hazard and volcanic lahar hazard profiles were reviewed by and approved by the Emergency Management Council after they were completed. The draft hazard profiles did not delineate hazard zones or include any vulnerability analysis. Furthermore, none of the jurisdictions developed mitigation initiatives in response to the new hazard profiles until the plan update process started in 2008. In addition, no changes were made to the earthquake hazard profile, earthquake vulnerability assessment, or the county wide or jurisdiction specific mitigation initiatives in response to the new countywide liquefaction susceptibility map until the plan update process began.

## Plan Update, 2008 to 2009

The entire plan was reviewed by TRPC staff and the Workgroup during the plan update process. Substantial changes were made throughout the document to improve its usefulness and fulfill the plan's compliance with current federal planning requirements. Changes were made to both content and format, but the plan outline remains much the same. Chapter titles and content are consistent between the original plan and the updated document (Hindu-Arabic numerals replaced Roman numerals for chapter titles). Major changes for each chapter are described below.

### Chapter 1: Introduction

The plan introduction was expanded to provide more background information to explain and support the function of natural hazards mitigation planning in the Thurston Region. Additional information was added to describe the region's disposition to natural hazards, various federal mitigation grant programs, the federal disaster declaration process, and various mitigation measures, and to document the history of hazards mitigation planning in the region.

### Chapter 2: Plan Process and Development

This chapter reflects the plan update process. The contents of the original chapter (2003 plan) in its entirety can be found in Appendix A.

### Chapter 3: Thurston County Community Profile

The nature of the content and the data included in this document is very similar to the original content in Chapter 3. Data tables and narratives were revised to reflect current conditions. Additional data was added to describe certain aspects of the region's services and capabilities in more detail.

### Chapter 4: Risk Assessment

The original plan consolidated the risk assessment and the hazard profiles into a single continuous section. It consisted of four hazard profiles including earthquake, flood, storm, and landslide. The plan update divided the risk assessment into nine sections. The four original hazard profiles were updated and new sections were added, including a wildland fire hazard profile, a volcanic events hazard profile, and a new section on climate change projections. The risk rating for the original profiled hazards did not change.

Section 4.0: Risk Assessment Introduction, provides more details about the chapter update and its structure. Section 4.8: Risk Assessment Methodology, describes the methods and data sources that were used to prepare the vulnerability assessments in the hazard profiles.

### Chapter 5: Mitigation Goals and Initiatives

Slight modifications were made to goals and initiatives (described in the chapter itself). The Workgroup selected the STAPLEE benefit cost review method over the Mitigation 20/20™ benefit cost analysis software tool. The County Wide mitigation initiatives remain in this chapter, but each jurisdiction's mitigation initiatives were relocated to their respective annex.

### Chapter 6: Adoption, Implementation, Monitoring, and Maintenance

The chapter title was slightly revised to reflect the chapter content. The Workgroup and the EMC each reviewed the original version of Chapter 6. The general concepts for the roles, responsibilities, and procedures for monitoring and maintaining the plan remain the same, but were refined to reflect current federal planning requirements, and provide clarity. Specific revisions are noted at the end of each section in Chapter 6.

### Annexes

The plan update added a new section for each participating jurisdiction, called an annex. It is a small section of the overall plan that is devoted specifically to a single jurisdiction. This section includes a copy of the adoption resolution, a community profile, documentation of the local planning process, a local risk assessment, mitigation initiatives, and documentation of the community's compliance with the National Flood Insurance Program, if relevant.

The planning partners utilized universal templates and forms to maintain format consistency. The inclusion of multiple annexes simplifies the plan format. They are intended to improve the process for local jurisdictions to update their information as well as to enable new partners to develop their own mitigation plans under the framework of the multi-jurisdictional plan.

Plan participants intending to forward and adopt their natural hazard mitigation plans developed an annex to the plan during the update process. Budget constraints and staff shortages prevented some plan partners from completing their annex in accordance with the plan update schedule. Several jurisdictions will submit their annex at a later date. Chapter 6 describes a process for adding new communities and their annexes to this plan.

### Appendices

The appendices were revised to serve the needs of the plan update.

## Technical Assistance and Regulatory Review

The *Natural Hazards Mitigation Plan for the Thurston Region* must be submitted to the Washington State Emergency Management Division and the Federal Emergency Management Agency for their review in order to certify that the plan satisfactorily meets all federal hazard mitigation planning requirements. This section explains this review process.

The mitigation planning regulations under 44 CFR Part 201 require that local jurisdictions submit mitigation plans to the State Hazard Mitigation Strategist (SHMS) for initial review and coordination, with the state then forwarding the plans to FEMA for formal review and approval. This approach assures local governing officials that their plans will be approved without delay subsequent to their local adoption process.

### Technical Assistance

TRPC staff consulted state and federal planning partners throughout the development of this plan to ensure that the planning process and the plan's contents would satisfactorily meet FEMA's hazard mitigation planning requirements. TRPC submitted a draft copy of Chapter 4: Risk Assessment, to the SHMS and FEMA in May 2008. Because of the importance of the risk assessment in influencing the plan's overall quality, early feedback was requested to determine if the section was on track to comply with federal planning requirements.

Table 2.12 lists the personnel that provided technical assistance and regulatory interpretation of federal planning requirements during the planning process.

**Table 2.12: State and Federal Hazard Mitigation Planning Personnel Consulted During the Plan Update**

| Agency | Point of Contact |
|---|---|
| FEMA, Region X, Bothell, WA | Kristen Meyers, Mitigation Planning Manager |
| Washington State Emergency Management Division, Camp Murray, WA | Beverly O'Dea, Mitigation Strategist (SHMS) |
| Washington State Emergency Management Division, Camp Murray, WA | Mark Stewart, State Hazards Mitigation Programs Manager |
| Insurance Services Office (National Flood Insurance Program), Tillamook, OR | Linda Ryan, ISO Specialist |

## Regulatory Review

On August 20, 2009, the EMC approved the Draft *Natural Hazards Mitigation Plan for the Thurston Region* for its regulatory review. Following a two week public review period, the plan was submitted to Washington State Emergency Management Division to begin the regulatory review process. The remainder of this section describes the state and federal review process.

### Washington State Emergency Management Division

Washington State, as the grantee of FEMA mitigation assistance program grant funds, is responsible for reviewing local government hazard mitigation plans. Plans are submitted to the SHMS to ensure that they comply with federal planning requirements and to ensure that local plans are consistent with the Washington State Hazard Mitigation Plan. The SHMS requires 30 days to review the plan. SHMS uses a FEMA plan review checklist to score all required planning elements. Should the reviewer identify a deficiency that requires improvement, the SHMS will notify the appropriate local agency. The SHMS may provide support to the submitting jurisdiction, if necessary, to fulfill the relevant planning requirements. If the plan meets the minimum requirements, the state forwards the plan to FEMA.

### Federal Emergency Management Agency

FEMA Region X is responsible for reviewing plans for Washington communities. FEMA requires a minimum of 45 days to review a plan. FEMA and the State utilize the same plan checklist to ensure that all of the federal hazard mitigation planning requirements are satisfactorily met by every local agency participating in the multi-jurisdictional plan. FEMA will notify the submitting jurisdiction if their portion of a plan requires improvements and subsequently review any required modifications.

Once the plan meets all of the local mitigation plan requirements, the plan is then returned to the jurisdiction with an *approvable pending adoption* status. FEMA typically will notify the jurisdiction of the plan status within one week after completing the plan review process. Once a jurisdiction receives notification that their plan is ready for adoption, they may begin the adoption process.

*See Chapter 6: Adoption, Implementation, Monitoring, and Maintenance for more information on the local adoption process.*

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# Chapter 3: Thurston County Community Profile

## Introduction

It is important that local governments, Washington State, and the Federal Government understand the unique characteristics of Thurston County. The composition of the region's population, employment, land uses, infrastructure, and government services provide a context for natural hazards mitigation planning. This chapter includes general information about the region's natural setting, its demographics, growth trends, and public and private resources. A variety of natural hazards endangers the health and safety of the population of the county. Each major disaster threatens local and regional economic vitality, and imperils the quality of the affected community's environment. Hazard events such as flooding, landslides, storms and earthquakes are relatively common and present major financial and emotional challenges during the recovery phases following these disasters.

As Thurston County continues to grow and become more urban, the risk associated with natural hazards could increase as more people move to areas affected by natural hazards. The importance of developing strategies, coordinating resources, and increasing public awareness to reduce risk and prevent loss from future natural hazard events is becoming increasingly urgent.

Much of the text and data tables within this chapter come from *The Profile,* an annual report published by Thurston Regional Planning Council. *The Profile* is a compilation of statistics, trends, analyses and comparisons for Thurston County and its individual jurisdictions. Since its inception, this document has developed a reputation as a comprehensive and reliable tool for a wide variety of users needing current, accurate data for the region.

## Geography and Topography

Thurston County, Washington lies in the southern part of western Washington at the terminus of Puget Sound (see Map 3.1). It is the 32$^{nd}$ largest county in the state with a total land mass of 737 square miles. Approximately 92 percent of the land area is unincorporated. Within the county there are seven cities and towns and two unincorporated communities: Olympia, the state capital, Lacey and Tumwater in the north, Yelm in the east, Rainier, Tenino and Bucoda in the south, and Grand Mound and Rochester in the southwest. There are several special purpose districts including fifteen fire districts in the unincorporated county, a port district, eight school districts, and a conservation district. Thurston County has three tribal areas including the Nisqually Indian Reservation in east county, the Confederated Tribes of the Chehalis Reservation in southwest county as well as the Squaxin Indian Reservation which borders the county in the northwest. Fort Lewis Military Reservation occupies a large tract in the east county.

The area topography ranges from coastal lowlands to prairie flatlands to the foothills of the Cascades. This diversity presents an element that needs to be considered in hazard mitigation planning efforts. The county's geography plays into the incidence of landslide, flood, and earthquake – all natural hazards which are addressed in this plan.

Glacial activity from the county's geologic past left the land dotted with lakes and ponds. The northernmost boundary of the county is determined by the shoreline of Puget Sound. Inlets exclusive to the county are Budd, Henderson, and Eld Inlets. Budd and Henderson Inlets are separated by Dana Passage. Other inlets form the boundaries between Thurston and adjacent counties. Totten Inlet divides Thurston and Mason counties, and the Nisqually River separates Thurston from Pierce County (see Map 3.2).

In Thurston County, there are four local watersheds that flow to the Pacific Ocean basin. Flowing to the Puget Sound basin are five local watersheds. Approximately 57 percent of the county's waters flow into Puget Sound with 43 percent flowing to the Pacific Ocean .

The northwest and southeast corners of the county are marked by peaks ranging from 1,700 to 3,000 feet in elevation. Once thought to be the highest in the county, Larch Mountain and Capitol Peak, both over 2,650 feet, reign over the 40,000 acre Capitol State Forest west of Olympia. United States Geological Survey (USGS) surveyors recently discovered the highest point in the county is actually in the extreme southeast corner near Alder Lake. Standing at 2,922 feet, Quiemuth Peak was named in 1993 by the Thurston County Historic Commission to honor the Nisqually Indian chief of that name.

## County Weather

Thurston County has a marine type climate with mild temperatures year-round. In the warmest months, the average high temperature ranges between 70 and 80 degrees. In the winter months, high temperatures usually hover around 45 degrees. Like most of western Washington, Thurston County's weather is characterized by sunny summers and wet winters. With about 52 clear days out of every 365, Thurston County residents live under some form of cloud cover 86 percent of the year, with more than a trace of rain falling on almost half of the days of the year.

## Environment and Quality of Life

### Agricultural and Forest Lands

Although Thurston County is not commonly noted for a strong agricultural base, approximately 16 percent of the county's land use is given to agricultural activities. In addition to providing economic diversity and food production for the long-term sustainability of our community, keeping these lands in agricultural use promotes land conservation.

Forest lands also promote land conservation. They are important to our community both in terms of economic sustainability, and the long-term environmental and quality of life benefits forest lands provide. If forest lands in timber production are managed correctly, they provide many environmental benefits including reduction of soil erosion, protecting wildlife habitat, enhancing water quality and air quality, mitigating the effects of storm and flood damage, and providing for recreational and scenic opportunities. The County has implemented several strategies for forest land conservation, including long-term zoning, designation of urban growth areas, protection for forest

**Table 3.1: Thurston County Weather**

| | Average Temperature (Degrees Farenheit) | | | | Precipitation (Inches) | | Average Total Snowfall (Inches) |
|---|---|---|---|---|---|---|---|
| | 2007 | | Normal [1] | | | | |
| | | Low | High | Low | 2007 | Normal[1] | Normal[1] |
| Jan | 43.5 | 28.1 | 44.5 | 31.6 | 6.0 | 8.0 | 7.3 |
| Feb | 49.1 | 35.6 | 49.2 | 32.4 | 5.5 | 5.8 | 3.7 |
| Mar | 54.4 | 38.0 | 53.3 | 33.8 | 7.0 | 5.1 | 1.9 |
| Apr | 58.1 | 37.9 | 59.0 | 36.5 | 2.3 | 3.3 | 0.1 |
| May | 66.6 | 40.1 | 65.8 | 41.6 | 1.2 | 2.0 | 0.0 |
| Jun | 68.8 | 46.9 | 70.9 | 46.6 | 1.3 | 1.6 | 0.0 |
| Jul | 77.7 | 53.0 | 77.1 | 49.5 | 1.9 | 0.7 | 0.0 |
| Aug | 75.3 | 49.5 | 77.1 | 49.4 | 0.7 | 1.2 | 0.0 |
| Sep | 68.9 | 46.7 | 71.6 | 45.2 | 2.2 | 2.0 | 0.0 |
| Oct | 57.7 | 39.4 | 60.5 | 39.7 | 4.9 | 4.7 | 0.0 |
| Nov | 50.2 | 34.3 | 50.4 | 35.5 | 4.0 | 8.2 | 1.3 |
| Dec | 43.8 | 33.9 | 44.9 | 32.8 | 11.7 | 8.3 | 3.9 |
| Average | 59.5 | 40.3 | 60.4 | 39.6 | | | |
| Total | | | | | 48.7 | 50.9 | |

**Source**: National Weather Service, Olympia Weather Station, #456114 (www.wrcc.dri.edu).
**Explanation**: ”Normal” is the statistical average of 1948 to 2007 data.

land owners against high tax rates and close monitoring of forest practice activity, especially in the designated urban areas. It is estimated that between 1985 and 2000, almost 56,000 acres of land were in the forest harvest cycle, for an average annual rate of approximately 4,000 acres per year. Forest lands have been harvested at a rate of approximately 1.3 percent annually, which translates to 20 percent of the county’s forest lands being harvested over the last 15 years. The rate of harvest is significantly higher in the rural county where most of the commercial forest lands are found.

## Urbanization

Trends in urbanization over time provide insight into changes in the physical environment of Thurston County. These trends also impact natural hazard mitigation planning. As more land is urbanized, land cover that prevents flooding and landslides is lost. Forests, shrub vegetation, and agricultural lands are replaced by a more urban landscape which is composed of a variety of physical features, including distinctly urban features such as roads and buildings, as well as trees, lawns, and other non-urban land cover. Measuring the change in land cover of built or urban features over the last 15 years in Thurston County can provide insight into conditions in the future. Large-scale change detectable from satellite imagery indicates that approximately 32,000 acres of land were converted from intact forest stands, agricultural lands, or large expanses of shrub vegetation to urban landscapes over the last 15 years in Thurston County. Due to differences in density of development in the urban and rural environment, significantly more land is consumed for rural development than

urban. Watersheds experiencing the greatest percent of urbanization over the last 15 years were Henderson Inlet with 14 percent and Black River with 10 percent.

## Water Quality

### Puget Sound Water Quality

The quality of the water in Puget Sound influences the quality of life in Thurston County. However, over time, human activity within the basin has degraded the water quality of Puget Sound. Excess run-off from developed areas flows into the Sound containing contaminants that are harmful to shellfish and marine life. Structured surfaces along the shoreline, such as bulkheads, have replaced valuable marine life habitat, and excessive affluent discharge into the Sound has raised fecal coliform levels which can be unhealthy for swimmers and contribute to the closure of commercial shellfish beds. The Puget Sound Partnership is a state agency established in 2007 to lead efforts to protect and restore Puget Sound.

The Washington State Department of Ecology generates a Water Quality Concern Index for inlets of the Puget Sound. Of the five inlets in Thurston County, Budd Inlet has been given a very high concern level, Nisqually Reach a high concern level, and Totten, Henderson and Eld Inlets have a low concern level.

### Groundwater

Groundwater is an important natural resource as nearly the entire County relies on it for residential, agricultural, and industrial needs. There are more than 1,200 public water supplies in Thurston County that tap groundwater sources, and over 8,000 private wells. These serve approximately 99 percent of the drinking supplies for County residents. Not only is groundwater important for residential, agricultural, and business uses, it is also the primary source of stream flow during the dry summer months, which is essential to maintaining the health of the County's ecosystems, fisheries, and recreational opportunities.

One factor affecting groundwater quality and quantity is development and associated stormwater runoff. When stormwater is channeled directly into a surface water body, less water goes into the ground. Even where stormwater is recharged to the ground through a pond or trench, it can carry pollutants in amounts that over time may contaminate groundwater. Other influences associated with development, such as septic system releases, lawn and garden chemical applications, and pollutants associated with vehicle use, can also cause groundwater pollution. Even if recharge rates exceed water use, water in adequate quantity may not be available in the areas where people want to live. Water supply in some places does not meet demand. For instance, in the Black Hills and Bald Hills regions, bedrock is found just below ground level.

In order to protect groundwater supplies, local jurisdictions have developed joint wellhead protection policies. These programs are designed to protect recharge areas near municipal water supplies such

as wells and springs. By identifying and controlling pollution sources, the jurisdictions will develop contingency plans needed to respond swiftly in case of unexpected loss of a water supply.

## Water Conservation Measures

Conservation has proven to be a successful way to extend water supplies and wastewater treatment capacity in Thurston County. The Cities of Lacey, Olympia, and Tumwater, with funding from the LOTT Alliance, have participated in several indoor water conservation projects since 1997. Projects such as water efficient toilet distribution and rebates for resource-efficient washing machines have resulted in over 600,000 gallons per day reduction in wastewater flow (and corresponding water use). This equals over 200 million gallons of water saved annually, and is equivalent to approximately 8 percent per capita per day wastewater flow reduction since the programs began.

## Wastewater Management Systems

### LOTT Alliance

The LOTT Alliance helps preserve and protect public health, the environment, and water resources by providing wastewater management and reclaimed water production services for the urbanized area of north Thurston County. The acronym "LOTT" stands for its four government partners Lacey, Olympia, Tumwater, and Thurston County.

LOTT was formed in 1976 through an intergovernmental agreement between the three cities and the county. The agreement provided for cooperative use and development of the Olympia wastewater treatment plant, established major sewer lines (interceptors) servicing multiple jurisdictions, and initiated a major 1983 upgrade of the Budd Inlet Treatment Plant to provide secondary treatment of wastewater. The City of Olympia continued to legally own, operate, and maintain the treatment plant and other LOTT facilities on behalf of the four partners. Another major upgrade occurred in 1994 with the addition of nitrogen removal and ultraviolet disinfection, enhancing LOTT's treatment quality to advanced secondary standards. Today, the LOTT partners serve about 90,000 people over a 23,000-acre area. In addition to the central wastewater treatment plant, pump stations and major interceptor sewer lines, LOTT is also responsible for flow management, long range planning, and a new service – production of reclaimed water.

The move to reclaimed water production was the result of a four-year long-range planning process that began in fall 1995 and resulted in a new Wastewater Resource Management Plan (WRMP). Implementation began in January 2000. The plan set the stage for new approaches to wastewater management in the Lacey-Olympia-Tumwater area through 2020 and beyond. To implement the plan, LOTT was reorganized from the paperwork partnership to an independent non-profit organization, owned by the four governments. LOTT was incorporated as the LOTT Wastewater Alliance in 2000, and became a stand-alone entity as of July 2001. LOTT continued contracting with the City of Olympia for operation and maintenance of the Budd Inlet Plant and other facilities through 2004. At the beginning of 2005, the contract was discontinued and LOTT assumed full operational responsibility. Reflecting its role as a producer of reclaimed water, LOTT took the further

step of eliminating "Wastewater" from its name to become the LOTT Alliance, effective January 2005. A new logo includes a tag line summarizing the expanded mission: "Cleaning and restoring water for our community."

As the focal point of its long-range plan, LOTT has begun treating part of its wastewater to tertiary standards and recycling that water through two methods. At the Budd Inlet Reclaimed Water Plant, housed at the Budd Inlet Treatment Plant, a continuously back-flushing sand filter is used to produce Class A Reclaimed Water, the highest quality of reclaimed water as designated by the State Departments of Health and Ecology. Class A Reclaimed Water is clean enough for public contact and most uses except drinking. Up to 1 million gallons per day is filtered to Class A Reclaimed Water standards at the Budd Inlet facility. The reclaimed water is currently being used for irrigation in the Heritage Park, Percival Landing, and Port of Olympia areas. The City of Olympia serves as the water utility to distribute that reclaimed water to users.

To meet future expanded wastewater treatment capacity needs, the Wastewater Resource Management Plan focuses on creating new capacity in small increments, in the form of satellite treatment plants that produce Class A Reclaimed Water. Each new increment of capacity will be built "just in time" to meet new capacity needs — based on population and employment projections, remaining capacity in existing facilities, and other constantly measured factors. Construction of the first satellite, the Hawks Prairie Reclaimed Water Satellite, was completed in 2006. The Martin Way Reclaimed Water Plant uses a membrane bioreactor technology to treat up to 2 million gallons per day, and is expandable to 5 mgd. The Cities of Lacey and Olympia are expected to begin distributing reclaimed water from the Hawks Prairie Satellite to users in 2009. Currently, reclaimed water is piped to the 40-acre Hawks Prairie Reclaimed Water Ponds, where it circulates through a series of constructed wetland ponds in an attractive park-like setting, before flowing into groundwater recharge basins.

The heart of the wastewater treatment system, however, remains the central Budd Inlet Treatment Plant in downtown Olympia. To gain maximum benefits from the existing Budd Inlet Treatment Plant, LOTT sought permission from the State Department of Ecology to increase the amount of its advanced secondary treated water that can be discharged into Budd Inlet in the wintertime. This helps LOTT manage peak winter flow conditions and also provides a "reserve capacity" buffer while each new satellite plant is built. A new interim discharge permit was issued by Ecology in fall 2005. Although the new permit included the requested increase in wintertime limits, up to 28 million gallons per day, it also included a phased reduction in summertime discharges, from 15 mgd to about 12.5. A number of major projects are planned for the Budd Inlet Treatment Plant in the next few years, including significant process control improvements, remodeling of the Water Quality Laboratory, and the addition of a new Administrative/Education Center.

### Yelm's Wastewater Reclamation Facility

Although the Cities of Rainier and Tenino are planning for a future sewer system of their own, Yelm is one of the first of the smaller county cities to have a septic tank effluent pump collection (STEP) system. Additionally, in 1999 a $9.6 million dollar expansion of this facility turned Yelm into one of

the first water reclamation facilities in the State of Washington. This expansion transitioned Yelm's existing secondary lagoon treatment plant into a Class "A" reclaimed water facility. The upgrade included the construction of Cochrane Park, a beautiful manmade constructed wetland park, featuring a trout pond, waterfowl habitat and groundwater recharge facility.
The plant expansion increased the current capacity of 300,000 gallons per day to 1,000,000 gallons per day, allowing for future connections within the present city limits and short-term urban growth boundary. The STEP collection tanks still serve as the primary phase of treatment prior to delivery of the effluent to the water reclamation facility.

Purple pipe distributes Yelm's reclaimed water to schools, churches, city park facilities, city streetscapes, and Thurston County Rails to Trails trailhead for irrigation purposes. The reclaimed water is also used by Yelm Middle School and the City's public works facility for vehicle washdown. In addition, the public works facility uses the reclaimed water for the city's tree nursery and greenhouse.

This project is unique for the Yelm community in that it allows the City of Yelm to reclaim 100 percent of its wastewater with upland use and streamflow augmentation. An additional regional benefit of the water reclamation facility in Yelm is a cleaner Nisqually River and Puget Sound salmon habitat. More importantly, the use of reclaimed water lessens the dependence upon regular potable groundwater, further conserving this precious natural water resource.

### Grand Mound Wastewater Facility

The Grand Mound Wastewater Facility has been serving the Grand Mound area since 1998. The Grand Mound wastewater facility is now operating with an average wastewater flow of 135,000 gallons a day, the bulk of which comes from Great Wolf Lodge, a 200+ room resort, water park and conference center, that opened in February 2008. Other contributors to the Grand Mound Wastewater Facility include the Maple Lane Juvenile Detention center, local businesses, and residential areas. The plant type is an activated sludge oxidation ditch system with a UV disinfection system. The plant's receiving water is the Chehalis River. The facility currently runs at about 35 percent of capacity.

### Tenino Wastewater Treatment Plant

Tenino is currently in the project bidding phase for a wastewater treatment plant and collection system. The city broke ground on construction of the conveyance system in April of 2008. The project is expected to be completed in late 2009.

## Parks and Public Lands

As population grows, the demand for access to public parks and open space increases, while there is also additional pressure to develop the remaining available land. Therefore, parks and natural resource departments at all governmental levels play an increasingly important role in acquiring parcels of land that will be used for public parks and open space preserves. City and County parks and preserves offer not only recreational opportunities for residents and visitors to Thurston

County, but also provide beneficial environmental services such as the protection of sensitive areas; enhancement of air and water quality, provision of flood control and landslide, and conservation of wildlife habitat.

The seven cities and towns in Thurston County provide approximately 1,900 acres of park, recreation, and open space. Facilities include memorials, playfields, natural areas, and campgrounds. Thurston County manages another 2,720 acres including sections of the Chehalis Western trail, a paved walking and bike path.[1]

The tables below contain information about parks and public lands located in Thurston County. Table 3.2 shows parks and public lands managed by local jurisdictions, while Table 3.4 provides information on parks and public lands under county, state and federal jurisdiction.

**Table 3.2: Municipal Parks by Jurisdiction, 2008**

| Site, Facilities, and Services Available | Acreage |
|---|---|
| **Bucoda** | |
| **Bucoda Volunteer Park** | 14 |
| Baseball, river, kitchen, playground equipment, and horseshoes. | |
| **Bucoda Memorial Park** | 0.8 |
| Memorial and picnic area. | |
| **Bucoda RV Park** | 0.4 |
| Sixteen campsites with water and power. Campfire areas, restrooms with showers, and dumpstation. Located next to Bucoda Volunteer Park. | |
| **Bucoda Penitentiary Park** | 1.5 |
| Picnic area, trails to and along river. | |
| **Total Bucoda** | 16.72 |
| **Lacey** | |
| **Avonlea Park** | 5.4 |
| Undeveloped. | |
| **Brooks Park (mini-park)** | 1 |
| Turf, picnic, and playground equipment. | |
| **City Center Parks (2)** | 2 |
| Limited development. | |
| **Community Center** | |
| 9,000 square foot banquet facility/meeting rooms. | |
| **Corporate Center Mini-Park** | 2.5 |
| Undeveloped. | |
| **Homann Park** | 8 |
| Baseball diamond, go-cart track, basketball hoops, picnic and playground equipment, restrooms and soccer fields. | |

| | |
|---|---|
| **Horizon Pointe** | 9.5 |
| Playground, picnic facilities, sport courts, two athletic fields. | |
| **Huntamer Park** | 1.5 |
| Picnic facilities, covered stage, playground and restrooms. | |
| **I-5 Park** | 3 |
| Picnic equipment/adjacent to bike path, landscaped plaza. | |
| **Jacob Smith House** | 3.2 |
| National historic register; rental facility for small meetings, weddings/receptions, etc. | |
| **Lacey Museum** | 0.5 |
| Restored house, periodic historic displays on exhibit. | |
| **Lake Lois Park** | 37 |
| Picnic equipment, nature trails, interpretive signs. | |
| **Lakepointe** | 7.9 |
| Picnic facilities, 2 athletic fields, tennis court, playground. | |
| **Long Lake** | 10 |
| Swim, beach, picnic area, walking trails, restrooms, boat launch, two sand volleyball courts. | |
| **McAllister Park** | 60 |
| Undeveloped. | |
| **Meridian Campus** | 5 |
| Undeveloped. | |
| **Meridian Neighborhood Park** | 26 |
| Picnic facilities and shelter, basketball half-court, playground, open play meadow, restroom. | |
| **Pleasant Glade Park** | 32 |
| Undeveloped. | |
| **Rainier Vista** | 46 |
| 3 baseball/softball fields, 3 soccer fields, 3 sand volleyball courts, skate park, 4 tennis courts, walking trails, 2 large picnic shelter, playground equipment, parking lot, restrooms. | |
| **Regional Athletic Complex** | 97 |
| Slated for completion in fall 2008; to include 11 athletic fields as well as community park facilities. | |
| **Senior Center** | |
| 5,000 square feet located in Woodland Creek Park. | |
| **Thornbury Park** | 9 |
| Turf play area, playground, picnic shelter, and equipment. | |
| **Timberland Wetlands** | 32.3 |
| Undeveloped wetlands. | |
| **Wanschers Community Park** | 16 |
| Wooded park area, lake. | |
| **William A. Bush Neighborhood Park** | 8.5 |
| Playground, picnic shelter, equipment, and grass play area. | |

| | |
|---|---|
| **Wonderwood Park** | 40 |
| Picnic and playground equipment, paved trails, restrooms, 2 softball/baseball/soccer fields, 4 tennis courts. | |
| **Woodland Creek Community Park** | 72 |
| Lacey Community Center; youth fishing pond, cultural arts building, site for new Senior Center, walking trails, picnic facilities and shelters, playground and restrooms. | |
| **Total Lacey** | 535.3 |
| **Olympia** | |
| **8th Ave Neighborhood Park** | 4 |
| Undeveloped neighborhood park. | |
| **Decatur Woods Park** | 6.3 |
| Picnic tables, playground, restrooms, trail, public art. | |
| **Bigelow Park** | 1.9 |
| Picnic and playground equipment, restrooms, small play field, basketball court, public art. | |
| **Bigelow Springs** | 1.3 |
| Spring, interpretive signs, seating areas, view of city, picnic areas. | |
| **Buchanan Parcel** | 2.3 |
| Neighborhood park with swings, small grassy area, and picnic tables | |
| **Cain Road Parcel** | 4 |
| Undeveloped neighborhood park. | |
| **Chambers Lake Parcel** | 46.2 |
| Undeveloped open space. | |
| **Cooper Crest Parcel** | 13.4 |
| Forested ravine with nature trail. | |
| **East Bay Waterfront Park** | 1.9 |
| Scenic waterfront park, interpretive signs, picnic areas, viewing platform. | |
| **Evergreen Park Drive Neighborhood Park** | 4 |
| Undeveloped neighborhood park. | |
| **Friendly Grove Park** | 14.5 |
| Shelter, playground, picnic area, skate court, basketball court, tennis court, paved trail, public art. | |
| **Garfield Nature Trail** | 7.4 |
| Forested ravine nature trail between West Bay Drive and Rogers Street. | |
| **Grass Lake Refuge** | 172.4 |
| Wildlife refuge with minimally improved trails | |
| **Greene Parcel** | 3.5 |
| Undeveloped community park. | |
| **Harry Fain's Legion Park** | 1.2 |
| Picnic shelter, playground equipment, nature trail. | |

| | |
|---|---|
| **Henderson Road Neighborhood Park** | 4.8 |
| Undeveloped neighborhood park. | |
| **Heritage Fountain** | 1.2 |
| Scenic park, walkways, benches, interactive fountain. | |
| **Yashiro Japanese Garden** | 0.7 |
| Small Japanese ornamental garden, walkway, water features, public art. Present from sister city Yashiro, Japan. | |
| **LBA Park** | 22.6 |
| Picnic shelter and picnic areas, playgrounds, basketball, tennis, ballfield complex, restrooms, paved trail, summer concession stands. | |
| **Lions Park** | 3.7 |
| Play equipment, picnic shelter and picnic areas, restrooms, horseshoe pits, 2 tennis courts, play field, public art. | |
| **Madison Scenic Park** | 2.2 |
| Park with walkways, benches, scenic views. | |
| **Marie's Vineyard Parcel** | 4.1 |
| Neighborhood park with swings, grassy area, short trail, picnic tables, and basketball hoop. | |
| **McRostie Parcel** | 0.2 |
| Undeveloped open space. | |
| **Mission Creek Park** | 7.6 |
| Undeveloped neighborhood park. | |
| **Mission Creek Refuge** | 29.2 |
| Open space with trail network. | |
| **O'Connor Parcel** | 4.5 |
| Undeveloped open space. | |
| **Olympia Woodland Trail** | 31 |
| Urban trail corridor with paved, multi-use trail and restrooms. | |
| **Percival Landing** | 3.4 |
| Walking and picnic areas, playground, overnight boat moorage, 4,000 ft. boardwalk, public showers/restrooms, public art. | |
| **Priest Point Park** | 313.5 |
| Large forested park, memorial garden, picnic and group gathering facilities, playground equipment, basketball, beach, nature trails. | |
| **South Capitol View Point** | 0.9 |
| Small scenic viewpoint with benches. | |
| **Stevens Field** | 13 |
| Ballfield complex, playground, picnic areas, restrooms, 2 tennis courts. | |
| **Sunrise Park** | 5.7 |
| Playground and picnic areas, basketball court, paved trail, view of Mt. Rainier. | |

| | |
|---|---|
| **The Olympia Center** | 1.3 |
| Community center, meeting rooms, gymnasium, classrooms, kitchen facilities. | |
| **Trillium Park** | 4.5 |
| Forested ravine with nature trail that leads to small pond. | |
| **Ward Lake Park** | 10.1 |
| Undeveloped freshwater swimming access - closed to public access | |
| **Watershed Park** | 153 |
| Large forested open space with springs and creek, 1-1/2 mile trail, and old growth temperate rain forest. | |
| **West Bay Park** | 17 |
| Undeveloped waterfront park. | |
| **Wildwood Glen** | 2.4 |
| Undeveloped open space. | |
| **Woodruff Park** | 2.4 |
| Tennis courts, picnic tables, sand volleyball court, restrooms. | |
| **Yauger Park** | 39.8 |
| Ballfield complex, skate court, restrooms, concession building, picnic shelter, horseshoe pits, playground, jogging track, open space, picnic facilities, interpretive trail, basketball. | |
| **Total Olympia** | **963** |
| <u>Rainier</u> | |
| **Gehrke Park** | 3.5 |
| Playground equipment, open space, shelter, and ballfield. | |
| **Holiday Park** | 0.3 |
| Grass, flowers, benches, and a gazebo. | |
| **Raintree Park** | 0.5 |
| Basketball court, picnic tables, grassy park. | |
| **Veteran's Memorial Park** | 0.3 |
| Wall of remembrance, flag plaza, benches, paved pathways connecting with Yelm to Tenino trail, flowering cherry trees and grassy area. | |
| **Wilkowski Park** | 3.5 |
| Grassy open space, BBQ pit, three fire rings, picnic shelter, baseball field, restrooms. | |
| **Total Rainier** | **8** |
| <u>Tenino</u> | |
| **Tenino City Park** | 45 |
| Overnight camping, picnic areas, restrooms, softball, swimming, playground equipment, trails, 4 ball fields, covered shelter, Quarry House (rental facility), Depot Museum, 75 percent of park in natural state. | |
| **Total Tenino** | **45** |

## Table 3.2 continued

| | |
|---|---|
| **Tumwater** | |
| **5th and Grant Park** | 0.3 |
| Playground equipment, basketball hoop, scenic view of Capitol Dome and Lake. | |
| **Barclift Park** | 3 |
| Picnic area, shelter, basketball and tennis courts, walking trail and children's play toys. | |
| **Jim Brown Park** | 1.4 |
| Basketball court, play toys, tennis court, picnic areas. | |
| **Overlook Park** | 1 |
| Picnic areas, scenic views. | |
| **Palermo Pocket Park** | 0.3 |
| Playground equipment, basketball court. | |
| **Pioneer Park** | 85 |
| Restrooms, 3 soccer fields, 3 ball fields, 1 1/2 mile trails, river access. | |
| **Tumwater Hill Park** | 9 |
| Baseball field, picnic areas, and 3/4 mile of trails. | |
| **Tumwater Historical Park** | 17 |
| Canoe launch, picnic and playground equipment, reservable picnic shelter, nature trail, restrooms. | |
| **Tumwater Valley Municipal Golf Course** | 232 |
| 18-hole golf course with driving range, pro-shop, and restaurant. | |
| **V Street Park** | 0.6 |
| Playground equipment, basketball court. | |
| **Total Tumwater** | 349.6 |
| **Yelm** | |
| **Cochrane Park** | 8 |
| Pedestrian paths, picnic tables, benches, catch & release pond with dock, barbecue pits and two covered picnic shelters. | |
| **Yelm City Park** | 4 |
| Playground equipment, picnic areas, kitchen, stage, softball, restrooms, 3 buildings for fair booths and bingo, outside amphitheater and skateboard park. | |
| **Longmire Community Park** | 13 |
| Recreational ballfields, trails, and playground equipment. Dedicated on April 19, 2008. | |
| **Total Yelm** | **25** |
| **Total Municipal Parks** | **1,943** |

**Source:** TRPC survey of Lacey, Olympia, and Tumwater Parks Departments, Cities/Towns of Bucoda, Rainier, Tenino, and Yelm.

## Table 3.3: County, State, and Federal Managed Lands and Parks in Thurston County, 2008

| Site, Facilities, and Services Available | Acreage |
|---|---|
| **Thurston County Land** | |
| **Black River - Mima Prairie Glacial Heritage Preserve** | 1,020 |
| Southwest of Littlerock on the Black River, undeveloped. | |
| **Black River Natural Area** | 13 |
| Natural habitat area on the Black River near Rochester. Currently no public access. | |
| **Boston Harbor Boat Launch** | 1 |
| Boat launch, saltwater access, restrooms. | |
| **Burfoot County Park** | 60 |
| Saltwater access, picnic areas, playground equipment and shelters (reserve picnics for large groups), trails, restrooms. | |
| **Chehalis Western Trail** | 182 |
| 15.5 miles of abandoned railroad right-of-way for trail from Pacific Avenue in Lacey to Vail; 14.5 miles of trail paved with trailhead facilities at 14th Avenue, 67th Avenue and Fir Tree Road. Trail connection to Yelm-Tenino Trail completed and opened for public use in 2003. | |
| **Chehalis Western Trailhead (89th Avenue)** | 10 |
| Proposed trailhead to access Chehalis Western Trail, undeveloped; Phase I development to be constructed in 2010. | |
| **Chehalis Western Trailhead (Vail Loop)** | 3 |
| Proposed trailhead to access the southern end of the Chehalis Western Trail, undeveloped; 1/2 mile Deschutes River frontage. | |
| **Cooper Point Park** | 30 |
| Saltwater access, undeveloped. | |
| **Deschutes Falls County Park** | 155 |
| River access in Bald Hills area, undeveloped. | |
| **Deschutes River Park** | 50 |
| Future access point to Chehalis Western Trail, including 3/4 mile frontage along Deschutes River, undeveloped. | |
| **Fort Eaton Monument Site** | 1 |
| Historic site, stone monument marking the site of the fort used during the Indian War of 1855. | |
| **Frye Cove County Park** | 86 |
| Saltwater access, nature trails, picnic areas, shelters, restrooms, play area. | |
| **Gate to Belmore Trail** | 243 |
| 12.45 miles of abandoned railroad right-of-way for trail linking Kenneydell Park, Tumwater and the Rochester-Gate area; includes several access points along Black River and various preserve areas. Undeveloped. | |
| **Griffin Athletic Fields** | 40 |
| Joint county/Griffin School District athletic complex that includes two soccer fields and a softball/baseball field, walking path, picnic areas and parking. | |
| **Guerin County Park** | 41 |
| Black Lake access, undeveloped. | |
| **Indian Road County Park** | 5 |
| Saltwater access, undeveloped. | |

| | |
|---|---|
| **Johnson Point Wetlands Preserve** | 26 |
| Undeveloped. | |
| **Kenneydell Park** | 41 |
| Freshwater beach including restrooms, swim area, nature trails, individual and group picnic facilities, disabled-accessible fishing area, and indoor lodge reserved for group rentals. Phase II development to construct additional parking, restroom, and athletic fields in 2009-2010. | |
| **Lake Lawrence County Park** | 15 |
| Lake Lawrence access, undeveloped. | |
| **Louise H. Meyers County Park** | 38 |
| On Totten Inlet, no water access, undeveloped. | |
| **Mima Prairie Pioneer Cemetery** | 2 |
| Historic site. | |
| **Rainier View Park** | 54 |
| Destination park located along the Chehalis Western Trail near Vail, undeveloped; Deschutes River frontage. | |
| River frontage. | |
| **Ruth Prairie Park** | 35 |
| Destination park located along the Chehalis Western Trail near Vail, undeveloped; Deschutes River frontage. | |
| **Thurston County Fairgrounds** | 27 |
| Picnic, ball fields, RV and boat storage. Groups may use facilities including building by arrangement. | |
| **Thurston County/Lacey Regional Athletic Complex (RAC)** | 68 |
| Joint county/city athletic complex to include 6 soccer and 5 softball/baseball fields, basketball courts, picnic areas, shelters, restrooms and other amenities. Phase I development of 4 soccer fields and support facilities opened for public use in 2005. Development plans ongoing. Phase II development for facility completion begins spring 2008. | |
| **Woodland Creek Wetlands Preserve** | 75 |
| South Bay near Henderson Inlet, undeveloped. | |
| **Yelm to Tenino Trail** | 400 |
| 14.42 miles of abandoned railroad right-of-way linking Yelm, Tenino, and Chehalis Western Trail; 3/4 mile frontage on McIntosh Lake and access to Deschutes River. 12 miles paved from Yelm to Tenino, with trailheads in each city. Development plans ongoing. | |
| **Total Thurston County** | **2,721** |
| **U.S. Fish and Wildlife Service** | |
| **Nisqually National Wildlife Refuge** | 2,945 |
| Wildlife habitat, wildlife-related recreation; 7 miles of hiking trails--Brown Farm Dike Trail (5.5 miles; closed to public during waterfowl season); Environmental Education Center (reservation only); observation deck open to public; $3.00 entrance fee per family; Visitor Center is open 9 a.m. to 4 p.m., Wednesday through Sunday. | |
| **Total U.S. Fish and Wildlife Service** | **2,945** |

| | |
|---|---|
| **U.S. Forest Service** | |
| **Mount Baker - Snoqualmie National Forest** | 640 |
| Public access via low standard forest service roads (land administered by Gifford Pinchot National Forest, Cowlitz Valley Ranger District). | |
| **Total U.S. Forest Service** | **640** |
| **Washington State Department of Fish and Wildlife** | |
| **Black River Habitat Management Area** | 112 |
| Wildlife habitat, wildlife viewing, hunting. | |
| **Deschutes River Fish Culture Facility** | 4 |
| Tumwater Falls Park; viewing of salmon spawning. | |
| **McAllister Salmon Hatchery** | 7 |
| Fish rearing can be viewed. | |
| **Nisqually River Access** | 7 |
| Bank fishing, suitable for wheel chair access. | |
| **Nisqually Wildlife Area** | 522 |
| Wildlife habitat, boat dock, nature center, waterfowl hunting, fishing. | |
| **Scatter Creek Wildlife Area** | 1,085 |
| Wildlife habitat, wildlife viewing, hunting, fishing. | |
| **Skookumchuck Wildlife Area** | 31 |
| Wildlife habitat, wildlife viewing, hunting, fishing. | |
| **Public Fishing/Boat Ramps on:** | |
| *Lakes:* Pattison, Long, Munn, Ward, St. Clair, Black, Offut, Summit, McIntosh, Clear, Lawrence, Hicks, Chambers; *Rivers:* Black (2); Nisqually (2), includes a wheelchair accessible bank for fishing and saltwater site at Luhr's Beach; Skookumchuck (1). | |
| **Total Washington State Department of Fish and Wildlife** | **1,768** |
| **Washington State Department of Natural Resources** | |
| **Black River** | 1 |
| Canoe launch off 110th Ave. | |
| **Capitol Forest Multiple Use Area** | 92,000 |
| (In Thurston County) Overnight camping; trails: hikers only, horse/hiker, mountain bike, ORV; picnicking; vistas; fishing; hunting. | |
| **Chehalis Western Trail** | 20 |
| 5.5 mile trail from Woodard Bay to Lacey; development for pedestrian, bicycle, equestrian use on 4 miles of trail. Chehalis Western Trail and Woodard Bay Natural Resource Conservation Area (N.R.C.A.) are linked. | |
| **McLane Creek Nature Trail and Centennial Demonstration Forest** | 240 |
| Beaver pond and stream with boardwalk and nature trails. Interpretive signs along nature trails and managed forest. | |

| | |
|---|---|
| **Mima Mounds Natural Area** | 625 |
| Interpretive center; trails; handicap facilities. | |
| **Woodard Bay Natural Resource Conservation Area** | 450 |
| Day use trails, nature viewing. Chehalis Western Trail and Woodard Bay Natural Resource Conservation Area (N.R.C.A) are linked. | |
| **Total Washington State Department of Natural Resources** | **93,336** |
| **Washington State General Administration** | |
| **Capitol Campus** | 21 |
| Public open space, fountain, rose garden, memorials, trail to Capitol Lake, and an overlook plaza North of the Temple of Justice. | |
| **Capitol Lake Basin, Heritage Park, and Marathon Park** | 77 |
| Linking trails and sidewalks, restrooms, and picnic tables at Marathon Park and Heritage Park. Heritage Park is developed with a trail from the West Capitol Campus, lake edge promenade, great lawn and lawn amphitheater, and restrooms. Future development will include a new restroom, and completion of plans for additional landscaping and park furnishings. | |
| **Sylvester Park** | 1.5 |
| Benches and performance gazebo. | |
| **Total Washington State General Administration** | **100** |
| **Washington State Parks and Recreation Commission** | |
| **Elbow Lake State Park** | 320 |
| Undeveloped, boating, fishing, and hiking, walk in only. | |
| **Millersylvania State Park** | 844 |
| Picnicking, swimming, fishing, boat launch, hiking, both tent camping and full hook-up, lakefront, exercise and fitness trails, kitchens, reservable cottage, and Environmental Learning Center. | |
| **Nisqually-Mashel State Park** | 1,230 |
| At confluence of Nisqually and Mashel Rivers in southeast county; undeveloped. Fishing, rafting, hiking, bird watching, picnicking and mountain biking. | |
| **Tolmie State Park** | 106 |
| Puget Sound frontage, picnicking, beach walking, clamming, fishing, underwater reefs for scuba diving, kitchens, mooring buoys, and hiking trails. No overnight camping. | |
| **Total Washington State Parks and Recreation Commission** | **2,500** |
| **Total Federal and State Lands** | **104,010** |

**Source:** TRPC survey of Thurston County Parks Department, U.S. Fish and Wildlife Service, National Forest Service, Washington State Department of Game, Washington State Department of Natural Resources, Washington State Parks.

## Historical Resources

Thurston County's rich legacy of pre-historic and historical cultural resources extends back thousands of years to the earliest habitation of the Coastal Salish people, ancestors of the members of the current Nisqually Tribe, Squaxin Island Tribe, and Confederated Tribes of the Chehalis Reservation.

Related to its long history of human habitation, the County has significant cultural resources that have been documented through historic preservation efforts beginning locally in the 1950s. Historic resources include archaeological sites, historic sites, buildings, cemeteries, objects, and structures ranging from the important Native American village site on Mud Bay to the historic Bush Butternut Tree.

Beginning in the mid 1980s the Washington State Office of Archaeology and Historic Preservation undertook a comprehensive survey of historic resources of Thurston County. Additional survey activities have occurred since that time, and in 2003 Thurston Regional Planning Council updated the information, creating an accessible database and map of these resources. The Washington State Office of Archaeology and Historic Preservation also maintains a confidential record of known archaeological sites. The Nisqually Tribe, Squaxin Island Tribe, and Confederated Tribes of the Chehalis each have cultural resource staff as well. Not all archaeological properties or sites are published, and knowledge about their location and significance remains a tribal matter.

The cities of Olympia, Lacey, Tumwater, Yelm, and Thurston County have established historic preservation programs. Each of these jurisdictions has established a Historic Inventory of properties and Register of Historic Places, as well as procedures for identifying and protecting cultural resources.

Although they do not have historic preservation programs, Bucoda, Rainier, and Tenino have historic resources and provide goals of preserving and protecting historic resources in their comprehensive plans.

In addition to local historic preservation programs, state and national historic registers also serve to preserve and protect local cultural resources. The Washington Heritage Register (WHR) recognizes historic and cultural properties that are significant to local communities and to the state. The National Register (NR) is a listing of the country's most significant historic properties. Properties nominated to the National Register automatically receive listing in the Washington Heritage Register. Table 3.4 displays historic properties found in Thurston County.

**Table 3.4: Identified Historic Properties in Thurston County, July 2006**

| Jurisdiction | Historic Register National | Historic Register State | Historic Register Local | Survey/ Inventory | Total[1] |
|---|---|---|---|---|---|
| Bucoda | 1 | 1 | 0 | 3 | 3 |
| Lacey | 2 | 4 | 5 | 241 | 242 |
| Olympia | 26 | 35 | 213 | 557 | 562 |
| Rainier | 1 | 2 | 0 | 2 | 3 |
| Tenino | 3 | 4 | 0 | 25 | 27 |
| Tumwater | 7 | 7 | 15 | 179 | 179 |
| Yelm | 0 | 0 | 6 | 170 | 170 |
| Thurston County (uninc.) | 17 | 21 | 43 | 131 | 133 |
| **Thurston County Total[1]** | **57** | **74** | **282** | **1,308** | **1,319** |

**Source:** Thurston County's historic properties inventory database (designed by the Office of Archaeology and Historic Preservation; data entered by TRPC).

**Explanations:** Historic properties include buildings, structures, objects, sites, and districts. This table does not include archeological resources, nor does it reflect tribal cultural resources.

[1]The total number of properties does not equal the sum of the jurisdictions because some properties are listed on more than one register.

## Growth - Population and Development Trends

### Population Trends

Thurston County has been one of the fastest growing counties in the State since the 1960s, exceeding the State's overall rate of growth consistently. During the 1990's Thurston County grew at a rate of 2.5 percent annually. This growth added over 46,000 new residents to the county's population between 1990 and 2000. Between 2000 and 2007, Thurston County's population grew by over 30,000 new residents, an annual growth rate of 2.1 percent. The 2007 estimate for Thurston County's population is 238,000[3]. Reflecting state trends, Thurston County experienced the most growth of the last three decades in the 70s, with a population increase of over 61 percent. Population increased by 40 percent in the 60s, 30 percent in the 80s, and 29 percent in the 90s.

Between 1980 and 1990 the incorporated county grew at nearly the same rate as the unincorporated county. This is in stark contrast with the previous decade, where growth was concentrated in the unincorporated county. In 1970, 47 percent of the population lived in the unincorporated county. By 1980, 58 percent of the population was living in the unincorporated county. In 2007, it was estimated that 57 percent of the population lived in the unincorporated county. Because more than half of all of the population is in the unincorporated areas of the county, planning for natural hazards needs to account for this trend. Often people in unincorporated areas have fewer public support services readily available to them and can be more impacted by widespread disasters. Table 3.5 shows population growth for Thurston County jurisdictions:

## Table 3.5: Small Area Population Estimates, Thurston County Cities and UGAs 1995, 2000, 2005-2008

| Jurisdiction | | Estimate | | | | | Preliminary Estimate |
|---|---|---|---|---|---|---|---|
| | | 1995 | 2000 | 2005 | 2006 | 2007 | 2008 |
| Bucoda | City | 600 | 628 | 650 | 650 | 655 | 660 |
| | UGA | * | * | 0 | 0 | 0 | 0 |
| | **Total** | **600** | **628** | **650** | **650** | **655** | **660** |
| Lacey | City | 25,880 | 31,226 | 33,180 | 34,060 | 35,870 | 38,040 |
| | UGA | 27,830 | 28,632 | 31,525 | 32,550 | 33,355 | 34,120 |
| | **Total** | **53,710** | **59,858** | **64,705** | **66,610** | **69,225** | **72,160** |
| Olympia | City | 37,730 | 42,514 | 43,330 | 43,740 | 44,460 | 44,800 |
| | UGA | 8,670 | 9,269 | 10,980 | 11,395 | 11,330 | 11,920 |
| | **Total** | **46,400** | **51,783** | **54,310** | **55,135** | **55,790** | **56,720** |
| Rainier | City | 1,420 | 1,492 | 1,585 | 1,665 | 1,705 | 1,740 |
| | UGA | 160 | 163 | 175 | 185 | 185 | 190 |
| | **Total** | **1,580** | **1,655** | **1,760** | **1,850** | **1,890** | **1,930** |
| Tenino | City | 1,390 | 1,447 | 1,500 | 1,515 | 1,520 | 1,525 |
| | UGA | 140 | 151 | 165 | 170 | 170 | 165 |
| | **Total** | **1,530** | **1,598** | **1,665** | **1,685** | **1,690** | **1,690** |
| Tumwater | City | 12,050 | 12,698 | 12,950 | 13,100 | 13,340 | 13,780 |
| | UGA | 6,860 | 7,281 | 8,410 | 8,725 | 8,765 | 9,020 |
| | **Total** | **18,910** | **19,979** | **21,360** | **21,825** | **22,105** | **22,800[4]** |
| Yelm | City | 2,295 | 3,289 | 4,455 | 4,565 | 4,845 | 5,150 |
| | UGA | 1,085 | 1,095 | 1,130 | 1,160 | 1,190 | 1,215 |
| | **Total** | **3,380** | **4,384** | **5,585** | **5,725** | **6,035** | **6,365** |
| Grand Mound UGA | **Total** | **805** | **811** | **820** | **855** | **950** | **1,055** |
| Chehalis Reservation[1] | **Total** | **35** | **35** | **35** | **35** | **35** | **35** |
| Nisqually Reservation[1] | **Total** | **610** | **599** | **580** | **600** | **610** | **620** |
| **Total Cities** | | **81,370** | **93,294** | **97,650** | **99,290** | **102,390** | **105,695** |
| **Total UGAs [2]** | | **45,550** | **47,401** | **53,210** | **55,040** | **55,950** | **57,690** |
| **Total Reservations[1]** | | **645** | **634** | **615** | **635** | **645** | **655** |
| **Rural Unincorporated County[3]** | | **58,850** | **66,027** | **72,630** | **76,130** | **79,010** | **81,270** |
| **Thurston County Total** | | **186,400** | **207,355** | **224,100** | **231,100** | **238,000** | **245,300** |

**Sources**: Cities and County Total - Washington State Office of Financial Management and U.S. Bureau of the Census; UGAs - TRPC Small Area Population Estimates.

**Explanations:** Includes population growth by annexation. Data are for April 1 of each year. Numbers may not add due to rounding.

*Bucoda did not have an Urban Growth Area prior to 2004.

[1]Data is for Thurston County portion of reservation only.

[2]UGA - Urban Growth Area. Unincorporated area designated to be annexed into city limits over 20 years time to accommodate urban growth.

[3]Rural unincorporated county is the portion of the unincorporated county that lies outside UGA and Reservation boundaries.

[4]Does not include west Tumwater Annexation. The annexation effects are shown in Table II-5, Fire District data, but the annexation was officially recorded after April 1, 2008 by the State Office of Financial Management and will be reported in 2009.

In 1988, when urban growth areas were defined around most of the incorporated jurisdictions within Thurston County, the relationship between incorporated and unincorporated population distribution became secondary to the relationship between urban and rural population jurisdiction. Analysis of trends in the 1990s reveal that while Thurston County's cities have been receiving an increasing share of the population throughout this decade, it is often through annexation of existing homes rather than redirection of new growth. Overall, the percentage of the county's population living in our rural areas has remained relatively constant.

As mandated by the 1990 Growth Management Act, each of the incorporated jurisdictions has defined its own Urban Growth Area (UGA). This identifies the area that each jurisdiction will incorporate into its city limits and provide city services within the next 20 years.

Population growth has not been evenly distributed among Thurston County's cities in recent years. Several of the urban areas of our smaller towns and cities have experienced high rates of growth. Between 2000 and 2007, the Yelm urban area (5.7 percent) and the Rainier urban area (1.9 percent) experienced the highest average annual growth rates in population compared to Thurston County's other small cities. In the northern regions of the county, the Lacey urban area (2.0 percent) has been growing at a higher annual rate than the Tumwater (0.7 percent) and Olympia urban areas (0.6 percent).

Below are some further population characteristics for Thurston County.

**Table 3.6: Estimates of Population by Age and Gender, Thurston County, 2007**

| Age Group | Male Population | % | Female Population | % |
|---|---|---|---|---|
| 0-19 | 32,427 | 27.80% | 30,642 | 25.30% |
| 20-54 | 58,465 | 50.10% | 60,312 | 49.80% |
| 55-64 | 13,980 | 12.00% | 14,446 | 11.90% |
| 65-84 | 10,542 | 9.00% | 12,996 | 10.70% |
| 85+ | 1,381 | 1.20% | 2,809 | 2.30% |
| ***Total*** | ***116,796*** | | ***121,204*** | |

**Source:** Washington Office of Financial Management, Intercensal and Postcensal Estimates of County Population by Age and Sex: 1980-2007.

**Table 3.7: Population by Race and Hispanic Origin in Thurston County, 2000**

| | Total Population by Race | % |
|---|---|---|
| White Alone | 177,617 | 86% |
| Black/African American Alone | 4,881 | 2% |
| American Indian & Alaska Native Alone | 3,143 | 2% |
| Asian Alone | 9,145 | 4% |
| Native Hawaiian & Other Pacific Islander | 1,078 | 1% |
| Other Race Alone | 3,506 | 2% |
| Total Single Race | 199,370 | 96% |
| Two or More Races Total | 7,985 | 4% |
| Hispanic Origin | 9,392 | 5% |
| **Total Population** | **207,355** | |

**Source:** U.S. Bureau of the Census, Census 2000

**Explanations:** Persons of Hispanic origin can be of any race. Does not include reservations, as that data includes persons living outside Thurston County.

## Dwelling Unit Trends

The share of total dwelling units in the urban areas has been steadily decreasing in the second half of the 1990s. Correspondingly, the share of total dwelling units which are located in the rural area has been steadily increasing. Interestingly, the rural area's average rate of growth in dwelling units has generally been declining over this same time period. Although the urban areas continue to be the location of the majority of the county's dwelling units, the above trends indicate that the amount of growth going into the rural area is large enough that even when it is declining in its rate of growth, it is still occurring at a high enough level to cause the rural area to have a steadily increasing share of the county's total dwelling units. The urban area's share of new dwelling units has declined, moving from 61.8 percent in 1995 to 58.7 percent in 2002. Correspondingly, the rural area's share of new dwelling units has increased from 38.2 percent in 1995 to 28.6 percent in 2002. The decline in the share of new dwelling units which are locating within city limits is significant, from 57.6 percent in 1995 to 28.6 percent in 2002. Not this entire decline reflects a movement of new dwelling units to the rural areas. Much of it is attributable to an increase in new dwelling units locating in the UGA's. A positive trend is the significant increase in the UGA share of new dwellings, moving from only 6.5 percent of new dwellings in 1994 to 28.4 percent of new dwellings in 2002.

### Table 3.8: Estimated Composition of Thurston County Housing Stock, 2007

| | Population | % |
|---|---|---|
| Single-Family | 67,200 | 66.70% |
| Multi-Family | 21,410 | 21.20% |
| Manufactured Homes | 12,170 | 12.10% |
| ***Total*** | **100,780** | **100%** |

**Sources:** TRPC; Bucoda, Lacey, Olympia, Rainier, Tenino, Tumwater, Yelm, and Thurston County building departments; U.S. Bureau of the Census; Washington State Office of Financial Management.

### Table 3.9: Year Housing Was Built, Thurston County Housing

| | Thurston County | Washington State |
|---|---|---|
| Pre-1939 - 1959 | 16.90% | 29.40% |
| 1960-1979 | 35.50% | 32.70% |
| 1980-2000 | 47.60% | 37.90% |

**Source:** U.S. Bureau of the Census, 2000 Census

### Table 3.10: Thurston County Household Characteristics, 2000

| | Population | % |
|---|---|---|
| Two-Parent Families | 43,352 | 53% |
| One-Parent Families | 11,599 | 14% |
| One-Person Households | 20,473 | 25% |
| Non-Family Households | 6,201 | 8% |
| ***Total Households*** | ***81,625*** | ***100%*** |

**Source:** U.S. Bureau of the Census, 2000 Census

## Table 3.11: Total Small Area Dwelling Unit Estimates Thurston County Cities and UGAs, 2000-2008

| Jurisdiction | | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 |
|---|---|---|---|---|---|---|---|---|---|---|
| Bucoda | City | 235 | 240 | 240 | 245 | 240 | 245 | 245 | 245 | 245 |
| | UGA | * | * | * | * | 0 | 0 | 0 | 0 | 0 |
| | **Total** | **235** | **240** | **240** | **245** | **240** | **245** | **245** | **245** | **245** |
| Lacey | City | 13,160 | 13,305 | 13,490 | 13,595 | 13,765 | 14,255 | 14,885 | 16,025 | 17,125 |
| | UGA | 11,015 | 11,130 | 11,505 | 11,885 | 12,285 | 12,705 | 12,790 | 12,980 | 13,060 |
| | **Total** | **24,170** | **24,430** | **24,990** | **25,480** | **26,050** | **26,960** | **27,680** | **29,010** | **30,180** |
| Olympia | City | 19,740 | 19,740 | 19,890 | 19,990 | 20,130 | 20,260 | 20,490 | 20,900 | 21,080 |
| | UGA | 3,810 | 3,950 | 4,090 | 4,230 | 4,530 | 4,700 | 4,740 | 4,660 | 4,840 |
| | **Total** | **23,540** | **23,690** | **23,980** | **24,220** | **24,660** | **24,950** | **25,240** | **25,550** | **25,910** |
| Rainier | City | 550 | 550 | 550 | 570 | 575 | 590 | 640 | 660 | 685 |
| | UGA | 65 | 65 | 70 | 70 | 70 | 75 | 75 | 75 | 75 |
| | **Total** | **615** | **615** | **620** | **640** | **645** | **665** | **715** | **735** | **760** |
| Tenino | City | 615 | 620 | 625 | 645 | 630 | 645 | 660 | 660 | 665 |
| | UGA | 60 | 60 | 65 | 65 | 70 | 70 | 70 | 70 | 65 |
| | **Total** | **675** | **680** | **690** | **710** | **700** | **710** | **725** | **730** | **730** |
| Tumwater | City | 5,950 | 5,990 | 6,030 | 6,030 | 6,090 | 6,160 | 6,310 | 6,520 | 6,850 |
| | UGA | 3,090 | 3,120 | 3,150 | 3,270 | 3,460 | 3,670 | 3,710 | 3,680 | 3,720 |
| | **Total** | **9,040** | **9,100** | **9,180** | **9,300** | **9,550** | **9,830** | **10,020** | **10,200** | **10,570** |
| Yelm | City | 1,325 | 1,380 | 1,485 | 1,610 | 1,710 | 1,860 | 1,975 | 2,140 | 2,305 |
| | UGA | 425 | 430 | 435 | 445 | 455 | 460 | 460 | 465 | 470 |
| | **Total** | **1,750** | **1,810** | **1,925** | **2,055** | **2,165** | **2,320** | **2,435** | **2,605** | **2,775** |
| Grand Mound UGA | **Total** | **315** | **320** | **320** | **330** | **335** | **335** | **340** | **375** | **410** |
| Chehalis Reservation[1] | **Total** | **15** | **15** | **15** | **15** | **15** | **15** | **15** | **15** | **15** |
| Nisqually Reservation[1] | **Total** | **210** | **210** | **210** | **215** | **215** | **215** | **220** | **220** | **225** |
| **Total Cities** | | **41,580** | **41,820** | **42,320** | **42,680** | **43,140** | **44,010** | **45,210** | **47,140** | **48,950** |
| **Total UGAs[2]** | | **18,780** | **19,070** | **19,630** | **20,290** | **21,200** | **22,010** | **22,190** | **22,310** | **22,630** |
| **Total Reservations[1]** | | **225** | **225** | **225** | **230** | **230** | **230** | **235** | **235** | **240** |
| **Rural Unincorporated County[3]** | | **26,080** | **26,700** | **27,390** | **28,350** | **29,150** | **30,060** | **30,750** | **31,610** | **31,980** |
| **Thurston County Total** | | **86,650** | **87,820** | **89,560** | **91,540** | **93,720** | **96,310** | **98,380** | **101,290** | **103,800** |

**Sources:** Thurston Regional Planning Council; Bucoda, Lacey, Olympia, Rainier, Tenino, Tumwater, Yelm, and Thurston County building departments; U.S. Bureau of the Census; Washington State Office of Financial Management.
**Explanations:** City and UGA boundaries may change over time due to annexations. Data are for April 1 of each year. Numbers may not add due to rounding. *Bucoda did not have an Urban Growth Area prior to 2004.
**Note:** Dwelling unit estimates incorporate housing starts data, however, the methodology also includes calibrating to U.S. Census and OFM data, includes demolitions, and does not include replacements and activity in manufactured home parks. [1]Data is for Thurston County portion of reservation only.
[2]UGA - Urban Growth Area. Unincorporated area designated to be annexed into city limits over 20 years time to accommodate urban growth.
[3]Rural unincorporated county is the portion of the unincorporated county that lies outside UGA and Reservation boundaries.

## Monitoring Land Supply – 2007 Buildable Lands Report

Since the late 1970s the Thurston Regional Planning Council has provided estimates of the buildable land supply in Thurston County. This helps local governments ensure that an adequate land supply is available to accommodate projected growth. During this time Thurston County has been one of the fastest growing counties in Washington State. In the last 35 years, population grew by over 150,000 people, and over 85,000 new jobs were created in the County.

In 1990 the State Growth Management Act (GMA) was passed requiring local cities, towns, and the County to develop detailed plans on how they planned to accommodate growth. These are called Comprehensive Plans. At the same time the seven cities and towns and Thurston County developed county-wide planning policies that laid out how Thurston County was to grow as a region. Under these policies, Thurston Regional Planning Council was formally asked to review land supply and planned densities to ensure that the urban areas were large enough to accommodate 20 years of projected growth.

The legislature added a monitoring and evaluation provision to the GMA in 1997. This provision is often referred to as the "Buildable Lands Program." It affects six western Washington counties (Clark, King, Kitsap, Pierce, Snohomish, and Thurston) and the cities and towns within them. Thurston Regional Planning Council was asked to develop the Buildable Lands Report for Thurston County, based on its long history of monitoring land supply. The first report was issued in 2002. The second report was issued in 2007.

The Buildable Lands Program in Thurston County answers two key growth-related questions. The first is whether residential development in the urban growth areas is occurring at the densities envisioned in local comprehensive plans. The second is whether there is an adequate land supply in the urban growth areas for anticipated future growth in population and employment.

The following information on development trends in Thurston County is excerpted from the 2007 Buildable Lands Report.

## Achieved Residential Density

Achieved residential density is the measurement of how much land each new home, condo, or apartment complex requires. As a rule of thumb, if development is occurring at four or more dwellings per net acre, it is considered urban and consistent with the Growth Management Act.

**Key Observations:**

- Overall, Thurston County urban areas are achieving urban densities greater than the rule of thumb threshold of four dwellings per net acre.
- Individually, all Thurston County urban areas with sewer service are achieving urban densities.
- For health code reasons, densities must be lower than four units per acre when sewer service is not available.
- The greatest increase in densities has been in the unincorporated urban areas. Densities in

these areas are starting to catch up to densities being achieved within city limits.

- It takes time between policy changes (changes in zoning and development regulations) and seeing the results of those changes in new developments. The average subdivision can take 3-5 years to go through the various review steps. Full results of post-GMA zoning are finally being seen in this second monitoring period (2000-2004).
- In the five year period before the Growth Management Act Comprehensive Plans and zoning were passed (1990-1994), new lots in the urban areas (cities plus unincorporated urban growth areas) averaged a gross density of 2.6 homes per acre. In the next five year interval (1995-1999), new subdivisions were coming in at gross densities of around 3 homes per acre, approved under a mix of pre-GMA and post-GMA zoning. In the most recent five-year period (2000-2004), gross density increased to 3.7 homes per acre. Based on the projects submitted to the cities and County for review, gross density is expected to increase even more in the near future, to 4.4 homes per gross acre.

### Residential and Commercial/Industrial Land Supply

Buildable Lands Report Assessment – A sufficient land supply exists to accommodate 20 years of projected population growth in the urban areas of Thurston County.

In Chapter 4: Risk Assessment, future growth and development trends for the jurisdictions are analyzed in depth as they pertain to natural hazards mitigation. Data is provided that gives both current (2006) and future (year 2030) value of structures and building contents. This information is broken down according to land use by ownership and is analyzed for the six natural hazards of earthquake, storm, flood, landslide, volcanic events, and wildland fire. There is also data that identifies amount of dwelling units that fall into a particular hazard area currently as well as the projected amount that may fall into a particular hazard area in the year 2030.

## Vulnerable Populations

Demographic information helps to identify vulnerable populations. Seniors, the disabled, children, and those living in poverty are all segments of the population that have special needs in times of a disaster. Also, they often have more challenges during the recovery period. Although the percentage of poverty in Thurston County is lower than the state average, 9.8 percent of residents under 18 years of age and 5.0 percent of residents over 65 in the county live in poverty.

Natural hazard mitigation planning efforts should address these special needs by making recovery centers more accessible; including members of special needs or vulnerable populations in decision-making processes; and ensuring that there is equal access to relief application or assistance. There is a sizeable population of non-English speaking household throughout the Thurston Region. Local, State, and Federal emergency response and recovery efforts must ensure that all segments of the population have access to critical information.

## Group Housing and People with Disabilities

### Table 3.12: Group Housing Types in Thurston County, 2000

| | Total |
|---|---|
| Institutionalized population: | 1,898 |
| Correctional institutions | 780 |
| Nursing homes | 784 |
| Other institutions | 334 |
| Noninstitutionalized population: | 1,500 |
| College dormitories (includes college quarters off campus) | 743 |
| Military quarters | 0 |
| Other noninstitutional group quarters | 757 |
| **Total:** | **3,398** |

**Source:** U.S. Bureau of the Census, 2000 Census

### Table 3.13: Disabled Population, Ages 5 and Over

| Age | Total Population | Population with a Disability | % |
|---|---|---|---|
| 5-15 | 33,107 | 2,384 | 7.20% |
| 16-64 | 155,628 | 21,321 | 13.70% |
| 65+ | 26,325 | 10,530 | 40.00% |

**Source:** U.S. Census Bureau, 2006 American Community Survey

### Table 3.14: Disability by Type, Ages 5 and Older

| Type | Population | % |
|---|---|---|
| Sensory | 8,895 | 4.10% |
| Physical | 21,744 | 10.10% |
| Mental | 13,516 | 6.30% |
| Self-Care | 5,428 | 2.50% |

**Source:** U.S. Census Bureau, 2006 American Community Survey

## Age Distribution

Overall the county's population is getting older. Census figures show that in 2000, the median age of the county's population was 36.5 years, up from 33.6 years in 1990. The intercensal estimate of median age for Thurston County for 2007 is 38.1. However, there are some interesting distinctions in the age characteristics between the cities within Thurston County. For example, Yelm has the youngest population. Its 2000 median age of 30.8 years is significantly lower than the county's median age, while its proportion of children (32 percent) is significantly higher than the county average (25 percent)[4].

The senior population continues to be a growing segment of the population, at national and state levels as well as in Thurston County. Because of health and mobility issues that can sometimes limit life activities, this population is a vulnerable segment of the population in Thurston County. In 2006, persons age 65 and over constituted 12 percent of the total county population. The percentage of residents in the county over 65 years of age is expected to climb to roughly 13 percent by 2010 and should reach 18 percent by 2020[5]. The first of the "baby boomers" will reach 65 in 2011.

**Table 3.15: Population age 65 years and older, 1990-2030 Washington State, Thurston, and Adjacent Counties**

| | Estimate | | | Percent of | Change | | Projections | | |
|---|---|---|---|---|---|---|---|---|---|
| Jurisdiction | 1990 | 2000 | 2007 | 2007 Pop. | 90-00 | 00-07 | 2010 | 2020 | 2030 |
| Grays Harbor County | 10,147 | 10,321 | 12,114 | 17.10% | 1.70% | 17.40% | 10,709 | 13,091 | 14,924 |
| Lewis County | 9,248 | 10,667 | 12,223 | 16.50% | 15.30% | 14.60% | 11,996 | 15,313 | 18,027 |
| Mason County | 6,251 | 8,149 | 10,181 | 18.60% | 30.40% | 24.90% | 11,266 | 16,421 | 22,792 |
| Pierce County | 61,062 | 71,620 | 81,399 | 10.30% | 17.30% | 13.70% | 89,367 | 134,579 | 192,599 |
| **Thurston County** | **18,707** | **23,629** | **29,553** | **12.40%** | **26.30%** | **25.10%** | **33,656** | **59,111** | **81,702** |
| Washington State | 571,403 | 662,148 | 752,560 | 11.60% | 15.90% | 13.70% | 818,437 | 1,231,193 | 1,659,664 |

**Sources**: Washington State Office of Financial Management, Forecasting Division, 2007 Growth Management Population Projections; 2007 Population Trends.

**Table 3.16: Gender by Age Categories Thurston County Jurisdictions, 2000**

| | Male | | Female | | | 0-17 Years | | 18-64 Years | | 65 & Over | | Total Population | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Jurisdiction | Number | Percent | Number | Percent | Median age | Number | Percent | Number | Percent | Number | Percent | Number | Percent |
| Bucoda | 328 | 52.2% | 300 | 47.8% | 34.4 | 187 | 29.8% | 388 | 61.8% | 53 | 8.4% | 628 | 100% |
| Lacey | 14,918 | 47.8% | 16,308 | 52.2% | 34.2 | 8,226 | 26.3% | 18,841 | 60.3% | 4,159 | 13.3% | 31,226 | 100% |
| Olympia | 20,319 | 47.8% | 22,195 | 52.2% | 36.0 | 9,120 | 21.5% | 27,722 | 65.2% | 5,672 | 13.3% | 42,514 | 100% |
| Rainier | 740 | 49.6% | 752 | 50.4% | 34.0 | 456 | 30.6% | 908 | 60.9% | 128 | 8.6% | 1,492 | 100% |
| Tenino | 691 | 47.8% | 756 | 52.2% | 34.2 | 431 | 29.8% | 809 | 55.9% | 207 | 14.3% | 1,447 | 100% |
| Tumwater | 6,007 | 47.3% | 6,691 | 52.7% | 36.2 | 2,943 | 23.2% | 8,035 | 63.3% | 1,720 | 13.5% | 12,698 | 100% |
| Yelm | 1,544 | 46.9% | 1,745 | 53.1% | 30.8 | 1,051 | 32.0% | 1,884 | 57.3% | 354 | 10.8% | 3,289 | 100% |
| Total incorporated | 44,547 | 47.7% | 48,747 | 52.2% | N/A | 22,414 | 24.0% | 58,587 | 62.8% | 12,293 | 13.2% | 93,294 | 100% |
| Total unincorporated | 56,996 | 50.0% | 57,065 | 50.0% | N/A | 30,113 | 26.4% | 72,612 | 63.7% | 11,336 | 9.9% | 114,061 | 100% |
| Chehalis Reservation | 337 | 48.8% | 354 | 51.2% | 24.5 | 284 | 41.1% | 366 | 53.0% | 41 | 5.9% | 691 | 100% |
| Nisqually Reservation | 274 | 46.6% | 314 | 53.4% | 25.8 | 215 | 36.6% | 344 | 58.5% | 29 | 4.9% | 588 | 100% |
| **Thurston County** | **101,543** | **49.0%** | **105,812** | **51.0%** | **36.5** | **52,527** | **25.3%** | **131,199** | **63.3%** | **23,629** | **11.4%** | **207,355** | **100%** |
| **Washington** | **2,934,300** | **49.8%** | **2,959,821** | **50.2%** | **35.3** | **1,513,843** | **25.7%** | **3,718,130** | **63.1%** | **662,148** | **11.2%** | **5,894,121** | **100%** |

**Source**: U.S. Census Bureau, Census 2000.

**Explanation**: 1Data is for reservation as a whole, including those portions outside Thurston County..

## Poverty

Poverty statistics can be a useful tool when assessing the special needs of vulnerable populations in disaster planning processes and targeting out-reach efforts. Data from the 2000 Census provides a glimpse of how wealth and poverty is distributed throughout the county. Census data historically have only been available every 10 years.

The county-wide average of households earning less than $15,000 was 12 percent. In Yelm and Olympia, approximately 18 percent of households earned less than $15,000 annually. Analysis of the census data at a fine level of detail reveals that the households with the highest incomes are located in the unincorporated County, specifically, in the urban growth areas of Lacey, Olympia, and Tumwater.

It is also informative to review how income is earned or received to understand poverty and wealth distribution in the county. Household income is a measure of household earnings and income from other sources such as social security, supplemental security income, income from public assistance, and income from retirement sources. At the national level, poverty thresholds are determined by the U.S. Census Bureau depending on household size, age of householders, and number of related children.

Taking a look at federal poverty statistics, Thurston County fared slightly better than the State for overall population below poverty, with 8.8 percent of its population falling below the poverty line in 2000. This better-than-State average holds true when poverty is examined in relation to the population under 18 and over 65, and parallels closely with trends from a decade ago. When comparing the cities and towns, the heaviest rates of poverty are concentrated in the small south county town of Bucoda, which has about triple the county average. Other south county cities and towns have seen significant changes in the last decade and have lower numbers of households falling below the poverty level. Of the cities, Olympia has the highest rate of poverty, in part due to the concentration of social services in urban areas that are unavailable in rural settings.

**Table 3.17: Individuals Below Poverty Level, 1999**

| Jurisdiction | Total Individuals | | 18+ Years | | 65+ Years | | Related Children Under 18 Years | |
|---|---|---|---|---|---|---|---|---|
| | Number | Percent | Number | Percent | Number | Percent | Number | Percent |
| Bucoda | 162 | 25.1% | 73 | 17.0% | 1 | 2.7% | 89 | 41.2% |
| Lacey | 2,798 | 9.2% | 1,865 | 8.2% | 266 | 6.5% | 892 | 11.5% |
| Olympia | 4,982 | 12.1% | 3,982 | 12.4% | 319 | 6.3% | 935 | 10.4% |
| Rainier | 100 | 6.8% | 63 | 6.4% | 8 | 6.8% | 33 | 6.8% |
| Tenino | 132 | 9.1% | 76 | 7.5% | 20 | 9.9% | 52 | 12.4% |
| Tumwater | 1,060 | 8.5% | 748 | 7.7% | 88 | 5.2% | 269 | 9.5% |
| Yelm | 333 | 10.1% | 204 | 8.8% | 25 | 6.8% | 111 | 11.3% |
| **Thurston County** | **17,992** | **8.8%** | **12,723** | **8.3%** | **1,135** | **5.0%** | **4,953** | **9.8%** |
| Chehalis Reservation[1] | 160 | 24.4% | 81 | 21.3% | 19 | 38.8% | 78 | 28.5% |
| Nisqually Reservation[1] | 107 | 18.2% | 62 | 16.3% | 6 | 26.1% | 37 | 18.4% |
| **Washington State** | **612,370** | **10.6%** | **409,479** | **9.6%** | **47,967** | **7.5%** | **193,569** | **13.2%** |

**Source:** U.S. Bureau of the Census, 2000 Census.

**Explanations:** 1999 income used to calculate poverty statistics. Percent denotes percent of total population in specified age category. Refer to Table II-9 for total population by age category.

[1]Data is for the reservation as a whole, including those portions outside Thurston County.

# Economics

## Median Household Income

Median household income measures the point at which half of all households earn more income and half of all households earn less. It measures money income only and does not include additional benefits such as employer contributions to pension plans and medical benefits.

Thurston County's median household income was estimated at $55,766 in 2005[6]. The county continues to have a higher median household income than adjacent counties, and moved above the state average during the last decade.

Between Census years, estimates of income are only available at the county-wide level. The most recent income statistics at the jurisdictional level are from the 2000 Census. Income from the 2000 Census reflects 1999 earnings. While the 2000 county-wide median household income was $46,975, income ranged widely between the local jurisdictions. Lacey continues to record the highest of the incorporated jurisdictions with a median of $43,848. In the past, the south county towns and cities have had a substantially lower median household income than the north county cities. Data from the 2000 Census, however, shows that for median household income, Rainier ranks third among the county's cities.

## Table 3.18: Household Income, 1999

| 1999 Income | Bucoda | Lacey | Olympia | Rainier | Tenino | Tumwater | Yelm | Thurston County[1] | Chehalis Reservation[2] | Nisqually Reservation[2] |
|---|---|---|---|---|---|---|---|---|---|---|
| Less than $10,000 | 7.1% | 7.6% | 10.3% | 5.9% | 10.0% | 5.7% | 10.1% | 6.6% | 14.5% | 11.1% |
| $10,000 to $14,999 | 7.7% | 5.0% | 7.2% | 7.1% | 7.2% | 5.2% | 8.3% | 5.2% | 9.1% | 5.0% |
| $15,000 to $24,999 | 22.4% | 12.6% | 13.4% | 7.5% | 14.5% | 13.4% | 12.2% | 11.1% | 16.7% | 11.1% |
| $25,000 to $34,999 | 13.8% | 13.0% | 13.5% | 15.4% | 19.3% | 14.4% | 12.4% | 12.8% | 24.2% | 22.8% |
| $35,000 to $49,999 | 19.4% | 19.7% | 15.7% | 23.5% | 16.1% | 19.6% | 21.0% | 17.8% | 18.8% | 15.0% |
| $50,000 to $74,999 | 19.9% | 24.5% | 20.5% | 27.9% | 23.5% | 20.3% | 24.9% | 23.9% | 9.7% | 17.2% |
| $75,000 to $99,999 | 2.6% | 10.1% | 9.8% | 9.3% | 3.7% | 11.5% | 6.8% | 11.8% | 4.8% | 13.3% |
| $100,000 to $149,999 | 3.6% | 6.0% | 7.3% | 1.6% | 4.6% | 7.1% | 3.3% | 7.9% | 2.2% | 4.4% |
| $150,000 to $199,999 | 1.0% | 0.9% | 1.2% | 1.4% | 0.4% | 1.1% | 0.7% | 1.4% | 0.0% | 0.0% |
| $200,000 or more | 2.6% | 0.6% | 1.0% | 0.4% | 0.9% | 1.6% | 0.2% | 1.5% | 0.0% | 0.0% |
| **Total** | **100.0%** | **100.0%** | **100.0%** | **100.0%** | **100.0%** | **100.0%** | **100.0%** | **100.0%** | **100.0%** | **100.0%** |
| Median Income | $34,286 | $43,848 | $40,846 | $42,955 | $34,526 | $43,329 | $39,453 | $46,975 | $30,000 | $35,000 |
| # of Households | 196 | 12,351 | 18,673 | 506 | 571 | 5,587 | 1,206 | 81,666 | 186 | 180 |

**Source:** U.S. Bureau of the Census, 2000 Census.

**Explanations:** Income earned by all household members 15 years of age and older. 2000 Census reflects 1999 income. Numbers may not add due to rounding.

[1]Data includes both incorporated and unincorporated Thurston County.

[2]Data is for the reservation as a whole, including those portions outside Thurston County.

## Employment and Jobs

The largest share of county jobs is in the government sector. State employment accounts for almost 24,000 jobs in Thurston County.[7] On a statewide per-capita basis, state employment has remained relatively steady at around 16 state employees per 1,000 people throughout the 1990s and 2000s.[8]

Thurston County has experienced a swell in the number of service industry jobs that increased its market share from 10 percent of the total county jobs in 1970, to 15 percent in 1980, and currently 23 percent in 2000. The services sector is a diverse grouping of industries. Not only does it include the hotel, recreation, and repair services that people traditionally associate with this sector, it also includes the health professions and professional services such as accounting, architecture, legal services, and engineering.

Natural hazard mitigation planning is needed at the business/employer level to address the safety of employees and to limit damage to commercial and industrial facilities and infrastructure. Thurston County's workers are highly mobile, often commuting from surrounding counties to jobs in and outside Thurston County. Employees have considerable dependence on the transportation and communications networks. Prior to a natural hazard event, it is important for employers to prepare emergency plans that prepare the workplace for natural hazards, prevent loss of life and property, as well as reunite employees with their families following a disaster.

**Table 3.19: Top Employers in Thurston County, 2008**

| Employer | Employees |
|---|---|
| State Government, including education | 20,000-25,000 |
| Local Government, including education | 10,000-15,000 |
| Providence St. Peter Hospital | 1,000-5,000 |
| Tribal Government | 1,000-5,000 |
| Federal Government | 500-1,000 |
| Group Health Cooperative | 500-1,000 |
| Great Wolf Lodge | 500-1,000 |
| Columbia Capital Medical Center | 100-500 |
| Wal-mart | 100-500 |
| Saint Martin's College | 100-500 |
| Costco Wholesale Corporation | 100-500 |
| Safeway | 100-500 |
| Target | 100-500 |
| Cabela's | 100-500 |

Source: The Olympian

**Table 3:20: Total Full-Time and Part-Time Employment NAICS Categories, Thurston County, 2002-2006**[9]

| | | | | | |
|---|---|---|---|---|---|
| **Total employment** | 115,465 | 118,440 | 121,301 | 124,663 | 129,244 |
| Wage and salary employment | 94,415 | 97,041 | 98,292 | 100,926 | 104,245 |
| Proprietors employment | 21,050 | 21,399 | 23,009 | 23,737 | 24,999 |
| Farm proprietors employment | 1,009 | 971 | 954 | 951 | 934 |
| Nonfarm proprietors employment 2/ | 20,041 | 20,428 | 22,055 | 22,786 | 24,065 |
| **Farm employment** | 1,734 | 1,771 | 1,652 | 1,557 | 1,575 |
| **Nonfarm employment** | 113,731 | 116,669 | 119,649 | 123,106 | 127,669 |
| Private employment | 77,534 | 80,455 | 83,426 | 86,398 | 90,452 |
| Forestry, fishing, related activities, and other | 1,321 | 1,294 | 1,439 | 1,418 | 1,443 |
| Mining | 132 | 131 | 149 | 119 | 124 |
| Utilities | 152 | 158 | 198 | 233 | 249 |
| Construction | 5,996 | 6,327 | 6,868 | 7,193 | 7,992 |
| Manufacturing | 3,511 | 3,485 | 3,338 | 3,249 | 3,291 |
| Wholesale trade | 1,994 | 2,183 | 2,624 | 2,838 | 3,286 |
| Retail trade | 13,439 | 14,153 | 14,015 | 14,355 | 14,719 |
| Transportation and warehousing | 1,647 | 2,127 | 2,197 | 2,451 | 2,518 |
| Information | 1,456 | 1,426 | 1,487 | 1,512 | 1,598 |
| Finance and insurance | 3,449 | 3,468 | 3,518 | 3,904 | 4,096 |
| Real estate and rental and leasing | 3,823 | 4,073 | 4,135 | 4,308 | 4,667 |
| Professional and technical services | 5,221 | 5,374 | 6,044 | 6,234 | 6,461 |
| Management of companies and enterprises | 416 | 439 | 486 | 520 | 544 |
| Administrative and waste services | 5,202 | 5,232 | 5,485 | 5,581 | 5,675 |
| Educational services | 2,168 | 2,345 | 2,522 | 2,607 | 2,752 |
| Health care and social assistance | 12,152 | 12,275 | 12,210 | 12,701 | 13,016 |
| Arts, entertainment, and recreation | 2,126 | 2,204 | 2,287 | 2,381 | 2,466 |
| Accommodation and food services | 6,585 | 6,640 | 6,855 | 7,315 | 7,747 |
| Other services, except public administration | 6,744 | 7,121 | 7,569 | 7,479 | 7,808 |
| **Government and government enterprises** | 36,197 | 36,214 | 36,223 | 36,708 | 37,217 |
| Federal, civilian | 990 | 999 | 987 | 993 | 970 |
| Military | 816 | 824 | 816 | 788 | 777 |
| State and local | 34,391 | 34,391 | 34,420 | 34,927 | 35,470 |
| State government | 23,327 | 23,306 | 23,557 | 23,948 | 23,988 |
| Local government | 11,064 | 11,085 | 10,863 | 10,979 | 11,482 |

## Agriculture

Agriculture remains an important component of Thurston County's economy. Activity on farms is varied, and ranges from tree farming to growing berries, to egg farms and organic farming. Much of the economic viability of farming is tied to access to local markets. This access needs to be addressed in natural hazard mitigation planning to minimize economic loss and loss of goods.

The 2002 Census of Agriculture revealed that there were 1,155 farms operating in Thurston County in 2002, designating over 74,442 acres of land to agriculture. While the number of farms has increased since 1987, the average size of farms has decreased from 70 acres to 64 acres; more small farms are being established in the County. The total value of all crops, including nursery crops, increased from over $19 million in 1992 to over $36 million in 1997. The total net cash from agriculture sales increased accordingly, from $8.6 million in 1992 to $22.5 million in 1997.

## Transportation

### Regional Transportation System

Communities throughout Thurston County adopted comprehensive strategies to meet the mobility needs of people, goods, and services well into the future. These strategies address all aspects of the region's transportation system, including streets and roads, public transportation, rail, bicycle and pedestrian facilities, and marine and aviation facilities (See Map 3 – Transportation Infrastructure). To ensure the system works seamlessly, individual efforts of local agencies are guided by principles established in the Regional Transportation Plan.

### Intercity Transit

Intercity Transit is the Public Transportation Benefits Area (PTBA) municipal corporation in the Thurston Region. Serving the community for 25 years, Intercity Transit is funded with local sales tax, transit fares, contracted services, and federal and state grants. Intercity Transit's 94 square mile service area includes the cities of Olympia, Lacey, Tumwater and Yelm (see Map 4 – IT Service Area). It is estimated that residents rode IT buses and vans around 4.3 million times in 2007. In addition to bus service in the greater Olympia area, IT operates a vanpool program, and provides accessible services to residents and commuters. In 2007, IT's vanpool program saw over 535,000 boardings, the equivalent of removing 1,000 vehicles from county roads each day. Intercity Transit's vehicle fleet consists of 98 buses, 8 fixed-route vans, 30 Dial-A-Lift vans and 171 vanpool vans,[10] five transit centers, including two main facilities in Olympia and Lacey, and primary transfer stations at Westfield Shoppingtown, Tumwater Square and Little Prairie Center; 890 bus stops, 175 bus shelters; and three park-and-ride lots. All buses are equipped with bike racks and all vehicles are ADA compliant. Buses are fueled by a cleaner, energy efficient blend of biodiesel and ultra low sulfur diesel.

Village Vans, an innovative service envisioned by the Thurston County Human Services Transportation Forum in the late 1990's, is run by Intercity Transit. The service is designed to help low income families working toward economic independence. The service operates by advanced

reservation, providing door-to-door transportation for low income individuals in their job search activities. This low cost, high impact program has helped more than 25,000 passengers, 75 percent of whom no longer rely on state assistance. The program also draws its volunteer drivers from low income job seekers, providing training and work experience as professional drivers while they are completing individualized curriculums designed to provide transferable job skills.

Intercity Transit is part of a six-county Regional Ridematch program for commuters traveling throughout the Puget Sound Region. This system helps customers identify carpool partners.

Intercity Transit provides two Community Vans. These 12-passenger vans, retired from the vanpool fleet, are available to non-profit and governmental agencies on a reservation basis. The transit agency houses, maintains, fuels and insures the vans, charging a per-mile rate for their use.

## Rural and Tribal Transportation (R/T)

Rural and Tribal Transportation (R/T) provides public transportation services to individuals living outside Intercity Transit's PTBA service area. It serves the southern and eastern portions of the Thurston Region, connecting to Intercity Transit and Twin Transit's (Lewis County) routes, also coordinating trips with Grays Harbor, Mason and Pierce counties. Special emphasis is placed on people with low incomes and work related trips. The service is customized differently to meet the needs of rural south and east county residents, Tribal transportation on the Nisqually Reservation and the Confederated Tribes of the Chehalis Reservation, after school programs, and senior services.

## Intercity Services

Greyhound and Northwestern Trailways provide intercity bus service, with a stop at their downtown Olympia terminal. Between the two companies, five daily trips stop in Olympia, with trips along the I-5 corridor.

The Amtrak Cascades and Coast Starlight make several daily stops at Centennial Station in the Thurston Region. The Amtrak station is run entirely by local volunteers. Intercity transit manages the parking and provides schedule bus service to the station. However, the station lies just outside Lacey's urban growth boundary, and the bus trip to downtown Olympia takes 45 minutes one way. Delays on the Coast Starlight and Cascades services make transit connections and trip planning difficult.

## Other Private and Non-Profit Programs

Many other social service programs provide transportation services to their clients. Some of the larger providers in the Thurston Region include:

Northwest Connections, the contractor for R/T, provides transportation services for Medicaid, Veterans Administration and other local and state programs. This non-profit agency is a leader in customer service and driver training.

Yelm Community Center, a multi-service community social service provider serving rural Yelm and Rainier, provides fixed route and demand response services.

A variety of senior and youth programs provide transportation services, such as the Area Agency on Aging (AAA), Senior Services of South Sound, Yelm Adult Community Center, Panorama City, Boys & Girls Clubs of Thurston County, the Rochester Organization of Families, Community Youth Services and Thurston County Parks Department.

Taxicab, cabulance, airporter and limousine services are also available to residents of the Thurston Region, although most are either designed with a specific trip purpose or tend to cost more than most public transportation options.

## Major Roads

### State Roads

The State maintained system includes the primary west coast freeway connecting Canada to Mexico. Interstate 5 runs in a north-easterly direction through the center of Thurston County, bisecting the cities of Lacey, Olympia and Tumwater. State Route 507, to the southeast of I-5, parallels its route, acting as a main street to the smaller communities of Bucoda, Tenino, Rainier and Yelm. State Route 510 connects I-5 to SR 507 through Lacey, the Nisqually Indian Reservation and Yelm. Scenic US Highway 101 begins its west coast route in Olympia, at its intersection with I-5. Continuing west, US 101 branches with State Route 8 at Mud Bay, the southernmost inlet of Puget Sound. SR 8 is paralleled in south Thurston County by US Highway 12, running west from I-5 through the communities of Grand Mound, Rochester, and the Confederated Tribes of the Chehalis Reservation. State Route 121, a loop route off I-5 in central Thurston County, provides access to Millersylvania State Park.

These state routes run through the hearts Thurston County's incorporated communities. I-5, built in the early 1960s, divides the northern cities, literally severing many of the local roadway connections. As a result, the state highways are used as part of the local arterial network in the Thurston Region. These same routes are also used for long distance trips, many of them through trips, moving people and goods into and out of central Puget Sound. The combined need to move people and goods both locally and around the Puget Sound region is increasing congestion on State routes in the Thurston Region. Demand for these facilities is expected to increase substantially as 1) more freight moves through the region, and 2) more commuters cross the County's boundaries to get to work.

### Local Roads

The cities and County maintain an extensive network of local roads. The most heavily used north-south arterials include:

- Black Lake Boulevard
- Littlerock Road
- Capitol Way/Capitol Boulevard/Old Highway 99
- Lilly Road
- Sleater-Kinney Road

- College Street/Rainier Road
- Marvin Road

The heavily traveled east-west arterials include:

- Mud Bay Road/Harrison/Fourth Avenue/State Street/Martin Way
- Britton Parkway
- Pacific Avenue
- Yelm Highway
- Deschutes Parkway
- Israel Road
- Tumwater Boulevard
- 93rd Avenue
- Maytown Road

### Tribal Roads

Reservation roadways and non-motorized facilities are maintained by the Nisqually Indian Tribe (northeast Thurston County) and the Confederated Tribes of the Chehalis Reservation (southwest Thurston County). In recent years, the Chehalis Tribes completed major improvements to Anderson Road and 188th Avenue SW, among others. The Nisqually Tribe worked with WSDOT for improvements on SR 507, as well as improving local reservation roads.

Natural hazards such as earthquake, flooding, and winter storms have historically impacted the transportation system to a great degree. Roads and bridges have been rendered unusable during and following certain events. Transportation systems have been severely disrupted due to road or bridge closures. Transportation system failures during and after a disaster have caused significant economic losses and are a good focus for mitigation efforts.

## Personal Travel Trends

The challenge of efficiently maintaining and operating a system comprised of over 2,000 miles of roadway, dozens of transit routes and services, hundreds of miles of bike lanes and sidewalks, almost 90 miles of rail, a marine terminal, and a regional airport is compounded by trends in personal travel. While population in the county has increased at an average annual rate of 3.1 percent from 1970 to 2006, vehicle registration during the same time period increased by 5.2 percent per year. This is compatible with trends in household vehicle ownership. In 1960, 67 percent of households in the region owned one or fewer vehicles, by 2000 only 36 percent of households owned one or fewer vehicles. The changes between 1960 and 2000 are most pronounced in the households with three or more cars. A mere 5 percent of households had three or more vehicles in 1960. By 2000, 24 percent, or about one in four households, owned three or more vehicles.[11]

## Present and Future Commuting Trends

In 2000, nearly 27,000 workers commuted out of Thurston County to work. By far, the largest number of the region's outbound commuters work in Pierce County (more than half). King County is the next most frequent commute destination (one-fifth of the outbound commuters). Commuters also traveled to Lewis County, with fewer trips to Mason, Grays Harbor, Kitsap and Snohomish counties. Additionally, approximately 3,500 commute trips flowed northbound through Thurston County by residents from counties to the south and west going to work north of Thurston County. Another 1,400 commuters traveled southbound, with homes north of Thurston County and jobs south of here.

The outbound commuting picture had changed somewhat by 2005. Just over 29,000 workers commuted out, still mostly to Pierce County (more than 60 percent). Due to the impact of the recession of the early 2000s, commuting to King County dropped from over 5,000 to about 3,000, comparable to the number of commuters to Lewis County. Outbound commuters continued to travel to Mason, Grays Harbor and other counties as well.

By 2025, the number of outbound commuters is expected to nearly double to about 56,000 commuters. An even greater percentage and actual number will travel north to Pierce and King counties, the primary focus of job creation in the Puget Sound region.

Nearly 15,000 workers commuted to Thurston County for work in 2000 according to the Census. About one-third live in Pierce County, followed by Mason, Lewis, King, and Grays Harbor counties. The number of inbound commuters increased to 20,000 by 2005, with about the same distribution of origins. Between 2000 and 2025, inbound commuting to Thurston County will have doubled to more than 30,000 trips during the morning peak period. The majority of workers will still live in Pierce County, however increasing shares will travel from Mason, Grays Harbor and Lewis counties (about half the inbound commuters all totaled).

These inbound commuters traveled primarily to Olympia and its urban growth area in 2000 (8,000 commuters or 55 percent). By 2025, this will increase to more than 13,000 inbound commuters. Olympia's share of the inbound commuters, however, drops to 44 percent, with larger shares traveling to Lacey and Tumwater. This follows the trend over recent years in state jobs moving from Olympia to Tumwater and Lacey.

## Freight/Cargo Transportation

Transporting and managing freight represented a 9 trillion dollar U.S. industry in 1998, expected to grow to 30 trillion dollars by 2020. Much of this traffic is managed through or near ports. Thurston County is situated on the main truck and rail corridors serving the Pacific Northwest complex of mega ports, Vancouver, B.C., Seattle, Tacoma, and Portland/Vancouver, as well as on the primary West Coast corridor additionally serving Los Angeles, Long Beach, and a host of other Ports, including the Port of Olympia. Freight shipments to, from, and within Washington State accounted for 477 million tons of goods in 2002, an amount projected to more than double to 976 million tons by 2035. Much of that freight will move through Thurston County.

The largest volumes of freight moved in Washington State include lumber/wood products, nonmetallic minerals, farm products, food/kindred products, and general freight. While volumes are projected to grow in all these categories, food/kindred products and general freight will see the largest increases, projected to more than double by 2020. The highest value products include transportation equipment, food/kindred products, general freight, machinery, and chemicals/allied products. The value of these products is expected to at least double, quadrupling in some cases by 2020. Primarily, these are products destined for domestic markets.

### Marine & Aviation – Port of Olympia

The citizens of Thurston County created the Port of Olympia in 1922. The Port District's boundaries are countywide and its primary holdings are located in Tumwater and Olympia with airport and marine terminals.

The marine terminal is located on the Port Peninsula in Budd Inlet. It provides a full range of services including breakbulk, roll-on/roll-off, bulk, forest products, and containerized cargo handling. This multimodal facility serves ocean-going and short-sea vessel, truck, and rail cargos. The marine terminal's focus is specialized services for its customers. The Port of Olympia plays a strategic role in serving the Puget Sound freight market. Its specialty services complement those provided on Puget Sound in Seattle and Tacoma, and will become increasingly important as mega port containerized demand grows, squeezing out specialized services for all but the super carriers at these super ports. The marine terminal can accommodate up to three vessels at one time. Historically, primary cargoes included logs, lumber, and food products. This has expanded in recent years to include a wide variety of bulk commodities and equipment. The Port's marine terminal also supports the deployment of equipment and supplies from Fort Lewis, as well as military installations from California and other states.

The Olympia Airport is among the first public airports in the country. It was created in 1927, with the Port of Olympia assuming ownership in 1963. Located near Interstate 5 in Tumwater, the airport's facilities include aircraft service operations, hangars, corporate offices, and a public terminal. Tower-controlled and full-instrument approach provides access on two runways for corporate, commercial and recreational users, including light freight aircraft. The 100-acre industrial aviation district at the airport supports air-oriented manufacturing and warehousing.

Near the airport, the Port's New Market Industrial Campus offers over 500 acres of commercial, corporate, mixed and warehousing, distribution and light industrial uses, with good access to Tumwater Boulevard and Interstate 5. While still developing, the area is home to a variety of distribution, manufacturing, service, lodging and commercial/retail businesses, some of which rely on aviation access.

### Industrial Activity

Freight transportation is closely associated with industrial activity, especially manufacturing. A host of industries manufacture products in Thurston County and several major distribution hubs have opened here along the Interstate 5 corridor. Some of the larger manufacturing employers include bottling, box and can plants, plastic products, concrete, windows, and lumber. These and many other

small- and medium-sized industries contribute to locally generated freight flows. The region has several manufacturing hubs, such as Olympia's Mottman Industrial Park, the Hawks Prairie area in Lacey, and the Port's marine terminal, airport and New Market Industrial Campus. The local freight industry itself, especially warehousing, trucking, marine and air cargo, has been growing steadily for many years. The new distribution centers have brought additional employment to Thurston County's freight sector. This, however, is balanced by the loss in recent years of some of the larger manufacturing employers, such as the brewery in Tumwater.

### Truck

About two thirds of all freight shipped to, from, and within Washington moves by truck, an amount that is expected to grow 105 percent between 2002 and 2035, with the value of those goods growing over 200 percent. While Interstate 90, U.S. 395, and State Route 12 will carry some of the volumes, the majority will be transported on Interstate 5 between Everett and Vancouver, WA, passing through Thurston County. The number of local freight transportation employees continues to steadily increase as well. Truck traffic will have a continuing impact on the region's transportation system. For example, in 2001, trucks accounted for 26 percent of all southbound traffic leaving Thurston County on Interstate 5 during the day (6 a.m. to 6 p.m.), and 35 percent at night (6 p.m. to 6 a.m.).

### Rail

Washington's main north/south rail line also runs through Thurston County. The primary freight rail flows connect Chicago, IL and Omaha, NE with Western Washington, traveling along the Columbia River and the north/south Burlington Northern Santa Fe (BNSF) mainline to/from Puget Sound. Rail freight in Washington State is forecast to nearly double in volume by 2035 and increase in value by 43 percent. This means Thurston County will see a significant increase in train traffic moving through the region.

Thurston County has nearly 90 miles of rail lines. Active rail includes portions of the Tacoma Rail Mountain Division, BNSF St. Clair Line, the Puget Sound and Pacific Railroad and the BNSF mainline. These make important intermodal connections at the Port of Tacoma and in Centralia. Also active, the Union Pacific branch line connects the Port of Olympia with the BNSF mainline, as well as connecting to another branch of BNSF serving Olympia's Mottman Industrial Area. The Port of Olympia's Marine Terminal is served by Tacoma Rail. The Yelm Prairie Line, owned by the City of Yelm, connects to their industrial area, although this portion of the Prairie Line is currently inactive.

Thurston County was previously traced with a web of small logging railroads as well as now defunct lines originally owned by the national railroads. Some of these, most notably the Chehalis Western, Yelm-to-Tenino (Prairie Line), Lacey and Olympia Woodland (St. Clair), and Gate-to-Belmore, are converted to, or held for, pedestrian and bicycle trails.

## Energy Transmission

Map 3.6 shows major electric, natural gas, and liquid fuel transmission utility corridors in Thurston County.

## Local Government Structure

In Washington State there are two different types of local governments: "general-purpose" and "limited-purpose." Counties, cities, and towns fall under the general-purpose government category by performing broad functions, providing a variety of public services, and representing local citizens. Limited-purpose governments, also referred to as special purpose districts, provide specific services to defined populations. Services that general-purpose and limited-purpose governments provide are not mutually exclusive. For example, water service can be supplied by a city, town, or special purpose district. The local government structure in Washington State is relatively flexible by allowing citizens to decide which services would be better provided by general-purpose or limited-purpose governments.

In Thurston County, there are seven incorporated cities/towns: Bucoda, Lacey, Olympia, Rainier, Tenino, Tumwater, and Yelm, which are independent municipalities. Bucoda, Rainier, Tenino, Tumwater, and Yelm all are represented by a Mayor and Council structure where the Council members and the Mayor are selected by public election. Olympia and Lacey have a Manager and Council administration where the Council members are selected by public election and the Council appoints the Manager. A Mayor may also be part of the administration in a Manager-Council structure. Thurston County government administers the remaining, unincorporated, part of the county which is represented by a three member Commission that is selected by public election.

Besides the eight general-purpose governments, Thurston County has several limited-purpose governments that provide a variety of functions, which include but are not limited to cemetery, parks and recreation, fire districts, and a library district. Also, within the county, the Nisqually Indian Reservation is governed by the Nisqually Tribal Council and the Confederated Tribes of the Chehalis Reservation is governed by the Chehalis Tribal Business Council.

### Timberland Regional Library

The Timberland Regional Library (TRL) District has 27 branches in five counties, Grays Harbor, Lewis, Mason, Pacific, and Thurston, and serves over 449,000 people. In 2007, TRL circulated nearly 4.8 million items and had 314,010 library cardholders. Thurston County libraries serve nearly half of Timberland Regional Library population base with five branches located in Lacey, Olympia, Tumwater, Yelm, and Tenino. The cities of Bucoda and Rainier have annexed to the library district for services[12].

## Public Health and Safety

### Adult Correctional Facilities

The Thurston County Corrections Facility has a total operational bed capacity of 408 inmates which consists of twelve general population housing units including intake, minimum, medium and maximum security, female unit, female work release and inmate worker unit, medical/protective custody unit; and disciplinary lockdown unit.

In addition to the general population units, the Corrections Facility provides direct supervision minimum-security beds in Post 6 and Chemical Dependency and internal inmate worker program beds in Post 5. Both are located in the basement part of the facility.

The Correctional Options annex houses up to 92 inmates serving sentences in work release and community betterment labor projects. The Annex also serves as the processing and monitoring center for up to 100 additional court-ordered offenders on Correctional Options Programs (i.e., Electronic Monitoring, Day Reporting, and Day Jail).

The average daily population for 2006 including General Population, Work Release, and Correctional Options Programs was 504[13].

## Juvenile Correctional Facilities

Juvenile detention and correctional facilities in Thurston County include a county juvenile detention center and a state correctional facility. The Thurston County Juvenile Court is responsible for meeting the juvenile justice needs of the County for offenders under the age of 18, with extensions to age 21 for select juvenile offenders. The Juvenile Department provides legal processing of referrals, probation, detention, and rehabilitative programs for area youth and their families.

## Public Health

Several agencies provide information to keep citizens well informed of the dangers of natural disasters, how to respond to the dangers associated with the events (before, during and after), and list emergency contacts for agencies at the disposal of victims of natural disasters.

### Thurston County Public Health and Social Services Department[14]

The Thurston County Public Health and Social Services Department is responsible for promoting and protecting the health of Thurston County citizens. The four major areas within the department are Personal Health Services, which provides services to prevent illnesses and chronic diseases; Environmental Health, which monitors and responds to environmental conditions and issues that may impact the public's health; Social Services, which contracts to provide and coordinate mental health, chemical dependency and developmental disabilities services in Thurston and Mason counties; and Administration, which provides for the management and oversight of the department and includes a role in community leadership and planning.

### Washington State Department of Health[15]

The Department of Health works with its federal, state and local partners to help people in Washington stay healthier and safer. Their programs and services help prevent illness and injury, promote healthy places to live and work, provide education to help people make good health decisions and ensure our state is prepared for emergencies.

The Thurston County Public Health and Social Services Department is the local health department under the Washington State Department of Health.

## Health Services[16]

Though there are numerous health care clinics and providers in Thurston County, in general there are three major health care service providers in the county.

### Providence St. Peter Hospital

Providence St. Peter Hospital is a 390-bed, not-for-profit regional teaching hospital founded by the Sisters of Providence in 1887. Located in Olympia, the state capital, Providence St. Peter Hospital offers comprehensive medical, surgical, and behavioral health services.

### Capital Medical Center

Capital Medical Center is a 119-bed hospital, with one general family practice clinic, serving all of Thurston and surrounding counties. Capital Medical Center is a forward thinking, innovative organization where trust and teamwork come together to respond to the needs of the greater community it serves.

### Group Health Cooperative

Founded in 1947, Group Health is a consumer-governed, nonprofit health care system that coordinates care and coverage. Based in Seattle, Group Health and its subsidiary health carriers, Group Health Options, Inc. and KPS Health Plans, serve approximately 568,344 members in Washington and Idaho.

## Law Enforcement

There are a total of nine agencies responsible for law enforcement in Thurston County. The City of Olympia and Thurston County have the largest number of total full-time employees. Law enforcement employees do not include those employed by correctional facilities.

### Thurston County Sheriff's Office[17]

***Operations Bureau***

The Bureau consists of two Divisions, Patrol and Detectives. These two divisions are responsible to provide most of the Law Enforcement services to the residents of the unincorporated County. Several specialty units operate within the Bureau such as S.W.A.T., Marine Services, Hostage Negotiations, Traffic, Narcotics, Special Enforcement Team, Riot Team and members of the Identity Theft Task Force.

The Patrol Division provides uniformed patrol services 24 hours a day, seven days a week. Patrol Deputies are the first responders to various emergencies including crimes in progress. They also do the initial investigations in most crimes reported in the County.

The Division also has a Traffic Enforcement Unit and is responsible for the S.W.A.T. team and Marine Services unit.

The Detective Division is primarily responsible for investigating crimes referred from the Patrol Division such as Arson, Sex Offenses, Identity Theft, Domestic Violence, and Auto Theft. The Division also provides services such as Sex Offender Registration, Evidence and Crime Scene Processing and Narcotics enforcement.

***Services Bureau***

The Services Bureau is responsible for the Civil, Records, Warrants, and Training Divisions within the Sheriff's Office. The Front Desk, Search & Rescue, Jeep Patrol, Mounted Patrol, Crime Prevention, and the Dive Team are also assigned to the Services Bureau.

### Washington State Patrol (District One)[18]

Thurston and Pierce Counties make up District 1 of the Washington State Patrol. A detachment office for Thurston County is located in Olympia. The three detachments of line troopers and sergeants who work out of this office are assigned to patrol duties in Thurston County and are responsible for enforcement efforts on interstate and state routes, with additional collision investigation responsibility on 995 miles of county roads.

Among the stated goals of District 1 is a dedication to Community outreach to encourage, develop, and nurture interagency partnerships at the local, state, and federal level in support of community interests.

### Washington State Department of Transportation (Olympic Region)[19]

The Olympic service region of the Washington State Department of Transportation includes Thurston, Pierce, Grays Harbor, Mason, Kitsap, Jefferson and Clallam Counties.

Highways in the State of Washington are operating at or above capacity and a blocked highway lane can result in miles of backups and long delays. A large portion of all congestion on urban freeways is caused by collisions, disabled vehicles, spills, and other events that impede the normal flow of traffic. As a result, four to ten minutes of traffic congestion (depending on the volume of traffic on the road) can result from every minute a lane remains blocked.
The average Washington motorist spends two weeks of every year stuck in traffic so it's easy to see why the Incident Response Team (IRT) serves a crucial role in keeping Washington on the move. IRT staff are a specially trained group of WSDOT maintenance employees who respond to blocking incidents on our state's freeways and highways. Their main function is to clear roads and help drivers and restore the normal flow of traffic as safely and quickly as possible.

Motorist and incident scene safety is the IR program's top priority. This priority is accomplished through safe, quick responses and incident clearance. Any incident has the potential for creating secondary incidents such as vehicles running out of fuel or overheating, or collisions that occur in the backup as a result of lane changing and rapid braking. The quicker the original incident is cleared, the less time motorists and response personnel are exposed to traffic hazards and the possibility of secondary collision.

The following entities are also involved with Incident Response:

- Washington State Patrol Troopers, Communication Center personnel and Cadets
- Local fire departments, police, and emergency medical service providers
- Private tow truck companies
- WSDOT Traffic Management Center (TMC) personnel
- WSDOT maintenance crews (providing equipment and traffic control as needed)
- Privately sponsored motorist assistance vans
- Dept. of Ecology and US Coast Guard (when spill clean-up is necessary)

### Crime Stoppers[20]

Crime Stoppers of the Olympia/Thurston County area is a joint effort of private citizens, the media and local law enforcement agencies to apprehend criminals. Since its inception on February 28, 1991, Olympia / Thurston County Crime Stoppers has cleared 844 cases, arrested 850 suspects, paid over $152,000 in rewards, recovered $1,617,450 in stolen property, recovered $6,790,451 in narcotics, has had 850 prosecutions and 842 convictions.

The local Crime Stoppers program depends on the full cooperation of the police departments of Lacey, Olympia and Tumwater and the Thurston County Sheriffs Office working closely with The Olympian, local radio stations KXXO, KGY, cable television and local citizens. An eleven member board approves the rewards and raises the funds for its operation. No government funds are used. The information received and other activities are coordinated by officers of one of the above law enforcement agencies.

## Fire Protection

Fifteen fire districts and three city fire departments in Olympia, Tumwater, and Bucoda serve residents of Thurston County. Fire protection for Lacey is provided by Fire District #3. Fire districts also provide Emergency Medical Services (Medic One), funded by a countywide special levy administered by the County (see Map - 6 Fire Districts). Table 3.21 shows the size and population of each fire district and also provides a forecast of future population through 2030.

## Other Agencies & Plans

### 9-1-1 CAPCOM (Capital Communications)[21]

CAPCOM is a countywide Enhanced 9-1-1 Public Safety Answering Point (PSAP) and Dispatch Center for all Public Safety Police, Fire and Medic One departments serving all of the cities, towns and unincorporated areas within Thurston County. It was formed in 1970, and consolidated from separate police and fire dispatch locations prior to that time. There are 7 police agencies offering police protection, and 18 fire departments that offer fire protection and tiered emergency medical response, which is overseen by the Medic One System.

**Table 3.21: Population Estimate and Forecast by Fire District, Thurston County 2008-2030**

| Fire District | District Name | Preliminary Estimate 2008 | Forecast 2010 | 2015 | 2020 | 2025 | 2030 |
|---|---|---|---|---|---|---|---|
| | Bucoda | 660 | 670 | 700 | 800 | 900 | 1,050 |
| | Olympia | 44,960 | 48,700 | 53,440 | 57,800 | 61,370 | 64,510 |
| | Tumwater[1] | 17,280 | 18,720 | 20,290 | 23,120 | 26,750 | 29,860 |
| 1 | Littlerock/Rochester | 21,730 | 21,890 | 24,420 | 28,200 | 31,080 | 33,660 |
| 2 | Yelm | 15,830 | 17,540 | 22,160 | 27,290 | 31,570 | 35,840 |
| 3 | Lacey | 84,040 | 86,180 | 95,920 | 106,030 | 114,190 | 121,240 |
| 4 | Rainier | 5,110 | 5,490 | 6,150 | 6,930 | 7,610 | 8,090 |
| 6 | East Olympia | 12,320 | 12,710 | 14,190 | 15,710 | 16,710 | 17,430 |
| 7 | North Olympia | 4,180 | 4,090 | 4,300 | 4,510 | 4,650 | 4,730 |
| 8 | South Bay | 7,690 | 7,620 | 8,580 | 9,650 | 10,530 | 11,050 |
| 9 | McLane/Black Lake | 15,740 | 15,770 | 16,830 | 18,500 | 20,030 | 21,420 |
| 12 | Tenino | 5,960 | 6,130 | 7,220 | 8,410 | 9,610 | 10,580 |
| 13 | Griffin | 5,350 | 5,520 | 5,960 | 6,380 | 6,700 | 6,870 |
| 16 | Gibson Valley | 560 | 580 | 740 | 970 | 1,220 | 1,430 |
| 17 | Bald Hills | 3,840 | 3,900 | 4,050 | 4,630 | 5,000 | 5,170 |

**Source:** TRPC - Small Area Population Estimates; Population and Employment Forecast Work Program, 2004/2005, 2007 update.
**Explanations:** Data is for Thurston County portion of fire districts only. 1 adjusted number in 2010. Numbers may not add due to rounding.
[1]Tumwater Fire Department provides services to FD15 Mann Lake and is reflected in Tumwater's values in this table.

The center operates 24 hours per day and 7 days per week to answer both 9-1-1 and 7 digit emergency calls from the public, insuring an appropriate level of response is sent based on protocols provided by and agreed to by local law enforcement and fire agencies.

## Consolidation

The consolidation of dispatch and 9-1-1 services was viewed as a clear benefit to the citizens of the county. By coming together it allowed all emergency telephone calls to be answered in a central location and all police, fire and emergency medical dispatches handled through a single agency.

To effect this consolidation it was clear that to protect the interest of each and every participating department a separate set of Boards needed to be established to ensure autonomy for the department and prevent any one jurisdiction from controlling the direction of the consolidated effort.

In 1999, the department was relocated to the Thurston County Emergency Services Center in Olympia. The building houses CAPCOM, Medic One and Thurston County Emergency Management.

The Department operates as a County department under county rules and regulations. Because of its 24-hour operation and essential services function, some variances have been made to those rules to assure its ability to fulfill its mission.

There are numerous major systems operated by CAPCOM for the safety of all agencies served. They include:

- A Digital Private Branch Exchange (PBX) Telephone system the supports the entire Emergency Services Center.
- A Digital 9-1-1 Telephone system
- 9-1-1 Operating Positions
- Telephone Device for the Deaf (TDD) from any position within the Communications Center on any telephone line
- A Law Enforcement (Very High Frequency) VHF repeater radio system, 3 Channels
- A Fire/EMS VHF repeater radio system, 4 Channels
- A Fire/EMS VHF simplex radio system, 3 Channels
- A 4 site Digital Microwave radio system
- A Digital Fire Simulcast radio system
- Ten remote radio sites
- A 21 position Computer Aided Dispatch (CAD) system
- 7 Remote CAD terminal locations at law enforcement locations
- Interface to Commercial Alphanumeric Paging for fire Service
- Interface to 2-tone/voice paging for fire service
- Mobile Data Computer backbone
- 111 Mobile Data Laptops (law enforcement)
- Emergency Services Center Local Area Network LAN for administrative computers

### Emergency Management Council[22]

The Emergency Management Council of Thurston County was created via an Interlocal Agreement in 1993 to coordinate the emergency management activities of the major jurisdictions of Thurston County. Presently the Council is composed of the Cities of Lacey, Olympia, Tenino, Tumwater and Yelm, the Town of Rainier, Bucoda, Thurston County, the Nisqually Indian Reservation, and the Confederated Tribes of the Chehalis Reservation.

### Thurston County Comprehensive Emergency Management Plan[23]

This plan, adopted in 1998, consists of a basic outline of emergency operations—including mitigation, preparedness, response and recovery—and the responsibilities of various entities

throughout Thurston County. There are also several functional annexes to the plan that detail how response will be handled. Some of these annexes include transportation and evacuation, search and rescue, and recovery and restoration.

### American Red Cross[24]

With offices in Tacoma, Olympia, Chehalis and Montesano, the Mount Rainier Chapter of the American Red Cross provides service to Thurston, Pierce, Mason, Lewis and Grays Harbor Counties. They provide relief assistance to victims of natural disasters and offer disaster preparedness information and online first aid and CPR courses on their website, http://www.rainier-redcross.org/.

In the floods of 2007, which affected Thurston and Lewis Counties, the Mount Rainier Red Cross assisted over 3,200 people who had been affected.

### Emergency Volunteers[25]

Throughout 1997, the Emergency Management Council of Thurston County, working with the local chapters of the American Red Cross, Volunteer Center, and Crisis Clinic, formed a core Disaster Assistance Council (DAC).

The need for a DAC was identified during and following the record floods of February 1996.

The Thurston County Emergency Operations Center (EOC) received several hundred calls from individuals and businesses offering service, labor or equipment. Those that could be used in support of government sponsored activities, such as flood fighting or debris clearance, were registered as emergency workers and used. However, the majority were offering to assist flood victims with their recovery, wanting to do such things as clean or repair houses, clear land, repair vehicles, provide building materials, prepare food, care for children and pets, and provide transportation.

Over the same period, the EOC received several hundred calls from disaster victims requesting many of the services, labor and equipment that were being offered. This required the county EOC to act as a broker between volunteers and victims, a job accepted with some reservation because there was not enough staff to do it. In the end, they could not keep up and ended up maintaining lists and doing little with them.

To prevent similar occurrences, the EMC asked the Volunteer Center and Crisis Clinic to explore ways they may be able to help the emergency management organization handle emergency volunteers.

After several months, and a couple of false starts, a core program was agreed upon and implemented in time for the 1997-98 winter storm and flood season.

The Volunteer Center will register and track all volunteers. The Crisis Clinic will provide its routine referral service, but on a much larger scale, and will also refer disaster victims to appropriate volunteer resources. Both organizations will have to supplement their staffs during a community emergency or disaster.

The DAC is anticipated to eventually grow into more than a volunteer tracking and referral service. Eventually, they envision functional groups with lead agents or agencies to better organize humanitarian services such as shelter, food procurement and preparation, donated goods management, animal care, spiritual and emotional care, and child care.

#### Faith Communities Disaster Preparedness[26]

Thurston County Emergency Management and other local partners meet with churches and other faith organizations on a quarterly basis to improve emergency preparedness and plan how to better serve the community.

The program builds upon the 3 Days, 3 Ways concept; Make a Plan, Have a Kit, Get Involved!

## Education

Thurston County has a variety of educational opportunities available to the students and adults of the community. These include both private and public primary, secondary, and higher education institutions. A number of these offer programs outside regular school hours, providing greater accessibility to working adults and students so that they may meet their educational goals.

### Public Schools

Eight school districts provide primary and secondary education to most of Thurston County's students (see Map 7 - School Districts). School districts in Thurston County provide a wide variety of services and opportunities for students, including the Head Start program for preschoolers, advanced placement courses for high school students, and numerous community-based learning experiences for all ages.

School districts in the county range in size from rural Griffin, with a total of 677 students district-wide, to the more urban North Thurston Public Schools with 13,601 students during the 2006-2007 school year. Roughly 73 percent of public school attendance is in three of the north county school districts. North Thurston serves 34 percent of the students, Olympia serves 23 percent, and Tumwater serves 16 percent of the county's students.

Thurston County has 18 secondary schools. While most of these schools are comprehensive and offer a full range of academic and activity programs, there are several non-traditional secondary schools available.

Table 3.23 is an estimate and forecast of population by school district, as well as enrollment data.

### Private Schools

In the 2005-06 academic year, there were 16 private State Board of Education approved schools in Thurston County serving 1,900 students. Many of the students enrolled in private schools are in elementary and middle schools.[27]

**Table 3.23: Population Estimate and Forecast by School District, Thurston County, 2000-2030**

| | Estimate | | | | Preliminary Estimate | Forecast | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| School District | 2000 | 2005 | 2006 | 2007 | 2008 | 2010 | 2015 | 2020 | 2025 | 2030 |
| Centralia | 390 | 430 | 440 | 450 | 470 | 470 | 580 | 770 | 980 | 1,190 |
| Griffin | 5,360 | 5,620 | 5,890 | 6,070 | 6,250 | 6,360 | 6,850 | 7,330 | 7,690 | 7,890 |
| North Thurston | 76,200 | 82,300 | 84,730 | 88,010 | 91,290 | 93,500 | 104,240 | 115,010 | 123,910 | 131,360 |
| Olympia | 54,260 | 57,070 | 58,100 | 58,700 | 59,760 | 64,020 | 69,440 | 74,970 | 79,750 | 83,730 |
| Rainier | 4,050 | 4,450 | 4,700 | 4,840 | 4,980 | 6,570 | 9,040 | 11,610 | 13,860 | 16,110 |
| Rochester | 10,750 | 12,090 | 12,640 | 13,230 | 13,670 | 13,400 | 14,700 | 16,220 | 17,830 | 19,380 |
| Tenino | 8,140 | 8,780 | 9,110 | 9,390 | 9,650 | 10,520 | 12,330 | 14,500 | 16,460 | 17,980 |
| Tumwater | 31,110 | 33,440 | 34,450 | 35,150 | 36,210 | 37,240 | 41,100 | 47,450 | 52,950 | 57,790 |
| Yelm | 17,090 | 19,920 | 21,040 | 22,160 | 23,010 | 22,900 | 26,730 | 31,160 | 34,570 | 37,560 |

**Source:** TRPC - Small Area Population Estimates; Population and Employment Forecast Work Program, 2004/2005, 2008 update.
**Explanations:** These data represent total residents in district, not just school age children. Data is for Thurston County portion of school districts only.

## Higher Education[28]

South Puget Sound Community College has served the residents of Thurston County for 40 years. Each quarter, nearly 6,000 students attend the college, making it the largest institution of higher education in Thurston County. South Puget Sound offers a comprehensive program of day and evening classes and continuing education courses, as well as basic education, job skills training, and personal enrichment courses.

The Evergreen State College is a public college of arts and sciences that is considered a national leader in developing innovative approaches to teaching and learning. Founded in 1967, Evergreen opened its doors in 1971 and now enrolls more than 4,000 students.

Saint Martin's College, is a four-year co-educational college with a strong liberal arts foundation. Located on a 360-acre campus in Lacey, more than 1,100 students attend Saint Martin's main campus. The college and Abbey employ about 450 people.

## Native American Tribes with Traditional Lands within Thurston County[29]

### Chehalis

The Chehalis Indian people historically occupied a large area within the Chehalis River watershed stretching from the foothills of the Cascade Mountains to the Pacific Ocean in Southwest Washington. The Tribe has been located on a reservation within the Chehalis watershed since the 1850s, though important historic and archaeological sites are scattered throughout the Tribe's aboriginal area.

The reservation is situated approximately 26 miles southwest of Olympia. Thurston and Grays Harbor Counties bisect the reservation's 4,215-acre boundaries. About 800 acres of the reservation are within Thurston County boundaries.

Census 2000 figures show a Chehalis Reservation population of 691 persons, with 41 percent of the population under the age of 18 years. This is an increase in total population of 41 percent over the 1990 Census. As of 2005, tribal enrollment stood at 728. In 2006, the Chehalis Reservation had a total service population – enrolled and non-enrolled Indians living on and near the reservation and those non-Indians with familial ties to the reservation – of 3,453.

The Chehalis tribe employs about 90 people in its tribal government and provides extensive community services including the Chehalis Tribal Health Clinic, Head Start and Early Head Start, Youth Center, Public Safety Facility including law enforcement, corrections, tribal court, child and family services, natural resources management, and the Chehalis Tribal Housing Authority.

The Chehalis tribal governing body is the General Council, which is comprised of all enrolled members 18 years of age and older. The Council meets twice annually, and may also convene special meetings. The Business Committee, a five-member body elected to the specific office by the General Council for two-year terms, oversees tribal administration and business. The Business Committee is composed of the Tribal Chairman, Vice Chairman, Secretary, Treasurer, and Fifth Council Member.

### Nisqually

The Nisqually are a Southern Coast Salish tribe whose reservation includes 1,400 acres in Thurston County. The Nisqually were signatories of the Treaty of Medicine Creek, signed on December 26, 1854. The Indian War of 1855-56 and an Executive Order of January 20, 1857 reduced the tribal holdings. The 3,300 acres of reservation lands in Pierce County were condemned when Fort Lewis was established in 1918.

The Nisqually are and were a river people who gathered and preserved food from a vast land area and whose economy was based upon the land, the river, and the salmon of their traditional homelands.

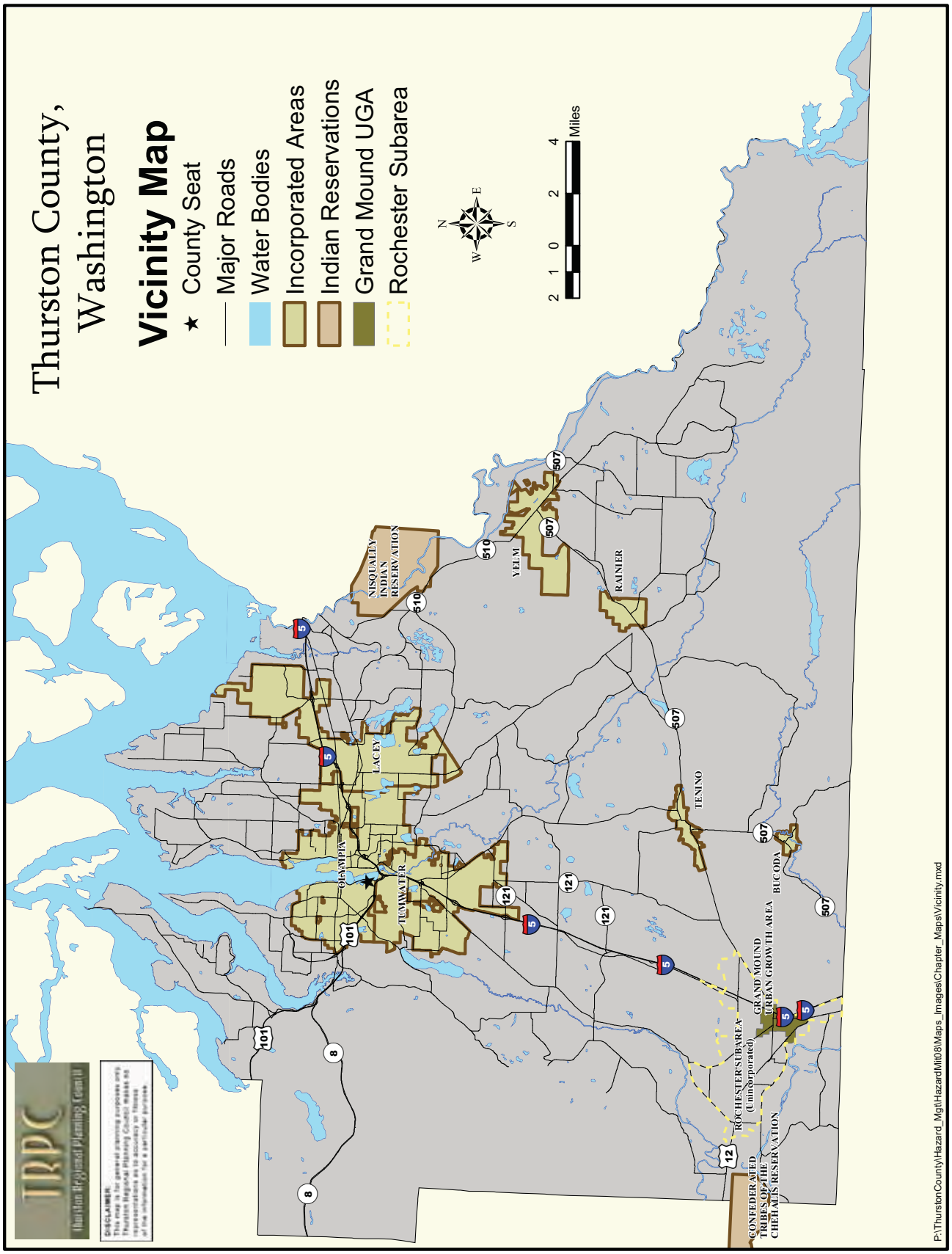
The Nisqually adopted their constitution in 1946 and tribal enrollment is now 602 members.

## Squaxin Island

The Squaxin people are a Southern Coast Salish group who traditionally lived in the forests and along the waters of southern Puget Sound, depending upon the fish, shellfish, animals, and plants of that area for their economy. The Squaxin Island Reservation was established under the Treaty of Medicine Creek in 1854. The Squaxin ancestors were confined to the Island during the Indian War of 1855-56 and dispersed after the war.

Today the tribe numbers 936 enrolled members who utilize the Island for fishing, hunting, shellfish gathering, camping and other activities. The tribe was organized in 1934 and adopted its Constitution in 1965. The traditional lands of the Squaxin include parts of Thurston County.

**Map 3.1**


Thurston County, Washington
Vicinity Map
County Seat
Major Roads
Water Bodies
Incorporated Areas
Indian Reservations
Grand Mound UGA
Rochester Subarea
N
E
S
W
2 1 0 2 4
Miles
TRPC
Thurston Regional Planning Council
DISCLAIMER:
This map is for general planning purposes only. Thurston Regional Planning Council makes no representations as to accuracy or fitness of the information for a particular purpose.
NISQUALLY INDIAN RESERVATION
YELM
RAINER
TENINO
BUCODA
OLYMPIA
LACEY
TUMWATER
GRAND MOUND URBAN GROWTH AREA
ROCHESTER SUBAREA (Unincorporated)
CONFEDERATED TRIBES OF THE CHEHALIS RESERVATION
5
101
8
510
507
121
12
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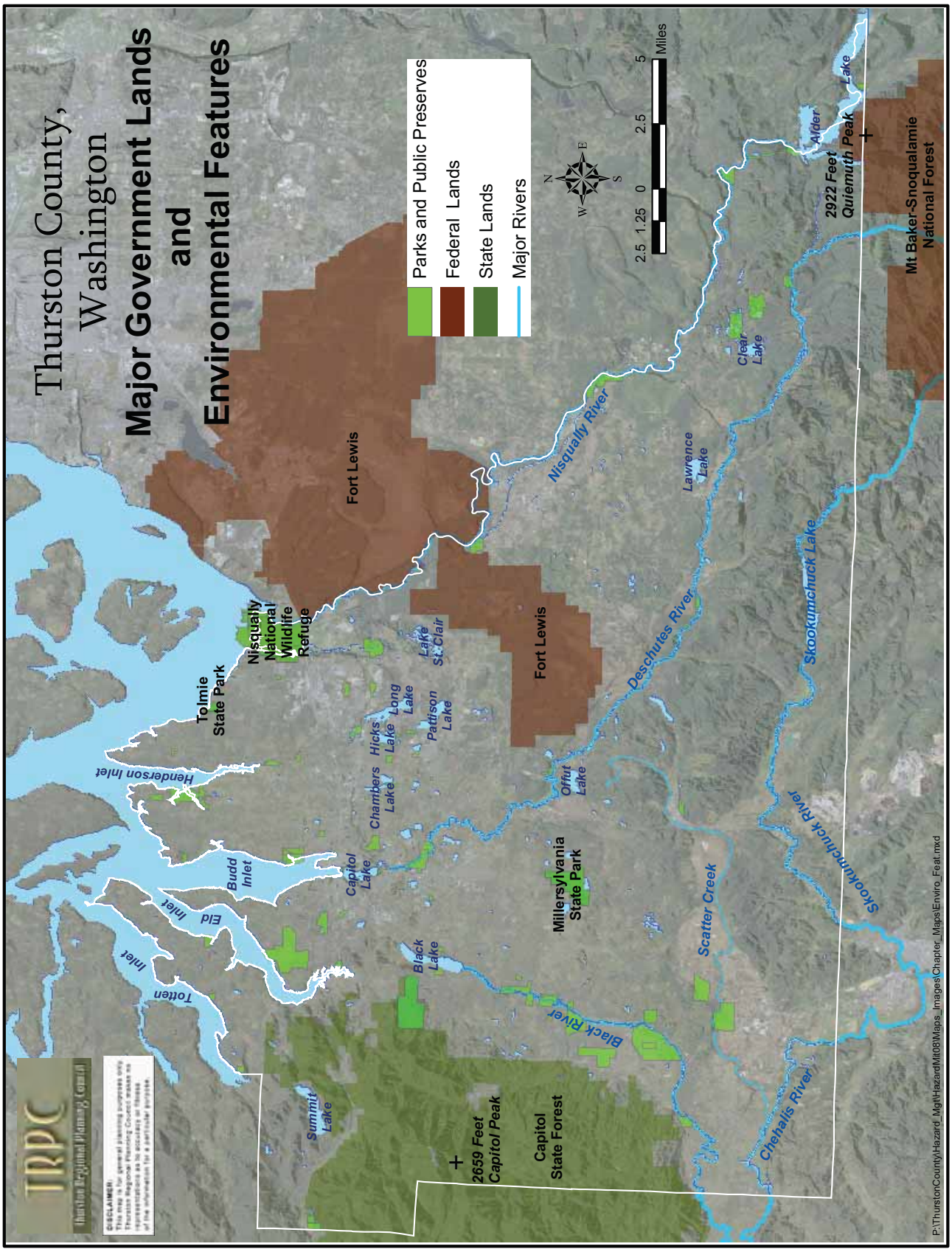
**Map 3.2**


Thurston County, Washington
Major Government Lands and Environmental Features
Parks and Public Preserves
Federal Lands
State Lands
Major Rivers
N
W
E
S
2.5 1.25 0 2.5 5 Miles
Fort Lewis
Fort Lewis
Nisqually National Wildlife Refuge
Tolmie State Park
Nisqually River
Lawrence Lake
Clear Lake
Alder Lake
2922 Feet Quiemuth Peak
Mt Baker-Snoqualamie National Forest
Lake St. Clair
Long Lake
Pattison Lake
Hicks Lake
Chambers Lake
Capitol Lake
Henderson Inlet
Budd Inlet
Eld Inlet
Totten Inlet
Deschutes River
Skookumchuck Lake
Skookumchuck River
Orfut Lake
Millersylvania State Park
Black Lake
Black River
Scatter Creek
Summit Lake
2659 Feet Capitol Peak
Capitol State Forest
Chehalis River
TRPC
Thurston Regional Planning Council
DISCLAIMER:
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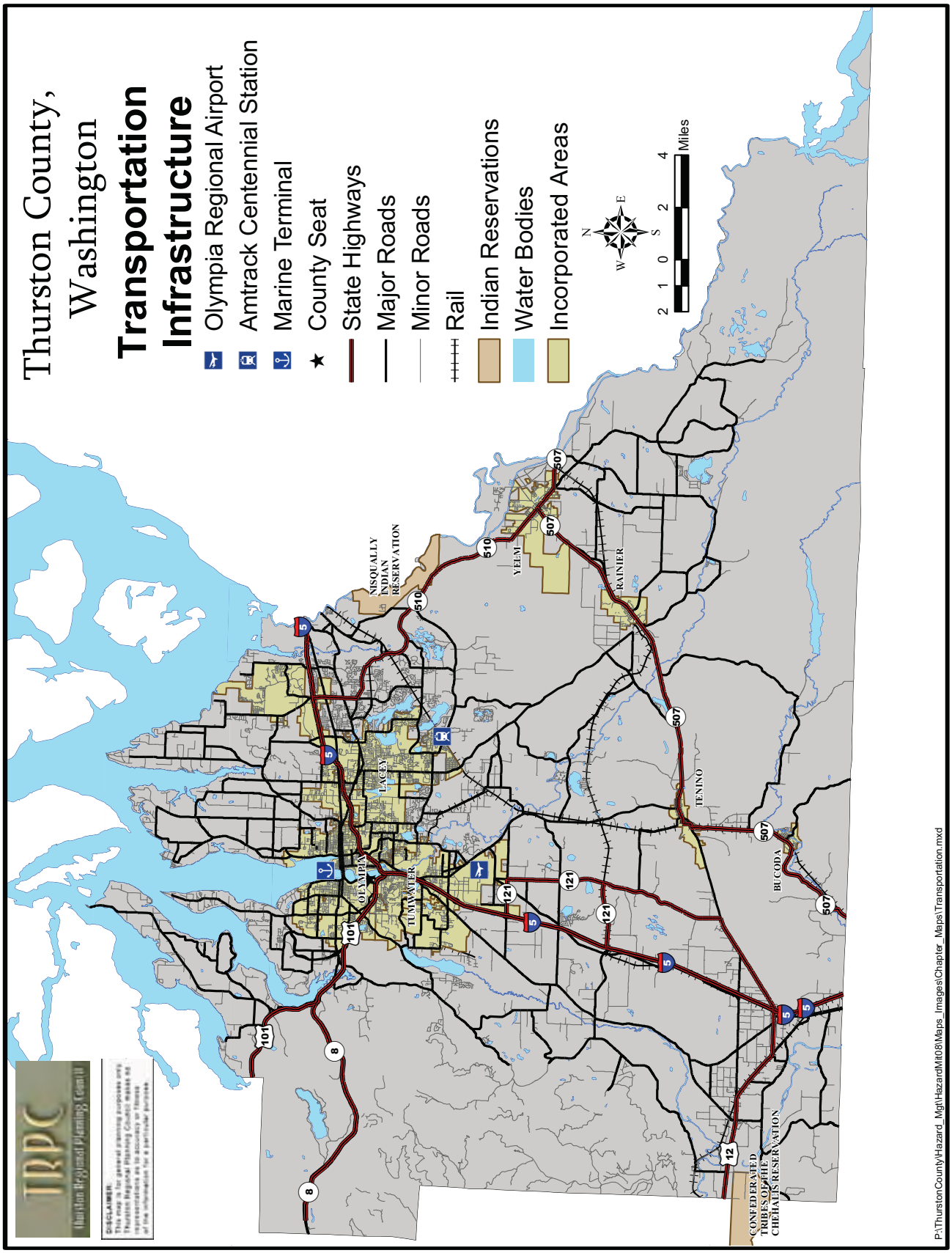
**Map 3.3**


Thurston County, Washington
Transportation Infrastructure
Olympia Regional Airport
Amtrack Centennial Station
Marine Terminal
County Seat
State Highways
Major Roads
Minor Roads
Rail
Indian Reservations
Water Bodies
Incorporated Areas
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2 1 0 2 4
Miles
NISQUALLY INDIAN RESERVATION
YELM
RAINER
TENINO
BUCODA
OLYMPIA
LACEY
TUMWATER
CONFEDERATED TRIBES OF THE CHEHALIS RESERVATION
5
507
510
121
101
8
12
TRPC
Thurston Regional Planning Council
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This map is for general planning purposes only. Thurston Regional Planning Council makes no representations as to accuracy or fitness of the information for a particular purpose.
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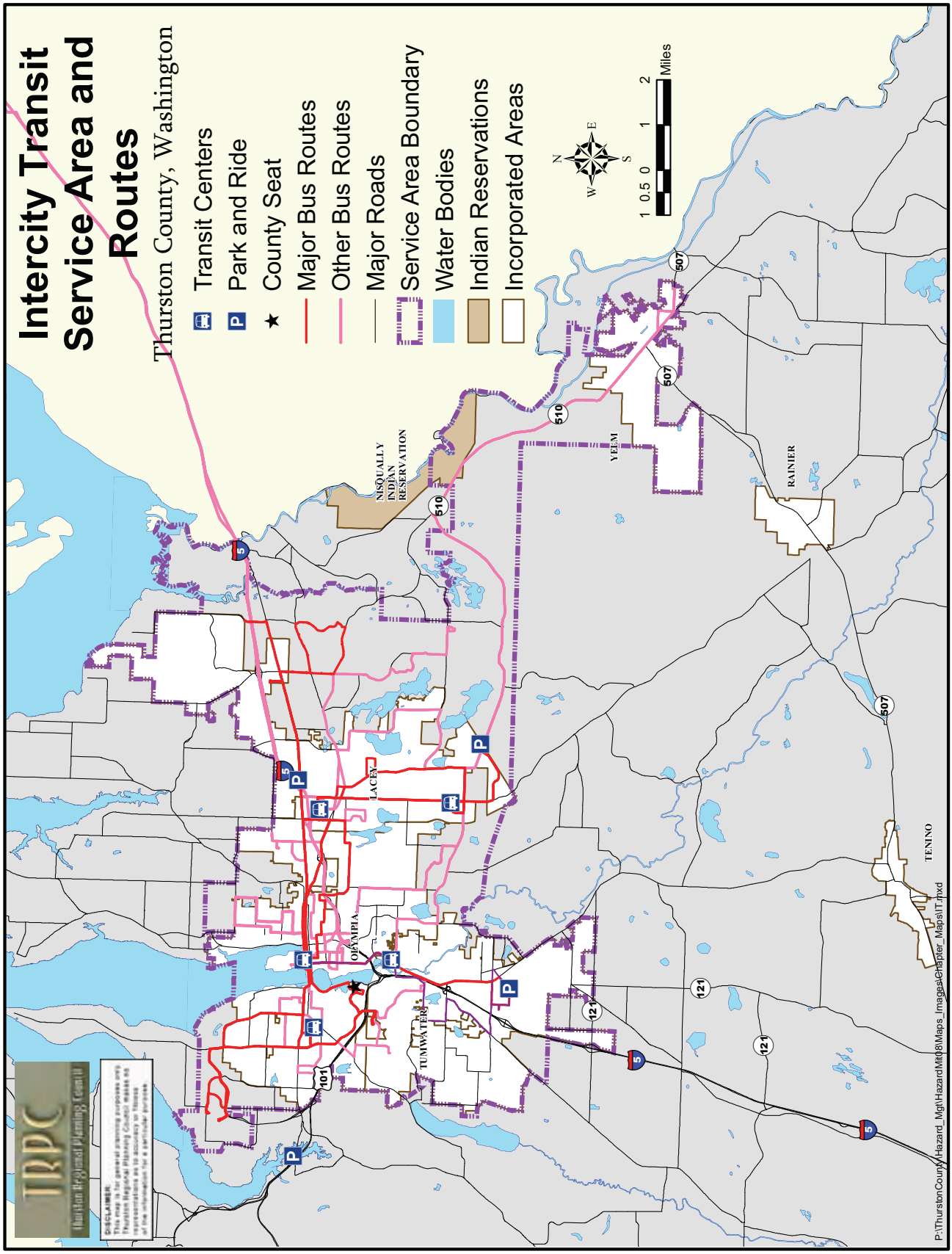
**Map 3.4**


Intercity Transit Service Area and Routes
Thurston County, Washington
Transit Centers
Park and Ride
County Seat
Major Bus Routes
Other Bus Routes
Major Roads
Service Area Boundary
Water Bodies
Indian Reservations
Incorporated Areas
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Miles
NISQUALLY INDIAN RESERVATION
YELM
RAINIER
TENINO
LACEY
OLYMPIA
TUMWATER
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121
101
TRPC
Thurston Regional Planning Council
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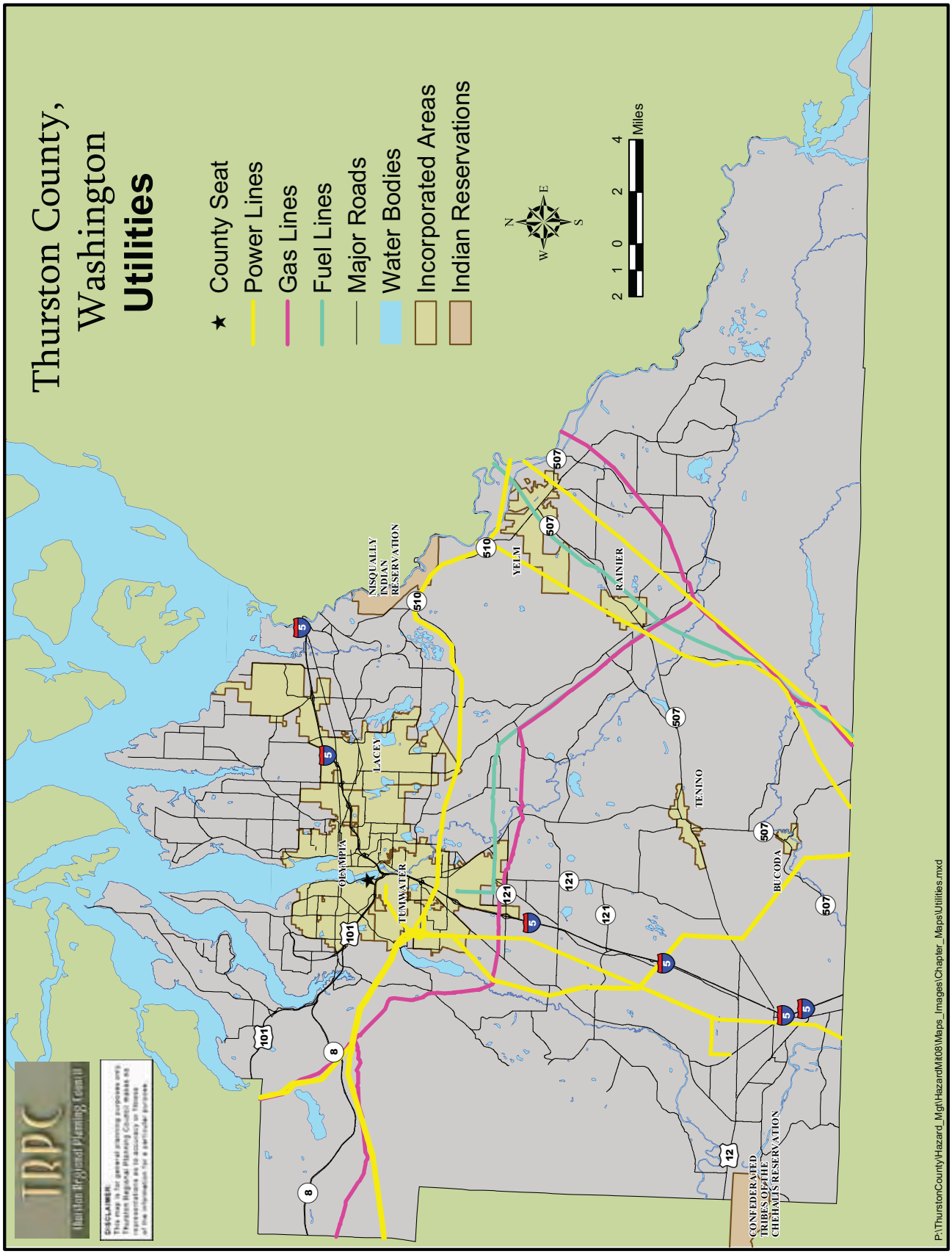
**Map 3.5**


Thurston County, Washington
Utilities
County Seat
Power Lines
Gas Lines
Fuel Lines
Major Roads
Water Bodies
Incorporated Areas
Indian Reservations
N
W
E
S
2 1 0 2 4 Miles
TRPC
Thurston Regional Planning Council
DISCLAIMER:
This map is for general planning purposes only. Thurston Regional Planning Council makes no representations as to accuracy or fitness of the information for a particular purpose.
OLYMPIA
TUMWATER
LACEY
NISQUALLY INDIAN RESERVATION
YELM
RAINIER
TENINO
BUCODA
CONFEDERATED TRIBES OF THE CHEHALIS RESERVATION
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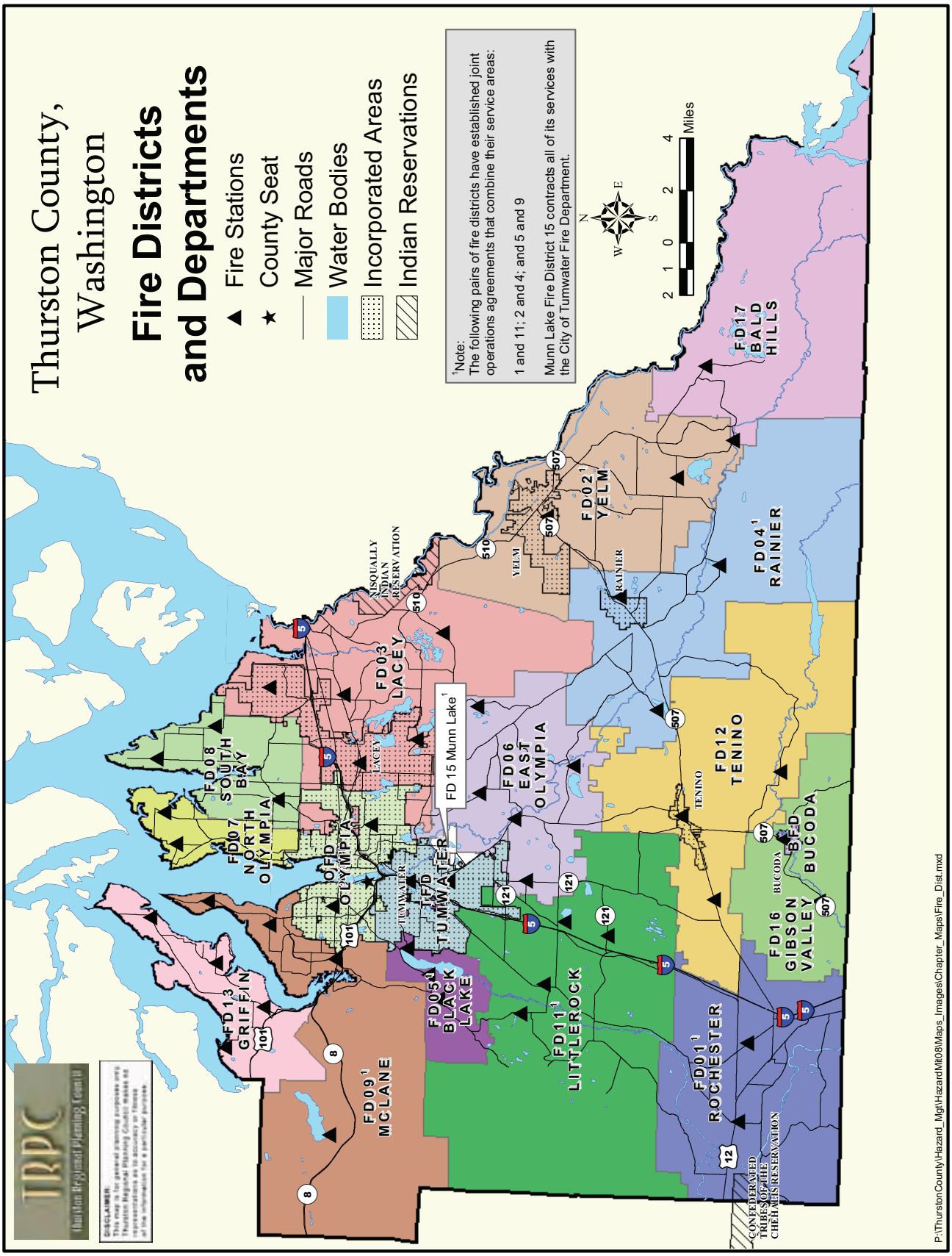
507
121
12
P:\ThurstonCounty\Hazard_Mgt\HazardMit08\Maps_Images\Chapter_Maps\Utilities.mxd

**Map 3.5**


Thurston County, Washington
Fire Districts and Departments
Fire Stations
County Seat
Major Roads
Water Bodies
Incorporated Areas
Indian Reservations
[1]Note:
The following pairs of fire districts have established joint operations agreements that combine their service areas:
1 and 11; 2 and 4; and 5 and 9
Munn Lake Fire District 15 contracts all of its services with the City of Tumwater Fire Department.
N
E
S
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2 1 0 2 4
Miles
FD 13 GRIFFIN
FD 08 SOUTH BAY
FD 07 NORTH OLYMPIA
FD 09[1] MCLANE
FD 03 LACEY
FD 15 Munn Lake[1]
FD 06 EAST OLYMPIA
FD 05[1] BLACK LAKE
FD 11[1] LITTLEROCK
FD 01[1] ROCHESTER
FD 16 GIBSON VALLEY
FD 12 TENINO
FD 04[1] RAINIER
FD 02[1] YELM
FD 17 BALD HILLS
NISQUALLY INDIAN RESERVATION
CONFEDERATED TRIBES OF THE CHEHALIS RESERVATION
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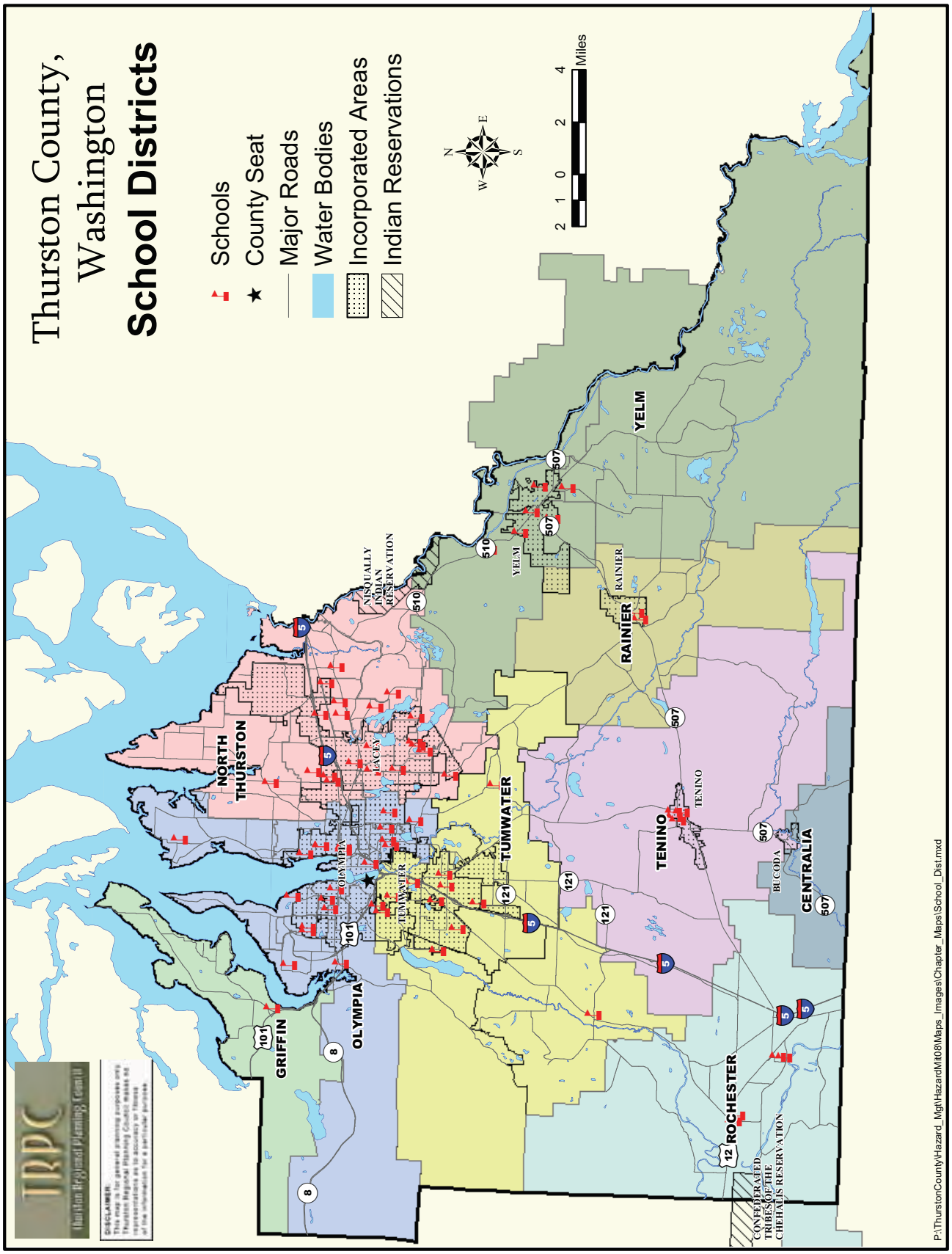
**Map 3.6**


Thurston County, Washington
School Districts
Schools
County Seat
Major Roads
Water Bodies
Incorporated Areas
Indian Reservations
N
E
S
W
2 1 0 2 4
Miles
NORTH THURSTON
GRIFFIN
OLYMPIA
TUMWATER
RAINIER
YELM
TENINO
CENTRALIA
ROCHESTER
NISQUALLY INDIAN RESERVATION
CONFEDERATED TRIBES OF THE CHEHALIS RESERVATION
LACEY
BUCODA
P:\ThurstonCounty\Hazard_Mgt\HazardMit08\Maps_Images\Chapter_Maps\School_Dist.mxd

## Community Profile Endnotes

[1]Acreage data was collected from each jurisdiction and Thurston County.
[2]Data collected from the LOTT Alliance.
[3]Population data collected from the Washington State Office of Financial Management.
[4]2007 data collected from the Washington State Office of Financial Management, Intercensal and Postcensal Estimates of County Population by Age and Sex: 1998-2007. 2000 data from U.S. Bureau of the Census.
[5]Data collected from the Washington State Office of Financial Management, Population Trends 2006.
[6]Washington State Office of Financial Management, Population Trends 2007.
[7]Bureau of Economic Analysis.
[8]Washington State Office of Financial Management
[9]Bureau of Economic Analysis
[10]Data collected from Intercity Transit website, www.intercitytransit.com.
[11]Data collected from U.S. Bureau of the Census and the Washington State Department of Licensing.
[12]Data provided by the Timberland Regional Library.
[13]Data for adult correctional facilities is provided by the Thurston County Sheriff's Office.
[14]Information located on the Thurston County Public Health and Social Services Department website; http://www.co.thurston.wa.us/health/welcome.html.
[15]Information located on the Washington State Department of Health website; http://www.doh.wa.gov/about.htm.
[16]Health Services information provided by the Thurston County Economic Development Council, http://www.thurstonedc.com/Page.aspx?nid=55.
[17]Information located on Thurston County Sheriff's Office website; http://www.co.thurston.wa.us/sheriff/.
[18]Information located on the Washington State Patrol website; http://www.wsp.wa.gov/index.htm.
[19]Information located on the Washington State Department of Transportation website; http://www.wsdot.wa.gov/Operations/IncidentResponse/.
[20]Information located on the Olympia/Thurston County Crime Stoppers website; http://www.crimebusters.org/default.htm.
[21]Information located on CAPCOM's website; http://www.co.thurston.wa.us/communications/.
[22]Information located on Emergency Management Council website; http://www.co.thurston.wa.us/em/EMC/index.htm.
[23]The plan is located at http://www.co.thurston.wa.us/em/cemp.htm.
[24]Information located on the website for the Mount Rainier Chapter of the American Red Cross; http://www.rainier-redcross.org/.
[25]Information located on Disaster Assistance Council website; http://www.co.thurston.wa.us/em/EMC/dac.htm.
[26]Information located on Faith Communities Disaster Preparedness website; http://www.co.thurston.wa.us/em/Faith/faith.asp.
[27]All Thurston County school enrollment data is provided by the Washington State Office of the Superintendent of Public Instruction.
[28]Data is provided by each institution.
[29]Data is provided by each tribe.

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# Chapter 4: Risk Assessment

## Chapter Contents

This Risk Assessment Chapter is comprised of several sections as follows:


| Section | Title |
|---|---|
| 4.0 | Risk Assessment Introduction |
| 4.1 | Earthquake Hazard Profile |
| 4.2 | Storm Hazard Profile |
| 4.3 | Flood Hazard Profile |
| 4.4 | Landslide Hazard Profile |
| 4.5 | Wildland Fire Hazard Profile |
| 4.6 | Volcanic Hazards Profile |
| 4.7 | Climate Change Projections |
| 4.8 | Risk Assessment Methodology |


Section 4.0 introduces the Thurston Region's risk assessment and explains its role in this plan. This introductory section includes an overview of Federal Disaster Declarations, a description of the hazards that affect the Thurston Region, an overview of the hazard profile format, and hazard analysis definitions. An explanation of how this chapter complies with the Federal Disaster Mitigation Act Risk Assessment Planning Requirements is also included in this section.

Sections 4.1 through 4.6 are individual hazard profiles for the six major hazards that are the focus of Thurston Region's planning partner's mitigation strategies. Section 4.7 provides an overview of climate change projections and the potential impacts to the Pacific Northwest. Section 4.8 provides a description the methodology and data sources that were used to prepare this risk assessment.

## 4.0 Risk Assessment Introduction

A comprehensive risk assessment of the major natural hazards that threaten the Thurston Region was developed for this plan. The entire chapter serves to provide local governments the factual basis to develop effective mitigation strategies. 44CFR Section 201.6(c)(2) of the Disaster Mitigation Act's (DMA) planning regulation requires local jurisdictions to:

> *...provide sufficient hazard and risk information from which to identify and prioritize appropriate mitigation actions to reduce losses from identified hazards. This includes detailed descriptions of all the hazards that could affect the jurisdiction along with an analysis of the jurisdiction's vulnerability to those hazards. Local risk assessments do not need to be based on the most sophisticated technology, but do need to be accurate, current, and relevant. Local risk assessments coupled with the local mitigation strategies are the basis for the State's evaluation of its resources and facilitate the establishment of statewide goals.*[1]

The content and structure of this plan's risk assessment was developed using the Federal Emergency Management Agency's (FEMA) 2008 "Local Multi-Hazard Mitigation Planning Guidance." Table 4.0.1 shows the DMA Risk Assessment Planning Requirements that must be met in order for this plan to receive a "satisfactory" score. Each of these planning requirements will be addressed independently or jointly throughout this section. The inclusion of the requirements is intended serve as a crosswalk for the plan reviewer.

**Table 4.0.1: Disaster Mitigation Act Risk Assessment Planning Requirements**

| DMA Section | Requirement |
|---|---|
| **§201.6(c)(2)(i):** | [The risk assessment **shall** include a] description of the type … of all natural hazards that can affect the jurisdiction … |
| **§201.6(c)(2)(i):** | [The risk assessment **shall** include a] description of the … location and extent of all natural hazards that can affect the jurisdiction. The plan **shall** include information on previous occurrences of hazard events and on the probability of future hazard events. |
| **§201.6(c)(2)(ii):** | [The risk assessment **shall** include a] description of the jurisdiction's vulnerability to the hazards described in paragraph (c)(2)(i) of this section. This description **shall** include an overall summary of each hazard and its impact on the community. |
| **§201.6(c)(2)(ii):** | [The risk assessment in all] plans approved after October 1, 2008 **must** also address National Flood Insurance Program (NFIP) insured structures that have been repetitively damaged by floods. |
| **§201.6(c)(2)(ii)(A):** | The plan **should** describe vulnerability in terms of the types and numbers of existing and future buildings, infrastructure, and critical facilities located in the identified hazard areas … |
| **§201.6(c)(2)(ii)(B):** | [The plan **should** describe vulnerability in terms of an] estimate of the potential dollar losses to vulnerable structures identified in paragraph (c)(2)(i)(A) of this section and a description of the methodology used to prepare the estimate … |
| **§201.6(c)(2)(ii)(C):** | [The plan **should** describe vulnerability in terms of] providing a general description of land uses and development trends within the community so that mitigation options can be considered in future land use decisions. |
| **§201.6(c)(2)(iii):** | For multi-jurisdictional plans, the risk assessment **must** assess each jurisdiction's risks where they vary from the risks facing the entire planning area. |

In general, the Federal DMA planning requirements with the words "**shall**" and "**must**" indicate that the item is mandatory and must be included in the plan, otherwise it will not be approved by FEMA. Regulations with the word "**should**" indicate that the item is strongly recommended to be included in the plan, but its absence will not cause FEMA to disapprove the plan.

## Federal Disaster Declarations

Since October 1962, Thurston County has been declared a Federal Disaster Area 23 times. Thurston County has received six Federal Disaster Declarations since the adoption of the Natural Hazard Mitigation Plan for the Thurston Region in October 2003. Table 4.0.2 lists the Federal Disaster Declarations that have included Thurston County.

**Table 4.0.2: Thurston County Federal Disaster Declarations, 1962 to 2009**

| | Date | Disaster Declaration | Event |
|---|---|---|---|
| | Oct-62 | 137 | Flooding, Wind (Columbus Day Storm) |
| | May-65 | 196 | Earthquake |
| | Jan-71 | 300 | Flooding |
| | Jan-72 | 322 | Severe Storms/Flooding |
| | Feb-72 | 328 | Heavy Rains/Flooding |
| | Jan-74 | 414 | Severe Storms/Flooding |
| | Dec-75 | 492 | Severe Storms/Flooding |
| | Dec-77 | 545 | Severe Storms/Mudslides/Flooding |
| | May-80 | 623 | Volcano (Mt. St. Helens Eruption) |
| | Jan-90 | 852 | Severe Storms/Flooding/Landslide/Wind |
| | Nov-90 | 883 | Severe Storms/Flooding |
| | Jan-93 | 981 | Windstorm (Inaugural Day Storm) |
| | Nov-95 | 1079 | Flooding/Windstorm |
| | Feb-96 | 1100 | Flooding |
| | Dec 1996 - Feb '97 | 1159 | Ice, Wind, Snow, Landslide, Flooding |
| | Mar-97 | 1172 | Heavy Rains/Landslide, Flooding |
| | Feb-01 | 1361 | Earthquake (Nisqually Earthquake) |
| First Natural Hazard Mitigation Plan adopted Oct 2003 | Nov-03 | 1499 | Severe Storms and Flooding |
| | Nov-06 | 1671 | Severe Storms, Flooding, Landslides, and Mudslides |
| | Dec-06 | 1682 | Severe Winter Storm, Landslides, and Mudslides |
| | Dec-07 | 1734 | Severe Storms, Flooding, Landslides, and Mudslides |
| | Dec-08 | 1825 | Severe Winter Storm and Record and Near Record Snow |
| | Jan-09 | 1817 | Severe Winter Storm, Landslides, Mudslides, and Flooding |

The number of Federal Disaster Declarations affecting the county provides some idea of the risk that natural hazards pose to the region. The following statistics highlight the frequency of major natural disaster in Thurston County:

- Between 1964 and 2007, Thurston County was included in 20 Federal Disaster Declarations. Only 29 counties or U.S. Census designated places nationwide have been declared a Federal Disaster area more than 20 times. Less than one percent (0.93%) of U.S. places or counties share this distinction.
- As of 2007, Thurston County was tied for second place with Grays Harbor and Snohomish County with the most disaster declarations in Washington State; second only to King County which received 22 Federal Disaster Declarations.

## Hazard Identification

| | |
|---|---|
| **§201.6(c)(2)(i):** | **[The risk assessment shall include a] description of the type … of all natural hazards that can affect the jurisdiction …** |

Several sources were referenced to identify the hazards that threaten the Thurston Region. Hazard identification was principally derived from Thurston County's and other local jurisdictions' *Hazard*

*Identification and Vulnerability Analysis* (HIVA) reports and the *Washington State Enhanced Hazard Mitigation Plan* (2007). Other sources included the National Climate Data Center, the Hazards and Vulnerability Research Institute, the National Weather Service, the United States Geological Survey, FEMA, and the Washington State Departments of Natural Resources and Ecology.

Local governments and the communities of Thurston County are subject to a wide variety of natural and human-influenced hazards. Some hazards pose a greater threat to Thurston County communities than others. The following hazards have been identified as those most likely to occur in the Thurston Region:

**Critical Shortage** – Critical shortages are the lack or reduction of essential goods or services due to a disruption in their supply. They are distinguished from shortages due to local emergencies by being caused by events that occur elsewhere. These events could include embargoes, strikes, natural disasters, epidemics, crop failures, over exploitation of a natural resource, terrorist activities and political unrest.

**Dam Failure** – There are 38 dams in or adjacent to Thurston County. There are three dams classified as high hazard dams in the county, Alder and LaGrande Dams on the Nisqually River and the Skooumchuck Damn on the Skookumchuck River. The Dam Safety Office of the Washington State Department of Ecology rates each dam's Downstream Hazard Classification. The Downstream Hazard Classification system used in Washington is similar to the types of classification systems used throughout the United States. The purpose of the system is to provide a simple characterization of the setting downstream of a dam to reflect the general nature of consequences if the dam were to fail and release the reservoir into the downstream valley. The Downstream Hazard Classification of Thurston County dams are shown in table 4.0.3.

**Table 4.0.3: Downstream Hazard Classification of Thurston County Dams**

| Dam | Classification | Rating |
|---|---|---|
| Alder Dam; and Skookumchuck Dam | 1A | High – Greater than 300 lives at risk |
| LaGrande Dam | 1B | High – From 31 to 300 lives at risk |
| All other Dams | 3 | Low – No lives at risk |

Dam failures can be caused by nature, such as flooding or an earthquake, but mostly they are caused by human error such as poor construction, operation, maintenance, or repair. The effects of a dam failure are highly variable depending on the dam, the amount of water stored behind the dam, the current stream flow, and the size and proximity of the downstream population. Some of the effects of a major dam failure include loss of life, destruction of homes and property, damage to roads, bridges, powerlines, and other infrastructure, loss of power generation and flood control capabilities, disruption of fish stock and spawning beds, and the erosion of stream and river banks.

Thurston County has not experienced a major dam failure and the three high hazard dams in the county are well-maintained and comply with current dam safety regulations. The Thurston County Hazard Inventory and Vulnerability Analysis report has assigned a low risk rating to all three

high hazard dams in the county. However, in the event of a dam failure, each of the three dams could affect a population of 300 or more, inundate major transportation routes and industries, and have long-term effects on water quality and wildlife. The high hazard dams in Thurston County are operated for electrical power generation and are licensed by the Federal Energy Regulatory Commission. Accordingly, they are inspected regularly and staffed 24 hours a day. If a dam were to show signs of failure, dam operators would initiate their emergency action plans and notify emergency management personnel and evacuation procedures would be implemented.

Refer to the Volcanic Hazard Profile for dam failure attributed to a catastrophic lahar. More information regarding Alder and LaGrande Dam failure can be found in Tacoma Power's "Emergency Action Plan for the Nisqually Hydroelectric Project." Information regarding a Skookumchuck Dam failure hazard can be found in TransAlta's "Skookumchuck Dam Emergency Action Plan."

**Drought** – Drought is a condition of climatic dryness that is severe enough to reduce soil moisture levels and water levels below the minimum necessary for sustaining plant, animal and human life systems.

**Earthquake** - Washington State is situated near a tectonic collision boundary where the oceanic Juan de Fuca plate dives beneath the continental North American plate. The plate boundary is the Cascadia Subduction Zone which lies about fifty miles offshore, extending from near Vancouver Island to northern California. These plates are converging at a rate of 1 to 1 ½ inches per year.

As the Juan de Fuca plate slides beneath the North American plate, cracks or faults develop at their boundary and at the surface in response to bending. The friction caused by this sliding movement tends to stick the two plates or two sides of a fault together. Over time, tremendous pressure builds up and friction is overcome. When this happens, one plate or one side of a fault moves relative to the other plate or side resulting in the sudden release of energy that is felt as an earthquake.

**Epidemic** – Epidemics are outbreaks of disease that affect or threaten to affect a significant portion of a population in a relatively short period of time. Although usually referring to a human contagious disease, epidemics can also affect domestic and wild animals as well as crops. Epidemic diseases are usually introduced into an area from remote regions and inflict devastation because there is not natural or induced immunity.

**Flood** – Of all natural hazards that affect Thurston County, floods are the most common and, on an annual average basis, the most costly. Four types of flooding occur in the county: riverine, tidal, groundwater, and urban.

**Hazardous Material Incident** – Hazardous materials include chemicals used in manufacturing, household chemicals, crude oil and petroleum products, pesticides, herbicides, fertilizers, paints, medical wastes, radioactive materials and a host of other substances. Their manufacture, transport, storage, use, and disposal place the public property and environment at risk from their inadvertent or intentional release.

**Heat Wave** – A heat wave is generally characterized by five or more consecutive days of unusually hot weather. Locally, the National Weather Service considers hot weather to be 90 degrees or higher.

**Landslide** – Landslides are the release of rock, soil, or other debris and its subsequent movement down a slope or hillside. They are generally caused or controlled by a combination of geology, topography, weather and hydrology and can be influenced by development practices. Landslides vary greatly in size and composition: from a thin mass of soil a few yards wide to deep-seated bedrock slides miles across. The travel rate of a landslide can range from a few inches per month to many feet per second depending on the slope, type of materials, and moisture content.

**Seiches -** Seiches are standing waves in an enclosed or partially enclosed body of water such as lakes or the Puget Sound. The effect is similar to water sloshing in a bathtub and are caused by massive displacement due to earthquakes and landslides. Marinas, docks, and shoreline infrastructure could be damaged or destroyed.

**Storm** – Destructive storms come in several varieties: wind, rain, ice, snow and combination. Nearly all destructive local storms occur from November through April when the jet stream is over the western United States and Pacific low pressure systems are more frequent. The trajectory of those lows determines their effect locally. The more southerly ones bring heavy rains while the more northerly ones bring cold air and the potential for snow and ice. Any winter storm, regardless of its trajectory, can pack high winds. Generally, winds above about thirty miles per hour can cause widespread damage and those above about fifty miles per hour can be disastrous. High winds of short duration, such as tornadoes and strong gusts from thunderstorms can also be destructive though generally not as widespread.

**Terrorist Attack** – Terrorism is the force or violence against persons or property violating the criminal laws of the United States for purposes of intimidation, coercion, or ransom. Terrorists often use threats to create fear among the public; try to convince citizens that their government is powerless to prevent terrorism; and try to get publicity for causes.

A terrorist attack can take several forms depending on the technological means available to the terrorist, the nature of the political issue motivating the attack, the points of weakness of terrorist targets. Bombings are the most frequently used terrorist method in the United States. Other possibilities include attacks upon transportation facilities, utilities, or other public services, or an incident involving chemical or biological agents.

**Tsunami** – A tsunami is a sea wave of extremely long length generated by a seismic disturbance (earthquake, volcanic eruption or debris slide) below or on the ocean floor. Tsunamis have wave lengths of more than sixty miles and travel at speeds of 300-600 miles per hour. They can be of local origin or may originate from a considerable distance such as Alaska or Japan. Tsunamis can be very destructive to coastal areas and can occur at any time. Refer to the Earthquake Hazard Profile for more information on Tsunami.

**Volcanic Activity** – A volcano is a vent in the earth's crust which ejects gases, ash, rock fragments, and magma from the earth's interior. Though there are no volcanoes within Thurston County,

however Mount Rainier is only 22 miles east of the southeast corner of Thurston County and Mount St. Helens is only 39 miles southeast of the county border. Volcanoes are known to periodically erupt due to internal pressure from gas and molten rock. They are capable of causing catastrophic destruction from events such as ash fall, lava and pyroclastic flows, debris avalanches, and lahars.

**Wildland Fire** – A wildland or wildfire is any instance of uncontrolled burning in grasslands, brush, or woodlands. Wildland fires are most likely to occur during the local dry season – mid-May through October or anytime during prolonged dry periods causing drought or near-drought conditions. The likelihood of a destructive fire occurring depends on weather, fuel conditions, topography, and human activities such as debris burning, land clearing, camping, and construction. Greater than four out of five forest and wildland fires are started by people, often due to negligent behavior such as failure to properly extinguish smoldering debris or campfires.

More detailed descriptions for the hazards selected for this risk assessment are located in the Hazard Profiles.

## Hazard Risk Assessments Included in this Chapter

The 2003 Natural Hazard Mitigation Plan for the Thurston Region profiled the most destructive and frequently occurring natural hazards that affect the region: earthquake, flood, storm, and landslide. Budget resources and time constrained a full analysis of every potential hazard identified during the 2003 planning process. The update of this plan includes two additional hazard profiles, volcanic hazards (ash fall and lahar) and wildland fire hazard. Every hazard profile was reevaluated and updated with this plan update. Every hazard that is profiled in this plan meets one or all of the following criteria:

1. There is a high probability of the natural hazard occurring in Thurston County within the next 25 years; and/or
2. There is the potential for significant damage to impacted buildings and infrastructure; and/or
3. There is the potential for loss of life.

The following natural hazards meet one or more of the above criteria and are profiled in this plan:

| Hazard | Probability of Occurrence | Vulnerability | Risk |
|---|---|---|---|
| Earthquake | High | High | High |
| Storm | High | High | High |
| Flood | High | Moderate | High |
| Landslide | Moderate | Low | Moderate |
| Wildland Fire | High | Moderate | Moderate |
| Volcanic Event | Low | High | Moderate |

## Hazard Profile Format

The Hazard Profiles that follow in sections 4.1 through 4.6 address the following DMA Risk Assessment Planning Requirements:

| | |
|---|---|
| §201.6(c)(2)(i): | [The risk assessment shall include a] description of the … location and extent of all natural hazards that can affect the jurisdiction. The plan shall include information on previous occurrences of hazard events and on the probability of future hazard events. |
| §201.6(c)(2)(ii): | [The risk assessment shall include a] description of the jurisdiction's vulnerability to the hazards described in paragraph (c)(2)(i) of this section. This description shall include an overall summary of each hazard and its impact on the community. |
| §201.6(c)(2)(ii)(A): | The plan should describe vulnerability in terms of the types and numbers of existing and future buildings, infrastructure, and critical facilities located in the identified hazard areas … |
| §201.6(c)(2)(ii)(B): | [The plan should describe vulnerability in terms of an] estimate of the potential dollar losses to vulnerable structures identified in paragraph (c)(2)(i)(A) of this section and a description of the methodology used to prepare the estimate … |

### General Contents

The six hazard profiles contain information that is useful to understand the risks the county and local communities face from the hazards included in the subsequent sections. Each hazard is described in terms of its source, effects, severity, impact, probability of occurrence, historical impacts and occurrences, geographic extent or delineation, and the portion of the population, assets, and critical infrastructure that is potentially exposed to the hazard. This information is presented in a non-technical manner with narrative passages, figures, tabular data, and maps. The sum of all of the information contained in each hazard profile leads to a summary risk assessment.

Information to support the hazard profiles was obtained through a variety of sources including local agency personnel, federal and state scientists, existing plans, books, scientific journals, newspaper articles, federal and state agency websites, and online data archives. Endnotes are included to cite relevant sources of information. There are sections in the plan that lack sufficient information and data to adequately address some of the required components of the risk assessment. Information gaps are noted in the narratives.

For more information on the data and procedures used to develop the risk assessment, refer to Chapter 4.8, Risk Assessment Methodology.

### Structure of Hazard Profiles

Each Hazard Profile is formatted as follows (a brief description of relevant headings is provided):

#### Introduction

*Hazard Identification*

**Definition**: Each hazard is defined by its elements, effects, and the source or origin of its energy

**Severity**: Severity describes or measures the strength or magnitude of hazard elements or hazard events. For example, wind speed can be measure in miles per hour, temperatures in degrees Fahrenheit, snow depth accumulations are measured in inches and, Earthquakes are measured using the Richter Scale, etc. Severity can also describe the duration or spatial extent of a hazard effect. Severity is an important factor for assessing vulnerability.

**Impacts**: This principally describes the negative physical, economical, environmental, and social consequences resulting from the effects of natural hazards. The impacts are based on both actual past events in Thurston County (or neighboring Washington State communities) and potential impacts. Repetition of the same types of destructive impacts between isolated hazard events is a good indication of exposure or vulnerability. Sometimes there are long-term environmental benefits from certain natural disasters and these are noted where relevant.

**Probability of Occurrence**: Probability is an important component for evaluating risk. It is a statistical measure of the likelihood of a hazard event occurring during a specific period of time such as annually, every 25 years, or for a specific period of recorded observations. Numerically it is expressed by the ratio of the number of actual occurrences to the total number of possible occurrences. It is described in both numeric and qualitative terms in this plan. The summary assessment (see below) considers probability for a 25 year interval.

**Historical Occurrences and Impacts:** Past events are perhaps the best indication of the type and extent of losses that local communities can expect to endure following future natural hazards. This section includes a chronological listing of notable past events that have impacted Thurston County and the Pacific Northwest. It is not an exhaustive list of all past events, but rather a representative history of hazard events that highlight the type, extent, location, and cost of destruction.

**Delineation of Hazard Area**: This is a description of the geographical extent of the hazard area based on the hazard profile such as flood plains for the flood hazard, liquefaction zones for earthquakes, and lahar inundation zones for volcanic events, etc. This section describes which communities are most vulnerable to a hazard when appropriate. Tabular data showing proportion of land area by jurisdiction that is in and out of the hazard area is shown. Geographical extent is also depicted on one or more maps for every hazard except Severe Storm. More detailed maps of each jurisdiction's hazard zone are located in the respective jurisdiction annex.

**Population and Employment in the Hazard Area**: Tabular data is provided to assess an aspect of current and future vulnerability by providing data on the number of people living and working within the hazard area as compared to total population, by jurisdiction, in the years 2006 and 2030. More information about population and growth trends can also be found in Chapter 3, Thurston County Community Profile. Data for Severe Storm are not included as the entire county is vulnerable to the effects of storm. Total population affected by storm can be inferred from the "total" columns from the other hazard profiles.

**Inventory of Assets and Dollar Value in the Hazard Area**: Tabular data is provided to assess the number of existing and future structures which are potentially impacted by the hazards. An estimate of structure and building contents value is also included to provide information on potential dollar losses. Estimates of buildings' value by residential, commercial/industrial, and government/

institutional are provided for each hazard. The values in the tables represent the sum of both the building replacement and contents replacement values. Tables are provided by jurisdiction for the years 2006 and 2030. Data for Severe Storm are not included as the entire county is vulnerable to the effects of storm. Total assets affected by storm can be inferred from the "total" columns from the other hazard profiles.

**Critical Facilities and Infrastructure in Hazard Area**: Natural hazards can destroy or damage facilities that may be critical for responding to the disaster and for maintaining a safe environment and public order. Nearly 270 critical facilities in Thurston County have been mapped. Data on the types and quantities of critical facilities that occur in hazard areas is summarized in a table within each profile. Specific information about the location of critical facilities and infrastructure is maintained by Thurston County Emergency Management.

**Summary Assessment**: A summary risk assessment is established for each Hazard Profile. This summary is based on a subjective examination of any given hazard's probability of occurrence combined with the region's overall vulnerability to the hazard. The risk rating is assigned on the probability of a hazard occurring over the next 25 years. This interval was chosen because it is the long term recurrence interval of a dangerous earthquake, the hazard of the greatest risk to Thurston County. More information about the summary assessment is included in the hazard analysis definitions.

## Hazard Analysis Definitions

The adjective descriptors (High, Moderate, and Low) for each hazard's probability of occurrence, vulnerability, and risk rating were derived from Thurston County's HIVA.

The following terms are borrowed from the county HIVA, and are used in this plan to analyze and summarize the risk of the hazards considered:

**Risk Rating**: An adjective description (High, Moderate, or Low) of the overall threat posed by a hazard is assessed for the next 25 years. Risk is the subjective estimate of the combination of any given hazard's probability of occurrence and the region's vulnerability to the hazard.

- High: There is strong potential for a disaster of major proportions during the next 25 years; or history suggests the occurrence of multiple disasters of moderate proportions during the next 25 years.
- Moderate: There is medium potential for a disaster of less than major proportions during the next 25 years.
- Low: There is little potential for a disaster during the next 25 years.

**Figure 4.0.1:**
Risk is a subjective estimate of the combination of a hazard's probability of occurrence and a community's vulnerability.

**Probability of Occurrence**: An adjective description (High, Moderate, or Low) of the probability of a hazard impacting Thurston County within the next 25 years.

- High: There is great likelihood that a hazardous event will occur within the next 25 years.
- Moderate: There is medium likelihood that a hazardous event will occur within the next 25 years.
- Low: There is little likelihood that a hazardous event will occur within the next 25 years.

**Vulnerability**: Vulnerability can be expressed as combination of the severity of a natural hazard's effect and its consequential impacts to the community. An adjective description (High, Moderate, or Low) of the potential impact a hazard could have on Thurston County. It considers the population, property, commerce, infrastructure and services at risk relative to the entire county.

- High: The total population, property, commerce, infrastructure and services of the county are uniformly exposed to the effects of a hazard of potentially great magnitude. In a worst case scenario, there could be a disaster of major to catastrophic proportions.
- Moderate: The total population, property, commerce, infrastructure, and services of the county are exposed to the effects of a hazard of moderate influence; or The total population, property, commerce, infrastructure, and services of the county are exposed to the effects of a hazard of moderate influence, but not all to the same degree; or An important segment of population, property, commerce, infrastructure and services of the county are exposed to the effects of a hazard. In a worst case scenario there could be a disaster of moderate to major, though not catastrophic, proportions.
- Low: A limited area or segment of population, property, commerce, infrastructure, or service is exposed to the effects of a hazard. In a worst case scenario, there could be a disaster of minor to moderate proportions.

## Local Annexes

| | |
|---|---|
| §201.6(c)(2)(iii): | **For multi-jurisdictional plans, the risk assessment must assess each jurisdiction's risks where they vary from the risks facing the entire planning area** |

A local risk assessment is included in the local annex for each hazard mitigation planning partner. The annex describes each jurisdiction's risk where they vary from the risks facing the entire planning area. The format of the local risk assessment is consistent with the regional hazard profiles as described in the section titled "Structure of Hazard Profiles."

## Development Trends

| | |
|---|---|
| §201.6(c)(2)(ii)(C): | [The plan should describe vulnerability in terms of] providing a general description of land uses and development trends within the community so that mitigation options can be considered in future land use decisions. |

Although FEMA recommends that the plan include a description of land uses and development trends within the risk assessment, a general assessment of this type of information is located in Chapter 3, Thurston County Community Profile. Estimates of the region's population, employment, and building stock in hazard zones for the year 2030 is also included in each hazard profile.

## Risk Assessment Endnotes

[1]Federal Emergency Management Agency. 2008. Local Multi-Hazard Mitigation Planning Guidance. U.S. Department of Homeland Security, July 1, 2008.

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# Chapter 4.1: Earthquake Hazard Profile

## Introduction

Of all the natural hazards that affect the Puget Sound Region, earthquakes cause the most widespread infrastructural damage and disruption of services and essential operations across all sectors of society. Washington State experiences more than 1,000 earthquakes a year,[1] but the majority of these events pass without notice. At least 20 damaging earthquakes have rattled the State in the last 125 years; most have occurred in western Washington. Thurston County, particularly properties in the City of Olympia, incurred significant damage from the effects of the 2001 Nisqually earthquake. Statewide, this magnitude 6.8 earthquake caused nearly 700 injuries. A precise damage figure for this earthquake is unknown, but estimates have been reported as high as $4 billion.[2]

Scientists still lack tools to predict the time, size, and location of earthquakes, but significant efforts have been made towards understanding their sources and effects. The western United States has been very proactive with earthquake mitigation. The mapping of known faults, soils, and liquefaction areas provides information that can assist communities with modifying building codes and developing appropriate land use zoning for high risk areas. Schools and public and private sector employers educate students and employees with earthquake safety drills and preparedness exercises.

The earthquakes of 1949, 1965, and 2001 are a clear indication that earthquakes of this magnitude are likely to reoccur within the 25 year planning horizon, a high probability of occurrence. Each of these events caused significant widespread damage. The 2001 earthquake revealed that the region remains highly vulnerable, therefore the Thurston Region has a high risk rating for earthquakes.

## Hazard Identification

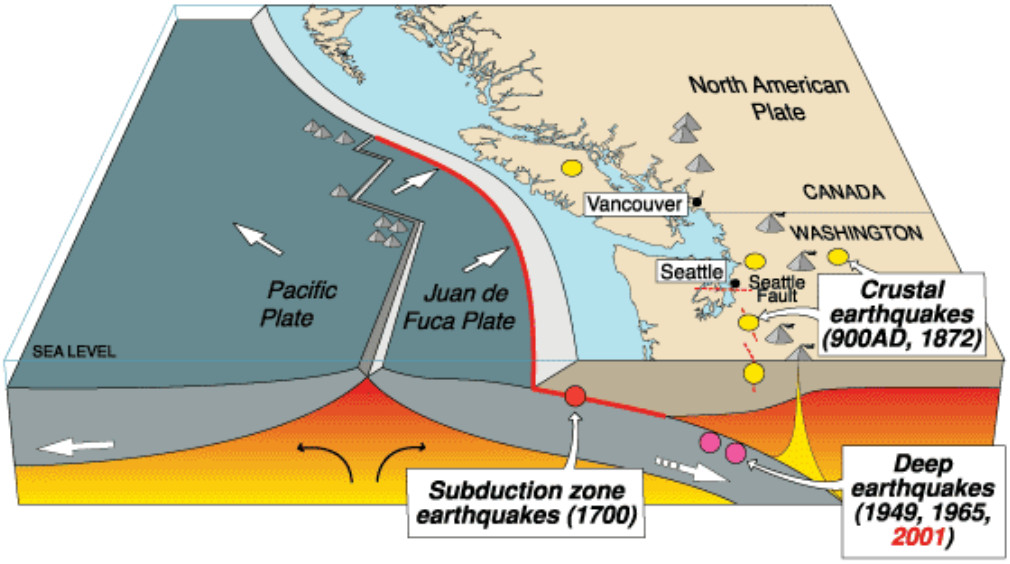
The Pacific Northwest is the most geologically active region in the contiguous U.S. Washington State is located on a convergent continental margin, the boundary between two colliding tectonic plates (Figure 4.1.1). This area is called the Cascadia Subduction Zone. It is located offshore, stretching from northernmost California to southernmost British Columbia. At this convergent zone, the North American continental plate collides with the Juan de Fuca oceanic plate. They converge at a rate of about two inches per year. A third plate, the Pacific plate, pushes the Juan de Fuca plate north causing a complex seismic strain where the plates converge.[3] The strain slowly builds up energy over time.

## Definition

An earthquake occurs when the pressure of seismic stress is abruptly released. The seismic energy is dispersed in waves that move through the earth and cause the ground to shake violently. It is this shaking motion and the subsequent behavior of the earth's surface – liquefaction, landslides, ruptures, or ground failure that causes the destruction of buildings and other infrastructure.

## Effects of Earthquakes

**Figure 4.1.1: Cascadia Earthquake Sources**




| Source | Affected area | Max. Size | Recurrence |
|---|---|---|---|
| Subduction Zone | W.WA, OR, CA | M 9 | 500-600 yr |
| Deep Juan de Fuca plate | W.WA, OR, | M 7+ | 30-50 yr |
| Crustal faults | WA, OR, CA | M 7+ | Hundreds of yr? |

When a fault ruptures, seismic waves radiate, causing the ground to vibrate. It is the vibration of these waves that cause the ground to shake during an earthquake. The effects of ground shaking produce ground failures, tsunamis, and seiches. Shaking is strongest in areas of soft soils, such as in river valleys or along the shorelines of bays and lakes. Wave velocity is slower in soils than in the underlying rock of the earth's crust. Softer soils amplify ground shaking. The greater the wave velocity difference, the greater the amplification of ground surface shaking. Consequently, ground shaking in areas of soft soils underlain by stiffer soils or rock is generally stronger than in areas where there is little or no variation between the surface and lower layer.[4] Observations of past earthquakes verify this phenomenon as evidenced by damage to buildings and infrastructure in downtown Olympia and Seattle in areas built on fill.

Ground failures include surface faulting, landslides, subsidence, and uplifting. Surface faulting is the differential movement of two sides of a fracture - in other words, the location where the ground breaks apart. The length, width, and displacement of the ground characterize surface faults. In the 2001 Nisqually Earthquake, surface faulting was evident in the damage that occurred along Deschutes Parkway and around Capitol Lake recreational trails. Subsidence is the sinking of soils and uplifting is the elevation of soils. Unstable and unconsolidated soils are most vulnerable to ground failures and surface faulting.

Liquefaction is the phenomenon that occurs when ground shaking causes loose soils to lose strength and act like viscous fluid. Liquefaction causes two types of ground failure: lateral spread and loss of bearing strength. Lateral spreads develop upon gentle slopes and entail the sidelong movement of large masses of soil as an underlying layer liquefies. Loss of bearing strength results when the soil

supporting the structures liquefies. This can cause structures to tip and topple. Liquefaction typically occurs in artificial fills and in areas of loose sandy soils that are saturated with water, such as low-lying coastal areas, lakeshores, and river valleys.

Tsunamis are large ocean waves generated by sudden changes in the sea floor elevation which displace a significant volume of water. Tsunamis can be caused by subduction zone earthquakes, submarine landslides, or a submarine volcanic explosion. A major earthquake from the Cascadia Subduction zone could cause a Pacific Northwest Tsunami. Tsunamis can be tens to thousands of kilometers in length and can threaten shorelines around the entire Pacific Rim. On December 26, 2004, a 9.2 magnitude earthquake occurred along a tectonic subduction zone where the India Plate, an oceanic plate, and the Burma micro-plate, part of the larger Sunda plate, collide. This event triggered the worst tsunami ever recorded in terms of lives lost. This tsunami ravaged coasts with waves as high as 20 to 30 meters and killed 230,000 people around the Indian Ocean.

A seiche is a lesser known effect that occurs in enclosed bodies of water. The effect is analogous to water sloshing in a bath tub. Portions of the Puget Sound may be vulnerable to seiches, but there is no evidence of such an event affecting Thurston County shorelines. Marinas, docks, and boats are most vulnerable to this effect.

*The sources of Pacific Northwest Earthquakes are included below in the "Severity" section.*

## Severity

There are several common measures of earthquakes. The Richter Magnitude Scale (used in this hazard profile) is a mathematical scale which measures the intensity of ground motion. Because of the logarithmic basis of the scale, each whole number increase in magnitude represents a ten-fold increase in measured amplitude, and 31 times more energy released. The Modified Mercalli Intensity Scale measures the earthquake intensity by the damage it causes. Peak ground acceleration (PGA) is a measure of the strength of ground movements. It expresses an earthquake's severity by comparing its acceleration to the normal acceleration due to gravity.

The severity of an earthquake is also dependent upon the source of the quake. The severity of the vibration increases with the amount of energy released and decreases with distance from the causative fault or epicenter. Three kinds of earthquakes are recognized in the Pacific Northwest: crustal earthquakes, subduction zone earthquakes, and deep earthquakes (Figure 4.1.1).

1. Crustal (shallow) earthquakes occur along faults close to the surface of the North American plate. They have a maximum depth of about 19 miles, though most occur much closer to the surface. The majority of earthquakes in the Pacific Northwest are of the shallow type. They could potentially produce magnitudes as high as 7.5, though most are less than 3.0. Scientists are locating and studying active faults that are located within the Puget Sound lowlands. The Seattle fault is perhaps the most infamous as it lies under the most densely populated area of the state. Evidence suggests that an Olympia fault structure may exist in the north end of Thurston County.[6] A strong earthquake is estimated to have occurred nearly 1100 years ago which caused one to three meter subsidence in lowland forests near present day McAllister

Creek, the Nisqually River, and at Little Skookum Inlet. A magnitude 6.0 or greater earthquake originating from a surface fault could render incredible destruction. More research is necessary to verify the existence of the Olympia fault structure and its probability of rupturing.[7]

2. Subduction zone or interplate earthquakes emanate from the boundary where the Juan de Fuca plate subducts eastward into the North American Plate. The width of the Cascadia Subduction Zone fault varies along its length, depending on the temperature of the subducted oceanic slab, which heats up as it is pushed deeper beneath the continent. As it becomes hotter and more molten it eventually loses the ability to store mechanical stress and generate earthquakes. An earthquake from this zone would be considered "the Big One," as it could travel over hundreds of miles and last for several minutes. Subduction zone earthquakes are considered to be the most destructive with potential magnitudes of 9.0 or greater. The last subduction zone earthquake is believed to have occurred in 1700.
3. Deep earthquakes occur along faults in the Juan de Fuca plate as it sinks beneath the North American plate. These earthquakes are located under the North American Plate, therefore their energy translation to the surface is buffered by their depth. Their depths generally range from 16-62 miles. Magnitudes of 7.5 have been recorded. The 1949, 1965, and 2001 earthquakes all emanated from this zone. The 2001 Nisqually earthquake's focus was located about 32 miles deep below its epicenter on Anderson Island.

## Impacts

The impact from earthquakes to communities is well evidenced by the catastrophic events in San Francisco and Los Angeles in the United States; Kobe, Japan; Chengdu, China; and Kashmir, Pakistan. Failed buildings, bridges, and other structures can trap or bury people causing injury and death. Damage to infrastructure such as roads, bridges, rail lines, runways, and almost all types of utilities is certain. Infrastructural failures can result in loss of public and private sector services and business. Communities are likely to face communication, electricity, motor fuel, and natural gas disruptions. Structural fires are a secondary hazard from earthquake destruction. Individuals and households may be displaced due to damaged homes. A subsequent economic downturn would likely result from major transportation disruptions and loss of revenue from suspended business and services.

In the Puget Sound Region, older unreinforced masonry structures such as buildings, walls, chimneys, and facades are vulnerable to crumbling from ground shaking. Areas with soft soils, such as downtown Olympia and adjacent neighborhoods have experienced these types of destruction during the 1949, 1965, and 2001 earthquakes.

Fire fighters, police, public works, and other safety and emergency personnel can quickly become over extended with response and recovery operations. Transportation disruptions will hinder emergency response to remote or hard to reach areas. Building and structural inspections will become priorities for public works and development services personnel and disrupt other operations.

The Washington State Hazard Mitigation Plan cites a study of an earthquake scenario of immense destruction and casualties. Should a magnitude 6.7 earthquake emanate from the Seattle Fault, a shallow crustal fault, the central Puget Sound could experience:

- Complete damage to at least 58,000 buildings, costing $36 billion
- More than 55,000 displaced households
- Possibly 2,400 deaths
- 800 injuries requiring hospitalization

Although tsunamis are known to impact the coast of Washington and some parts of the Puget Sound, the Thurston Region is unlikely to be impacted by this hazard. It is plausible that an earthquake emanating from an Olympia fault, or a large landslide off the southern tip of Harstene Island, could generate a one to two foot tsunami. However the inundation and subsequent damage from such a tsunami scenario would be minimal.[8] Should the Washington coast be struck, the entire region could be indirectly affected by evacuating populations. Local governments in Thurston County could likely be challenged with response and recovery support assistance to affected populations and communities.

## Probability of Occurrence

Earthquakes are certain to impact the Thurston Region in the future. The following probabilities of occurrence for the three earth quake sources are offered by the Washington State Hazard Mitigation Plan:

- Crustal Earthquake - A magnitude 6.5 or greater earthquake is estimated to occur once about every 333 years in the Puget Sound Lowlands
- Subduction Zone Earthquake - A magnitude 9.0 earthquake is estimated to recur every 350 to 500 years.
- Deep Earthquakes - Five magnitude 6 or greater earthquakes have occurred in the Puget Sound basin since 1900. Since 2001, the Thurston region has been rocked by three deep earthquakes; spaced 16 and 36 years apart since 1949 and 1965 respectively (about every 26 years). It is estimated that a magnitude 7.1 earthquake (1949 type event) will occur every 110 years.

Regardless the source of earthquake, past events suggest that a destructive event reoccurs about every 26 years. Therefore, the overall probability of occurrence of a damaging earthquake is high.

## Earthquake Historical Occurrences and Impacts

<u>February 28, 2001, Federal Disaster 1361: Nisqually Earthquake</u>

At 10:54 a.m. a magnitude 6.8 earthquake produced strong ground shaking across Washington State. The epicenter was located near Anderson Island, approximately 11 miles north of Olympia near the Nisqually River Delta. The focus was located nearly 32 miles underground. The depth of the earthquake minimized the intensity of the shaking and limited the impact to the built environment. In

addition, drought conditions in the Puget Sound region reduced the number of landslides and amount of liquefaction that would have otherwise been caused by a quake of that magnitude with saturated soils. Nevertheless, the observations of geotechnical engineers indicate that liquefaction was widespread in parts of Olympia and South Seattle. Several significant lateral spreads, embankment slides, and landslides also occurred. The relatively long duration of the event and the relatively low cyclic resistances of some of the fills in the area are likely causes for the significant liquefaction and ground failure which occurred.

Thurston County was among the hardest hit counties in the State. A federal disaster declaration was issued only one day after the event. Statewide, the Nisqually earthquake resulted in 700 injuries (a dozen of them serious) and one confirmed death (a trauma-induced heart attack). Federal Emergency Management Agency (FEMA) reported that 41,414 people registered for federal disaster aid, more than three times the number of a previous disaster in Washington.

One year after the earthquake, news reports put reported property damage at approximately $500 million. However, when factoring in unreported damage, actual losses may run significantly higher. A University of Washington study of damage to households only, estimates that the earthquake caused $1.5 billion in damage to nearly 300,000 residences, or almost one in four households in the Puget Sound area.[9] This estimate does not include public and business sector losses. Other estimates of the combined losses to public, business, and household property have ranged from $2 billion to $4 billion.

Building damage varied throughout the region. In particular, Downtown Olympia, including many historic structures, and Seattle's historic Pioneer Square area were hit hard. Unreinforced brick masonry buildings with un-braced parapets and without wall anchors were particularly vulnerable, resulting in several collapses. In many cases, fallen brick resulted in damage to objects, such as cars and canopies, outside the building. This type of damage mirrored the damage of the 1949 Olympia earthquake.

Most buildings performed well from a life-safety standpoint, in that the limited structural damage that occurred caused no loss of life or collapse. However, the economic cost of nonstructural damage, i.e., damage to nonessential building elements, such as architectural features, ceiling failures, shifting of equipment, fallen furniture/shelving, desktop computer damage, fallen light fixtures, and losses due to lost productivity, was high. In general, new buildings and buildings that had recently been seismically upgraded typically displayed good structural performance, but many still sustained non-structural damage.

In the Puget Sound region, over a thousand buildings were either red-tagged or yellow-tagged for inspection. Many of these businesses were declared unsafe and were closed for weeks. Other businesses, most with non-structural, cosmetic damage, closed temporarily for detailed inspections. While severe structural damage to businesses was relatively limited, non-structural damage, and the associated business disruption, caused significant economic loss.

In Unincorporated Thurston County, 120 buildings were inspected, two buildings red-tagged, and six buildings yellow-tagged. In Olympia, 27 buildings were closed immediately following the earthquake.

Several of the government buildings in Olympia, including the capitol, were significantly damaged. Other state agency buildings were closed for inspection and repair. The 74 year-old capitol dome sustained a deep crack in its limestone exterior and damage to supporting columns. There were a number of other non-structural damage areas throughout the Legislative Building. Previously scheduled renovation of the building was started early to accommodate $20 - $22 million in earthquake repairs and seismic upgrades.

Damage to residences came in a variety of forms, from severe mudslide destruction of entire houses to breakage of replaceable personal property. The most common damage was to chimneys. FEMA records indicate that one-third of the 30,000 homes inspected by FEMA sustained chimney damage. In the City of Olympia, chimney damage in the South Capitol neighborhood was the most concentrated of anywhere in Puget Sound. The 40-80-foot depth of loosely consolidated soils and gravel found in the South Capitol neighborhood of Olympia serves as a conduit for earthquake energy that is particularly hard on single-family homes.

Other residential areas hit hard include road and foundation failures in a Nisqually area mobile home park and the Tumwater Mobile Estates in Tumwater. Residents of 50 mobile homes in Tumwater Mobile Estates were evacuated when a gas line ruptured during the earthquake. Part of a private street located within the mobile home park, a block of Pine Street, collapsed into a neighboring pond, taking two unoccupied cars into the water.

Transportation systems suffered extensive damage. There was serious damage to the region's largest airport, the Seattle-Tacoma International Airport. While the area's overall road network remained functional, numerous parts of highways, roads, and bridges were damaged. Several state routes and local roadways were closed due to slumping and pavement fractures.

The 4th Avenue Bridge in Olympia was one of four bridges in the state to suffer substantial damage from the quake. Constructed in 1920 and retrofitted after the 1949 earthquake, the bridge had been scheduled for replacement even before the 2001 earthquake. The closure of the bridge severely restricted access to downtown Olympia and the City's west side. Replacing the bridge and connecting infrastructure cost $39 million; the largest public works endeavor in the city's history.

According to the State, the Deschutes Parkway in Olympia suffered the most damage of any road in the state. Waterlogged soil under the road liquefied during the shaking. Huge voids were created beneath portions of the concrete road surface. Sections of road and sidewalk buckled from the force of the earthquake. This road, a vital link between downtown Olympia, the city's west side and Tumwater, was closed to traffic for 20 months. Preliminary estimates to fix the road were put at $7 million.

A number of landslides occurred. Most of these slides occurred in natural materials, including a 400 foot slide on the northeast side of Capitol Lake. Other slides occurred in engineered fills, particularly at locations where they spanned low-lying areas of natural soils. A flow slide removed part of Highway 101 just west of Olympia, closing both northbound lanes of traffic, as well as Madrona Beach Road. Some damage to earth structures occurred. The failure of a large retaining wall (a mechanically stabilized earth wall, or MSE) supporting the parking lot of the Extended Stay America hotel on Mottman Road was caused by the earthquake.

With the exception of transportation systems, lifeline systems generally performed well during the earthquake. Lifeline systems include water, wastewater, electrical power, communications, natural gas, and liquid fuels, and transportation systems. The impact of lifeline damage was in most cases minimal. Puget Sound Energy reported 200,000 customer power outages, and Seattle City Light reported 17,000 outages, but power was restored to most within a day. Landline and wireless communication systems were extremely overloaded immediately following the earthquake.

Only five of the state's 290 dams were found to have earthquake-related damage. One of these was the McAllister Springs Reservoir Dam in Thurston County.

April 29, 1965, Federal Disaster 196: Seattle Tacoma Earthquake

A magnitude 6.5 earthquake struck the Puget Sound Region at 7:28 a.m.. The epicenter was located about 12 miles north of Tacoma at a depth of about 40 miles. Damage from the 1965 quake killed seven people and damage was estimated to be $12.5 million; with much of the loss in King County. In Olympia, the Union Pacific Railroad reported a hillside fill slid away from beneath a 400-foot section of a branch line just outside Olympia. Damage to the legislative building forced the closure of the legislative session. Governor Dan Evans closed the Capitol Campus and state government operations came to a standstill except for retention of key personnel and critical services. In the Temple of Justice, cracks developed in the walls of the law library; a cabinet tipped over; books scattered around the floors; pictures fell from walls. In the Legislative Building, there was a crack about 3-feet long on the inside of the inner dome of the rotunda. The 5-ton chandelier in the Capitol Building swung like a pendulum clock on its 110-foot chain in a 1-foot orbit for half an hour after the shock. The new post office was damaged considerably and ordered closed. A road around Capitol Lake, at the base of the Capitol complex, was damaged, allowing water to flow beneath the road. St. Peters Hospital reported four persons were treated for minor injuries. Damage to light fixtures and elevator shafts in the Capitol Building was about $200,000; damage to the road and railroad was estimated at the same amount. Chimney and interior plaster damage occurred throughout Olympia, but the greatest damage occurred in the area between 15th Avenue and 20th Avenue and between Capitol Way and Cherry Street.[10]

April 13, 1949, Olympia Earthquake

A magnitude 7.1 earthquake rattled the region at 11:55 a.m. The epicenter was located about eight miles north-northeast of Olympia. Property damage for the Puget Sound Region likely exceeded $25 million (1949 dollars). Eight capitol buildings in Olympia were damaged with a loss of two million dollars. Two deaths occurred. Nearly all large buildings in Olympia were damaged through cracked or fallen walls and plaster. Two large smokestacks and many chimneys fell. Streets were damaged extensively. Water and gas mains were broken. A large portion of a sandy spit jutting into Puget Sound north of the city disappeared completely during the earthquake.[11]

## Delineation of Earthquake Hazard Area

In 2003, the hazard mitigation planning workgroup factored the location of damage from the 2001 Nisqually earthquake as a factor for determining which risk levels to use in defining the earthquake

hazard area. Areas most damaged reflected liquefaction susceptibility levels. The previous plan's earthquake hazard extent was confined to the north urban core of the County, as the liquefaction susceptibility data was limited to this area. In 2004, the Washington State Department of Natural Resources updated the Liquefaction Susceptibility Map of Thurston County to include the entire County. The data tables in this hazard profile reflect data for the entire county. The earthquake hazard area is defined by the areas of the County with a liquefaction risk levels between "Low to Moderate" and "High." Map 4.1.1 shows earthquake liquefaction hazard area.

### Communities Most Vulnerable to Earthquake

The following communities contain "High" liquefaction susceptibility levels and are at the greatest risk for earthquake damage (reference Map 4.1.1):

1. The City of Olympia
   - The entire Port Peninsula property more or less north of State Avenue
   - The entire margin of the north basin of Capitol Lake from Marathon Park to Budd Inlet, including Deschutes Parkway, the isthmus between Capitol Lake and West Bay, and the 4th and 5th Avenue Bridge Corridors
   - The filled portions of the western shore of West Bay including the site of the future West Bay Park and the former Hardel Plywood property
   - The Henderson Boulevard/Moxlie Creek corridor from north of Watershed Park to East Bay
2. The City of Tumwater
   - The entire Deschutes River Valley from Henderson Boulevard SE to the former Olympia Brewery
   - Percival Creek vicinity from Trosper Road SW to Sapp Road SW
3. Thurston County
   - The north and west end of Young Cove on the Steamboat Island Peninsula in the vicinity of the Gravelly Beach Road NW and Gravelly Beach Loop NW intersections
   - Mud Bay at the southern end of Eld Inlet along Delphi Rd to 40th Ave SW. Highway 101 runs through this vicinity
   - The Deschutes River valley from Henderson Boulevard SE to north of Offut Lake
   - The entire Nisqually River Delta
4. The Town of Bucoda
   - Most of the town is located on alluvial soils deposited by the Skookumchuck River.

## Population and Employment in the Hazard Area

Approximately 99,200 people (43 percent) and 73,800 employees (61 percent) live and work respectively in the area designated as at risk for earthquakes. Estimates of the region's population and employment in the earthquake hazard area are summarized in tables 4.1.3 through 4.1.6. These

tables assesses an aspect of current and future vulnerability by providing data on the number of people living and working within the hazard area as compared to total population, by jurisdiction, in the years 2006 and 2030.

The Washington State Emergency Management Division calculated the annualized earthquake loss for all Washington counties using a hazard loss estimation tool called HAZUS. This model factors for the probability of ground motion occurring in the study area and the consequences of the ground motion. Parameters include direct economic losses to buildings attributed to repair and replacement, damage of contents, and loss of income. Note that this loss estimate represents a long term average and the analysis is based on state and federal data sets. The Washington State Hazard Mitigation Plan reports that Thurston County has an annualized earthquake loss of $6,732,000. An annualized earthquake loss ratio was also calculated. This ratio represents the annualized earthquake loss as a fraction of the replacement value of the building inventory. Thurston County has a 0.05 annualized earthquake loss ratio.[12]

Estimates of the region's structures and their contents in the earthquake hazard area is summarized in tables 4.1.7 through 4.1.10. These tables provide an estimate of the number of existing and future structures which may be potentially affected by the hazard, as well as an estimate of structure and building contents value in order to provide information on potential dollar losses. No detailed earthquake hazard scenario analysis of potential losses was conducted during the planning process. Tables are provided by jurisdiction, for the years 2006 and 2030.

## Critical Facilities and Infrastructure in Hazard Area

Based on historical earthquake community impacts, it is clear that earthquakes can destroy or damage facilities that may be critical for responding to the disaster and for maintaining a safe environment and public order. Among these are communications installations; electrical generation and transmission facilities; water storage, purification, and pumping facilities; sewage treatment facilities; hospitals; and police and fire stations. In addition, earthquakes can seriously disrupt the transportation network; bridges can be knocked out, and roads and highways damaged or blocked by debris, further isolating resources. In a major earthquake, almost all surface means of transportation within a community may be disrupted, particularly in the initial stages of the hazard event.

Specific information on the location of critical facilities and infrastructure is housed with the Emergency Management Council of Thurston County. Critical facilities include both public and private facilities.

Table 4.1.14 lists the type and number of critical facilities located in the earthquake hazard area.

## Summary Assessment

History suggests a high probability of occurrence of another damaging earthquake sometime in the next 25 years. With the 2001 Nisqually earthquake still fresh in the region's memory, it is important to note that it was not the largest earthquake event possible in the Puget Sound region. It is conceivable that a similar magnitude earthquake could emanate from a shallow crustal fault which would result in much greater damages. Damage from the 1949, 1965, and 2001 earthquakes indicate that an earthquake of a greater magnitude would have a catastrophic impact on Thurston County. Considering that a large population lives and works in higher risk earthquake hazard areas, the entire region has a high vulnerability rating. Accordingly, a high risk rating is assigned.

**Summary Risk Assessment for Earthquakes in the Thurston Region**

| Earthquake | Probability of Occurrence | Vulnerability | Risk |
|---|---|---|---|
| | High | High | High |

## Table 4.1.1: Earthquake Hazard Area, by Jurisdiction

| Jurisdiction | | Total Acres | Earthquake Hazard Area: In Hazard Area | Earthquake Hazard Area: % In Hazard Area |
|---|---|---|---|---|
| Bucoda | **Total** | **379.6** | 237.9 | **62.7%** |
| Lacey | City | 10549.7 | 3885.0 | 36.8% |
| | UGA | 10645.1 | 2871.1 | 27.0% |
| | **Total** | **21194.9** | **6756.1** | **31.9%** |
| Olympia | City | 11858.8 | 5894.1 | 49.7% |
| | UGA | 4119.2 | 2634.6 | 64.0% |
| | **Total** | **15978.0** | **8528.7** | **53.4%** |
| Rainier | City | 1104.8 | 0.0 | 0.0% |
| | UGA | 319.5 | 0.0 | 0.0% |
| | **Total** | **1424.2** | **0.0** | **0.0%** |
| Tenino | City | 924.0 | 58.4 | 6.3% |
| | UGA | 65.2 | 0.4 | 0.6% |
| | **Total** | **989.3** | **58.8** | **5.9%** |
| Tumwater | City | 9274.2 | 6837.2 | 73.7% |
| | UGA | 5811.5 | 4483.8 | 77.2% |
| | **Total** | **15085.7** | **11321.0** | **75.0%** |
| Yelm | City | 3633.7 | 0.0 | 0.0% |
| | UGA | 2395.9 | 0.0 | 0.0% |
| | **Total** | **6029.6** | **0.0** | **0.0%** |
| Ground Mound UGA | **Total** | **982.9** | **73.6** | **7.5%** |
| Chehalis Tribe | **Total** | **832.6** | **831.7** | **99.9%** |
| Nisqually Tribe | **Total** | **1699.5** | **490.3** | **28.9%** |
| **Total Cities** | | **37724.9** | **16912.5** | **44.8%** |
| **Total UGAs** | | **24339.4** | **10063.6** | **41.3%** |
| **Total Reservations** | | **2532.1** | **1322.0** | **52.2%** |
| **Rural Unincorporated County** | | **406242.4** | **54119.2** | **7.5%** |
| **Thurston County Total** | | **470838.8** | **82417.4** | **17.5%** |

## Table 4.1.2: Earthquake Hazard Area, by Special Districts

| | | | Earthquake Hazard | |
|---|---|---|---|---|
| | | Total Acres | In Hazard Area | % In Hazard Area |
| **Fire Districts** | | | | |
| | Bucoda | 379 | 238 | 63% |
| | Olympia | 11,882 | 5,920 | 50% |
| | Tumwater[1] | 10,057 | 7,552 | 75% |
| 1,11 | Rochester/Littlerock[2] | 101,349 | 19,801 | 20% |
| 2,4 | Yelm/Rainer[2] | 83,420 | 3,368 | 4% |
| 3 | Lacey | 45,769 | 16,559 | 36% |
| 6 | East Olympia | 25,108 | 9,793 | 39% |
| 7 | North Olympia | 7,060 | 1,656 | 23% |
| 8 | South Bay | 13,113 | 3,520 | 27% |
| 9,5 | McLane/Black Lake[2] | 50,984 | 2,688 | 5% |
| 12 | Tenino | 44,254 | 3,807 | 9% |
| 13 | Griffin | 13,953 | 833 | 6% |
| 16 | Gibson Valley | 19,081 | 4,025 | 21% |
| 17 | Bald Hills | 44,962 | 2,803 | 6% |
| **School Districts** | | | | |
| Centralia | | 12,852 | 2,799 | 22% |
| Griffin | | 21,768 | 840 | 4% |
| North Thurston | | 48,504 | 17,489 | 36% |
| Olympia | | 51,918 | 9,577 | 18% |
| Rainier | | 35,550 | 1,369 | 4% |
| Rochester | | 68,314 | 13,764 | 20% |
| Tenino | | 70,501 | 7,012 | 10% |
| Tumwater | | 73,848 | 24,727 | 33% |
| Yelm | | 126,543 | 10,682 | 8% |
| **Other Participating Jurisdictions (Service Area)** | | | | |
| Intercity Transit | | 62,333 | 26,035 | 42% |
| LOTT* | | 21,160 | 11,277 | 53% |
| (*Sewered Area). | | | | |
| **Colleges** | | | | |
| SPSCC-Main Campus | | 92 | 0 | 0% |
| TESC - Main Campus | | 939 | 10 | 1% |
| **Non-Profit** | | | | |
| Providence St. Peter Hospital | | 157 | 109 | 69% |

**Note:** The service areas for the following participating jurisdictions are multi-county: Thurston County PUD, Timberland Regional Library (see local annex for details)

[1]Munn Lake Fire District 15 contracts services with the City of Tumwater Fire Department; its data is combined with Tumwater's.
[2]Fire Districts 1 and 11, 2 and 4, 5 and 9 have joint operations agreements; therefore the data for the paired districts is combined.

## Table 4.1.3: Earthquake Hazard Area, Population by Jurisdiction, 2006 and 2030

| | | 2006 Population Estimate | | | 2030 Population Forecast | | |
|---|---|---|---|---|---|---|---|
| Jurisdiction | | Total | In Hazard Area | % In Hazard Area | Total | In Hazard Area | % In Hazard Area |
| Bucoda | **Total** | **650** | **605** | **93%** | **1,050** | **940** | **90%** |
| Lacey | City | 34,115 | 22,210 | 65% | 52,015 | 29,385 | 56% |
| | UGA | 32,820 | 8,045 | 25% | 54,740 | 17,770 | 32% |
| | **Total** | **66,935** | **30,255** | **45%** | **106,755** | **47,155** | **44%** |
| Olympia | City | 44,350 | 24,725 | 56% | 64,385 | 35,170 | 55% |
| | UGA | 10,820 | 7,630 | 71% | 17,710 | 12,970 | 73% |
| | **Total** | **55,170** | **32,355** | **59%** | **82,095** | **48,140** | **59%** |
| Rainier | City | 1,675 | 0 | 0% | 2,540 | 0 | 0% |
| | UGA | 115 | 0 | 0% | 355 | 0 | 0% |
| | **Total** | **1,790** | **0** | **0%** | **2,895** | **0** | **0%** |
| Tenino | City | 1,525 | 85 | 6% | 3,110 | 225 | 7% |
| | UGA | 20 | 0 | 0% | 475 | 0 | 0% |
| | **Total** | **1,545** | **85** | **6%** | **3,585** | **225** | **6%** |
| Tumwater | City | 15,475 | 11,970 | 77% | 27,610 | 21,060 | 76% |
| | UGA | 6,180 | 5,340 | 86% | 13,805 | 11,690 | 85% |
| | **Total** | **21,655** | **17,310** | **80%** | **41,415** | **32,750** | **79%** |
| Yelm | City | 4,570 | 0 | 0% | 21,025 | 0 | 0% |
| | UGA | 1,335 | 0 | 0% | 3,035 | 0 | 0% |
| | **Total** | **5,905** | **0** | **0%** | **24,060** | **0** | **0%** |
| Grand Mound UGA | **Total** | **845** | **125** | **15%** | **2,685** | **360** | **13%** |
| Chehalis Reservation[1] | **Total** | **35** | **35** | **100%** | **175** | **175** | **100%** |
| Nisqually Reservation[1] | **Total** | **635** | **240** | **38%** | **940** | **270** | **29%** |
| **Total Cities** | | **102,360** | **59,600** | **58%** | **171,735** | **86,780** | **51%** |
| **Total UGAs[2]** | | **52,140** | **21,140** | **41%** | **92,810** | **42,790** | **46%** |
| **Total Reservations[1]** | | **670** | **275** | **41%** | **1,115** | **445** | **40%** |
| **Rural Unincorporated County[3]** | | **75,880** | **18,180** | **24%** | **107,285** | **27,034** | **25%** |
| **Thurston County Total** | | **231,100** | **99,200** | **43%** | **372,900** | **157,000** | **42%** |

**Source:** Thurston Regional Planning Council Population Forecast, 2007.

**Explanations:** Numbers may not add due to rounding.

[1]Data is for Thurston County portion of reservation only.

[2]UGA - Urban Growth Area. Unincorporated area designated to be annexed into city limits over 20 years time to accommodate urban growth.

[3]Rural unincorporated county is the portion of the unincorporated county that lies outside UGA and Reservation boundaries.

## Table 4.1.4: Earthquake Hazard Area, Population - Special Districts, 2006 and 2030

| | | 2006 Population Estimate | | | 2030 Population Forecast | | |
|---|---|---|---|---|---|---|---|
| | | Total | In Hazard Area | % In Hazard Area | Total | In Hazard Area | % In Hazard Area |
| **Fire Districts** | | | | | | | |
| | Bucoda | 650 | 605 | 93% | 1,050 | 940 | 90% |
| | Olympia | 44,380 | 24,725 | 56% | 64,505 | 35,170 | 55% |
| | Tumwater[1] | 16,365 | 12,855 | 79% | 29,855 | 23,300 | 78% |
| 1,11 | Rochester/Littlerock[2] | 20,200 | 5,830 | 29% | 33,665 | 11,695 | 35% |
| 2,4 | Yelm/Rainier[2] | 19,390 | 170 | 1% | 43,935 | 640 | 1% |
| 3 | Lacey | 78,040 | 39,205 | 50% | 121,245 | 59,580 | 49% |
| 6 | East Olympia | 11,815 | 7,300 | 62% | 17,430 | 11,650 | 67% |
| 7 | North Olympia | 3,920 | 1,675 | 43% | 4,730 | 1,885 | 40% |
| 8 | South Bay | 7,165 | 2,180 | 30% | 11,050 | 4,145 | 38% |
| 9,5 | McLane/Black Lake[2] | 14,990 | 2,710 | 18% | 21,420 | 4,105 | 19% |
| 12 | Tenino | 5,425 | 715 | 13% | 10,580 | 1,455 | 14% |
| 13 | Griffin | 5,075 | 340 | 7% | 6,870 | 675 | 10% |
| 16 | Gibson Valley | 465 | 285 | 61% | 1,430 | 860 | 60% |
| 17 | Bald Hills | 3,170 | 455 | 14% | 5,170 | 950 | 18% |
| **School Districts** | | | | | | | |
| Centralia | | 380 | 230 | 61% | 1,190 | 785 | 66% |
| Griffin | | 5,885 | 350 | 6% | 7,885 | 690 | 9% |
| North Thurston | | 85,305 | 40,425 | 47% | 131,365 | 61,675 | 47% |
| Olympia | | 58,000 | 29,335 | 51% | 83,735 | 41,885 | 50% |
| Rainier | | 4,580 | 190 | 4% | 16,110 | 400 | 2% |
| Rochester | | 12,555 | 1,845 | 15% | 19,380 | 3,790 | 20% |
| Tenino | | 9,175 | 1,885 | 21% | 17,985 | 3,355 | 19% |
| Tumwater | | 34,185 | 22,490 | 66% | 57,795 | 39,795 | 69% |
| Yelm | | 21,040 | 2,440 | 12% | 37,565 | 4,670 | 12% |
| **Other Participating Jurisdictions (Service Area)** | | | | | | | |
| Intercity Transit | | 143,815 | 76,335 | 53% | 236,195 | 115,710 | 49% |
| LOTT* | | 95,525 | 57,340 | 60% | 230,265 | 128,045 | 56% |

(*Sewered Area for 2006; Lacey, Olympia Tumwater UGA for 2030).

**Note:** The service areas for the following participating jurisdictions are multi-county or county-wide: The Evergreen State College, South Puget Sound Community College, Thurston County PUD, Port of Olympia, Timberland Regional Library

[1]Munn Lake Fire District 15 contracts services with the City of Tumwater Fire Department; its data is combined with Tumwater's.
[2]Fire Districts 1 and 11, 2 and 4, 5 and 9 have joint operations agreements; therefore the data for the paired districts is combined.

## Table 4.1.5: Earthquake Hazard Area, Employment, 2006 and 2030

| Jurisdiction | | 2006 Employment Estimate | | | 2030 Employment Forecast | | |
|---|---|---|---|---|---|---|---|
| | | Total | In Hazard Area | % in Hazard Area | Total | In Hazard Area | % in Hazard Area |
| Bucoda | **Total** | **35** | **35** | **100%** | **175** | **110** | **63%** |
| Lacey | City | 21,955 | 14,055 | 64% | 34,120 | 17,355 | 51% |
| | UGA | 5,195 | 915 | 18% | 7,995 | 1,800 | 23% |
| | **Total** | **27,150** | **14,970** | **55%** | **42,115** | **19,155** | **45%** |
| Olympia | City | 53,400 | 36,420 | 68% | 70,870 | 47,385 | 67% |
| | UGA | 1,470 | 1,120 | 76% | 2,550 | 1,990 | 78% |
| | **Total** | **54,870** | **37,540** | **68%** | **73,420** | **49,375** | **67%** |
| Rainier | City | 375 | 0 | 0% | 1,065 | 0 | 0% |
| | UGA | 10 | 0 | 0% | 20 | 0 | 0% |
| | **Total** | **385** | **0** | **0%** | **1,085** | **0** | **0%** |
| Tenino | City | 810 | 45 | 6% | 2,100 | 95 | 5% |
| | UGA | 35 | 0 | 0% | 45 | 0 | 0% |
| | **Total** | **845** | **45** | **5%** | **2,145** | **95** | **4%** |
| Tumwater | City | 17,775 | 14,450 | 81% | 28,260 | 24,275 | 86% |
| | UGA | 2,270 | 2,085 | 92% | 4,850 | 4,595 | 95% |
| | **Total** | **20,045** | **16,535** | **82%** | **33,110** | **28,870** | **87%** |
| Yelm | City | 3,290 | 0 | 0% | 8,080 | 0 | 0% |
| | UGA | 325 | 0 | 0% | 545 | 0 | 0% |
| | **Total** | **3,615** | **0** | **0%** | **8,625** | **0** | **0%** |
| Grand Mound UGA | **Total** | **445** | **5** | **1%** | **1,110** | **105** | **9%** |
| Chehalis Reservation[1] | **Total** | **860** | **860** | **100%** | **2,450** | **2,075** | **85%** |
| Nisqually Reservation[1] | **Total** | **720** | **15** | **2%** | **1,650** | **15** | **1%** |
| **Total Cities** | | **97,640** | **65,010** | **67%** | **144,670** | **89,220** | **62%** |
| **Total UGAs [2]** | | **9,750** | **4,130** | **42%** | **17,120** | **8,490** | **50%** |
| **Total Reservations[1]** | | **1,580** | **875** | **55%** | **4,100** | **2,090** | **51%** |
| **Rural Unincorporated County[3]** | | **12,370** | **3,810** | **31%** | **18,795** | **5,580** | **30%** |
| **Thurston County Total** | | **121,300** | **73,800** | **61%** | **184,700** | **105,400** | **57%** |

**Source:** Thurston Regional Planning Council Population Forecast, 2007.

**Explanations:** Numbers may not add due to rounding.

[1]Data is for Thurston County portion of reservation only.

[2]UGA - Urban Growth Area. Unincorporated area designated to be annexed into city limits over 20 years time to accommodate urban growth.

[3]Rural unincorporated county is the portion of the unincorporated county that lies outside UGA and Reservation boundaries.

## Table 4.1.6: Earthquake Hazard Area, Employment - Special Districts, 2006 and 2030

| | | 2006 Employment Estimate | | | 2030 Employment Forecast | | |
|---|---|---|---|---|---|---|---|
| | | Total | In Hazard Area | % In Hazard Area | Total | In Hazard Area | % In Hazard Area |
| **Fire Districts** | | | | | | | |
| | Bucoda | 35 | 35 | 100% | 175 | 110 | 63% |
| | Olympia | 53,445 | 36,460 | 68% | 71,015 | 47,515 | 67% |
| | Tumwater[1] | 18,545 | 15,215 | 82% | 29,290 | 25,305 | 86% |
| 1,11 | Rochester/Littlerock[2] | 5,460 | 2,595 | 48% | 11,570 | 6,335 | 55% |
| 2,4 | Yelm/Rainier[2] | 5,510 | 140 | 3% | 12,030 | 225 | 2% |
| 3 | Lacey | 29,625 | 16,580 | 56% | 45,875 | 21,130 | 46% |
| 6 | East Olympia | 2,095 | 1,400 | 67% | 3,400 | 2,415 | 71% |
| 7 | North Olympia | 450 | 180 | 40% | 615 | 240 | 39% |
| 8 | South Bay | 1,110 | 395 | 36% | 1,645 | 645 | 39% |
| 9,5 | McLane/Black Lake[2] | 2,755 | 540 | 20% | 4,095 | 770 | 19% |
| 12 | Tenino | 1,240 | 155 | 13% | 3,075 | 345 | 11% |
| 13 | Griffin | 765 | 70 | 9% | 1,120 | 105 | 9% |
| 16 | Gibson Valley | 60 | 25 | 42% | 165 | 95 | 58% |
| 17 | Bald Hills | 240 | 45 | 19% | 610 | 130 | 21% |
| **School Districts** | | | | | | | |
| Centralia | | 40 | 25 | 63% | 115 | 70 | 61% |
| Griffin | | 850 | 70 | 8% | 1,230 | 105 | 9% |
| North Thurston | | 37,675 | 23,295 | 62% | 57,820 | 31,735 | 55% |
| Olympia | | 48,130 | 30,535 | 63% | 62,085 | 38,015 | 61% |
| Rainier | | 855 | 35 | 4% | 2,005 | 80 | 4% |
| Rochester | | 3,790 | 1,620 | 43% | 7,600 | 3,405 | 45% |
| Tenino | | 1,755 | 235 | 13% | 4,115 | 595 | 14% |
| Tumwater | | 22,170 | 17,455 | 79% | 36,835 | 30,530 | 83% |
| Yelm | | 6,090 | 545 | 9% | 12,880 | 835 | 6% |
| **Other Participating Jurisdictions (Service Area)** | | | | | | | |
| Intercity Transit | | 104,795 | 67,300 | 64% | 154,615 | 93,600 | 61% |
| LOTT* | | 90,055 | 62,395 | 69% | 148,645 | 97,400 | 66% |

(*Sewered Area for 2006; Lacey, Olympia Tumwater UGA for 2030).

Note: The service areas for the following participating jurisdictions are multi-county or county-wide: The Evergreen State College, South Puget Sound Community College, Thurston County PUD, Port of Olympia, Timberland Regional Library

**Source:** Thurston Regional Planning Council Population Forecast, 2007.

**Explanations:** Numbers may not add due to rounding.

[1]Munn Lake Fire District 15 contracts services with the City of Tumwater Fire Department; its data is combined with Tumwater's.

[2]Fire Districts 1 and 11, 2 and 4, 5 and 9 have joint operations agreements; therefore the data for the paired districts is combined.

## Table 4.1.7: Earthquake Hazard Area, Residential Dwellings, 2006 and 2030

| Jurisdiction | | 2006 Dwelling Estimate Total | In Hazard Area | % in Hazard Area | 2030 Dwelling Forecast Total | In Hazard Area | % in Hazard Area |
|---|---|---|---|---|---|---|---|
| Bucoda | **Total** | **255** | **235** | **92%** | **420** | **375** | **89%** |
| Lacey | City | 14,995 | 10,040 | 67% | 23,390 | 13,575 | 58% |
| | UGA | 12,540 | 3,190 | 25% | 22,045 | 7,360 | 33% |
| | **Total** | **27,535** | **13,230** | **48%** | **45,435** | **20,935** | **46%** |
| Olympia | City | 20,820 | 11,530 | 55% | 31,655 | 17,210 | 54% |
| | UGA | 4,365 | 3,030 | 69% | 7,460 | 5,385 | 72% |
| | **Total** | **25,185** | **14,560** | **58%** | **39,115** | **22,595** | **58%** |
| Rainier | City | 610 | 0 | 0% | 1,045 | 0 | 0% |
| | UGA | 45 | 0 | 0% | 155 | 0 | 0% |
| | **Total** | **655** | **0** | **0%** | **1,200** | **0** | **0%** |
| Tenino | City | 700 | 40 | 6% | 1,320 | 95 | 7% |
| | UGA | 5 | 0 | 0% | 195 | 0 | 0% |
| | **Total** | **705** | **40** | **6%** | **1,515** | **95** | **6%** |
| Tumwater | City | 7,370 | 5,575 | 76% | 12,975 | 9,895 | 76% |
| | UGA | 2,555 | 2,155 | 84% | 5,785 | 4,835 | 84% |
| | **Total** | **9,925** | **7,730** | **78%** | **18,760** | **14,730** | **79%** |
| Yelm | City | 2,000 | 0 | 0% | 9,410 | 0 | 0% |
| | UGA | 515 | 0 | 0% | 1,255 | 0 | 0% |
| | **Total** | **2,515** | **0** | **0%** | **10,665** | **0** | **0%** |
| Grand Mound UGA | **Total** | **325** | **45** | **14%** | **1,125** | **150** | **13%** |
| Chehalis Reservation[1] | **Total** | **15** | **15** | **100%** | **70** | **70** | **100%** |
| Nisqually Reservation[1] | **Total** | **225** | **85** | **38%** | **360** | **105** | **29%** |
| **Total Cities** | | **46,750** | **27,420** | **59%** | **80,215** | **41,150** | **51%** |
| **Total UGAs [2]** | | **20,350** | **8,420** | **41%** | **38,020** | **17,730** | **47%** |
| **Total Reservations[1]** | | **240** | **100** | **42%** | **430** | **175** | **41%** |
| **Rural Unincorporated County[3]** | | **29,795** | **7,065** | **24%** | **44,260** | **10,935** | **25%** |
| **Thurston County Total** | | **97,100** | **43,000** | **44%** | **162,900** | **70,000** | **43%** |

**Source:** Thurston Regional Planning Council Population Forecast, 2007.

**Explanations:** Numbers may not add due to rounding.

[1]Data is for Thurston County portion of reservation only.

[2]UGA - Urban Growth Area. Unincorporated area designated to be annexed into city limits over 20 years time to accommodate urban growth.

[3]Rural unincorporated county is the portion of the unincorporated county that lies outside UGA and Reservation boundaries.

**Table 4.1.8: Earthquake Hazard Area, Residential Dwellings - Special Districts, 2006 and 2030**

| | | 2006 Dwelling Estimate | | | 2030 Dwelling Forecast | | |
|---|---|---|---|---|---|---|---|
| | | Total | In Hazard Area | % In Hazard Area | Total | In Hazard Area | % In Hazard Area |
| **Fire Districts** | | | | | | | |
| | Bucoda | 255 | 235 | 92% | 420 | 375 | 89% |
| | Olympia | 20,840 | 11,535 | 55% | 31,725 | 17,215 | 54% |
| | Tumwater[1] | 7,755 | 5,960 | 77% | 13,940 | 10,865 | 78% |
| 1,11 | Littlerock/Rochester[2] | 7,525 | 2,180 | 29% | 13,295 | 4,585 | 34% |
| 2,4 | Yelm/Rainier[2] | 7,810 | 125 | 2% | 31,220 | 270 | 1% |
| 3 | Lacey | 31,885 | 16,810 | 53% | 51,430 | 26,150 | 51% |
| 6 | East Olympia | 4,550 | 2,805 | 62% | 7,015 | 4,655 | 66% |
| 7 | North Olympia | 1,690 | 735 | 43% | 2,150 | 865 | 40% |
| 8 | South Bay | 2,855 | 880 | 31% | 4,610 | 1,740 | 38% |
| 9,5 | McLane/Black Lake[2] | 6,000 | 1,025 | 17% | 8,830 | 1,595 | 18% |
| 12 | Tenino | 2,170 | 275 | 13% | 4,345 | 590 | 14% |
| 13 | Griffin | 2,315 | 155 | 7% | 3,315 | 330 | 10% |
| 16 | Gibson Valley | 175 | 105 | 60% | 580 | 345 | 59% |
| 17 | Bald Hills | 1,320 | 185 | 14% | 2,250 | 410 | 18% |
| **School Districts** | | | | | | | |
| Centralia | | 145 | 85 | 59% | 480 | 315 | 66% |
| Griffin | | 2,680 | 160 | 6% | 3,805 | 335 | 9% |
| North Thurston | | 35,325 | 17,645 | 50% | 56,380 | 27,510 | 49% |
| Olympia | | 25,740 | 12,995 | 50% | 39,095 | 19,615 | 50% |
| Rainier | | 1,780 | 75 | 4% | 7,180 | 170 | 2% |
| Rochester | | 4,570 | 605 | 13% | 7,515 | 1,355 | 18% |
| Tenino | | 3,600 | 725 | 20% | 7,335 | 1,355 | 18% |
| Tumwater | | 14,775 | 9,755 | 66% | 25,220 | 17,420 | 69% |
| Yelm | | 8,550 | 960 | 11% | 15,935 | 1,915 | 12% |
| **Other Participating Jurisdictions (Service Area)** | | | | | | | |
| Intercity Transit | | 62,475 | 33,975 | 54% | 105,855 | 52,965 | 50% |
| LOTT* | | 43,335 | 26,225 | 61% | 103,310 | 58,260 | 56% |

(*Sewered Area for 2006; Lacey, Olympia Tumwater UGA for 2030).

Note: The service areas for the following participating jurisdictions are multi-county or county-wide: The Evergreen State College, South Puget Sound Community College, Thurston County PUD, Port of Olympia, Timberland Regional Library

[1]Munn Lake Fire District 15 contracts services with the City of Tumwater Fire Department; its data is combined with Tumwater's.
[2]Fire Districts 1 and 11, 2 and 4, 5 and 9 have joint operations agreements; therefore the data for the paired districts is combined.

## Table 4.1.9: Earthquake Hazard Area, Valuation of Building and Contents, 2006 and 2008

| Jurisdiction | | Residential | | | Commercial/Industrial | | | Government/Institutional | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Total (mil. $) | In Hazard Area | % in Hazard Area | Total (mil. $) | In Hazard Area | % in Hazard Area | Total (mil. $) | In Hazard Area | % in Hazard Area |
| Bucoda | **Total** | **19** | **18** | **92%** | **1** | **1** | **100%** | **2** | **2** | **91%** |
| Lacey | City | 1,944 | 1,133 | 58% | 1,265 | 695 | 55% | 433 | 214 | 49% |
| | UGA | 2,036 | 514 | 25% | 112 | 12 | 11% | 133 | 39 | 30% |
| | **Total** | **3,980** | **1,646** | **41%** | **1,377** | **708** | **51%** | **567** | **253** | **45%** |
| Olympia | City | 3,062 | 1,722 | 56% | 1,952 | 1,162 | 60% | 1,727 | 1,455 | 84% |
| | UGA | 930 | 646 | 69% | 43 | 33 | 79% | 17 | 10 | 59% |
| | **Total** | **3,993** | **2,368** | **59%** | **1,994** | **1,195** | **60%** | **1,745** | **1,465** | **84%** |
| Rainier | City | 70 | 0 | 0% | 6 | 0 | 0% | 28 | 0 | 0% |
| | UGA | 7 | 0 | 0% | 0 | 0 | 0% | 0 | 0 | 0% |
| | **Total** | **77** | **0** | **0%** | **6** | **0** | **0%** | **28** | **0** | **0%** |
| Tenino | City | 75 | 5 | 7% | 17 | 0 | 0% | 42 | 10 | 24% |
| | UGA | 1 | 0 | 0% | 0 | 0 | 0% | 0 | 0 | 0% |
| | **Total** | **76** | **5** | **7%** | **17** | **0** | **0%** | **42** | **10** | **24%** |
| Tumwater | City | 1,039 | 782 | 75% | 703 | 545 | 78% | 423 | 380 | 90% |
| | UGA | 395 | 362 | 92% | 119 | 116 | 97% | 18 | 18 | 98% |
| | **Total** | **1,434** | **1,144** | **80%** | **822** | **661** | **80%** | **441** | **397** | **90%** |
| Yelm | City | 266 | 0 | 0% | 127 | 0 | 0% | 140 | 0 | 0% |
| | UGA | 76 | 0 | 0% | 6 | 0 | 0% | 11 | 0 | 0% |
| | **Total** | **342** | **0** | **0%** | **134** | **0** | **0%** | **151** | **0** | **0%** |
| Grand Mound UGA | **Total** | **15** | **2** | **15%** | **16** | **1** | **6%** | **15** | **0** | **0%** |
| Chehalis Reservation[1] | **Total** | **1** | **1** | **100%** | **9** | **9** | **100%** | **0** | **0** | **100%** |
| Nisqually Reservation[1] | **Total** | **11** | **0** | **1%** | **0** | **0** | **0%** | **50** | **0** | **0%** |
| **Total Cities** | | **6,476** | **3,660** | **57%** | **4,071** | **2,403** | **59%** | **2,797** | **2,061** | **74%** |
| **Total UGAs [2]** | | **3,460** | **1,524** | **44%** | **296** | **163** | **55%** | **194** | **67** | **35%** |
| **Total Reservations[1]** | | **12** | **1** | **10%** | **9** | **9** | **100%** | **50** | **0** | **0%** |
| **Rural Unincorporated County[3]** | | **5,672** | **1,223** | **22%** | **193** | **54** | **28%** | **755** | **101** | **13%** |
| **Thurston County Total** | | **15,620** | **6,408** | **41%** | **4,569** | **2,629** | **58%** | **3,796** | **2,229** | **59%** |

**Source:** Thurston Regional Planning Council Population Forecast, 2007.

**Explanations:** Numbers may not add due to rounding.

[1]Data is for Thurston County portion of reservation only.

[2]UGA - Urban Growth Area. Unincorporated area designated to be annexed into city limits over 20 years time to accommodate urban growth.

[3]Rural unincorporated county is the portion of the unincorporated county that lies outside UGA and Reservation boundaries.

## Table 4.1.10: Earthquake Hazard Area, Valuation of Building and Contents - Special Districts, 2006/2008

| | | Residential | | | Commercial/Industrial | | | Government/Institutional | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Total (mil. $) | In Hazard Area | % In Hazard Area | Total (mil. $) | In Hazard Area | % In Hazard Area | Total (mil. $) | In Hazard Area | % In Hazard Area |
| **Fire Districts** | | | | | | | | | | |
| | Bucoda | 19 | 18 | 92% | 1 | 1 | 100% | 2 | 2 | 91% |
| | Olympia | 3,064 | 1,722 | 56% | 1,952 | 1,162 | 60% | 1,727 | 1,455 | 84% |
| | Tumwater[1] | 1,091 | 834 | 76% | 755 | 598 | 79% | 424 | 380 | 90% |
| 1,11 | Rochester/Littlerock[2] | 1,114 | 308 | 28% | 126 | 53 | 42% | 135 | 60 | 44% |
| 2,4 | Yelm/Rainier[2] | 1,099 | 23 | 2% | 165 | 0 | 0% | 192 | 0 | 0% |
| 3 | Lacey | 4,783 | 2,222 | 46% | 1,415 | 744 | 53% | 640 | 273 | 43% |
| 4 | Rainier | 270 | 18 | 7% | 9 | 0 | 0% | 30 | 0 | 0% |
| 6 | East Olympia | 991 | 655 | 66% | 48 | 44 | 91% | 26 | 18 | 69% |
| 7 | North Olympia | 347 | 124 | 36% | 6 | 4 | 65% | 20 | 0 | 2% |
| 8 | South Bay | 719 | 212 | 29% | 20 | 2 | 9% | 13 | 10 | 77% |
| 9,5 | McLane/Black Lake[2] | 1,313 | 168 | 13% | 39 | 20 | 52% | 550 | 18 | 3% |
| 12 | Tenino | 313 | 42 | 13% | 29 | 1 | 3% | 45 | 13 | 28% |
| 13 | Griffin | 534 | 41 | 8% | 5 | 0 | 2% | 16 | 0 | 0% |
| 16 | Gibson Valley | 22 | 14 | 63% | 0 | 0 | 0% | 0 | 0 | 0% |
| 17 | Bald Hills | 211 | 27 | 13% | 8 | 0 | 3% | 4 | 0 | 1% |
| **School Districts** | | | | | | | | | | |
| Centralia | | 20 | 12 | 63% | 0 | 0 | 0% | 1 | 0 | 17% |
| Griffin | | 606 | 42 | 7% | 5 | 0 | 2% | 16 | 0 | 0% |
| North Thurston | | 5,475 | 2,345 | 43% | 1,931 | 1,180 | 61% | 642 | 286 | 45% |
| Olympia | | 4,540 | 2,189 | 48% | 1,500 | 744 | 50% | 2,151 | 1,466 | 68% |
| Rainier | | 258 | 14 | 5% | 9 | 0 | 0% | 30 | 0 | 0% |
| Rochester | | 572 | 76 | 13% | 75 | 19 | 25% | 107 | 40 | 38% |
| Tenino | | 536 | 95 | 18% | 42 | 2 | 5% | 49 | 16 | 33% |
| Tumwater | | 2,342 | 1,448 | 62% | 832 | 678 | 81% | 582 | 418 | 72% |
| Yelm | | 1,275 | 186 | 15% | 175 | 7 | 4% | 219 | 2 | 1% |
| **Other Participating Jurisdictions (Service Area)** | | | | | | | | | | |
| Intercity Transit | | 9,356 | 4,915 | 53% | 4,208 | 2,458 | 58% | 3,453 | 2,109 | 61% |
| LOTT* | | 6,438 | 3,698 | 57% | 3,604 | 2,291 | 64% | 2,443 | 1,930 | 79% |

*Sewered Area.

Note: The service areas for the following participating jurisdictions are multi-county or county-wide: The Evergreen State College, South Puget Sound Community College, Thurston County PUD, Port of Olympia, Timberland Regional Library

[1]Munn Lake Fire District 15 contracts services with the City of Tumwater Fire Department; its data is combined with Tumwater's.

[2]Fire Districts 1 and 11, 2 and 4, 5 and 9 have joint operations agreements; therefore the data for the paired districts is combined.

**Table 4.1.11: Earthquake Hazard Area, Valuation of Building and Contents - Colleges, 2006 and 2008**

| | Government/Institutional | | |
|---|---|---|---|
| | Total (mil. $) | In Hazard Area | % in Hazard Area |
| **College** | | | |
| The Evergreen State College | 505 | 0 | 0% |
| South Puget Sound Community College | 63 | 0 | 0% |

**Table 4.1.12: Earthquake Hazard Area, Valuation of Building and Contents - Multi-County Districts, 2006 and 2008**

| | Government/Institutional | | |
|---|---|---|---|
| | Total (1,000 $) | In Hazard Area | % in Hazard Area |
| **Thurston PUD** | | | |
| Thurston County | 1,780 | 448 | 25% |
| Lewis County | 1,046 | 52 | 5% |
| Grays Harbor County | 69 | 0 | 0% |
| Mason County | 63 | 0 | 0% |
| Pierce County | 1,204 | 19 | 2% |
| **Total** | 4,162 | 519 | 12% |
| **Timberland Regional Library** | | | |
| Thurston County | 6,700 | 6,625 | 99% |
| Lewis County | 4,533 | 1,656 | 37% |
| Grays Harbor County | 4,277 | 1,366 | 32% |
| Mason County | 5,273 | 0 | 0% |
| Pacific County | 2,698 | 2,248 | 83% |
| **Total** | 23,481 | 11,895 | 51% |

**Note**: The service areas for these jurisdictions are multi-county-wide

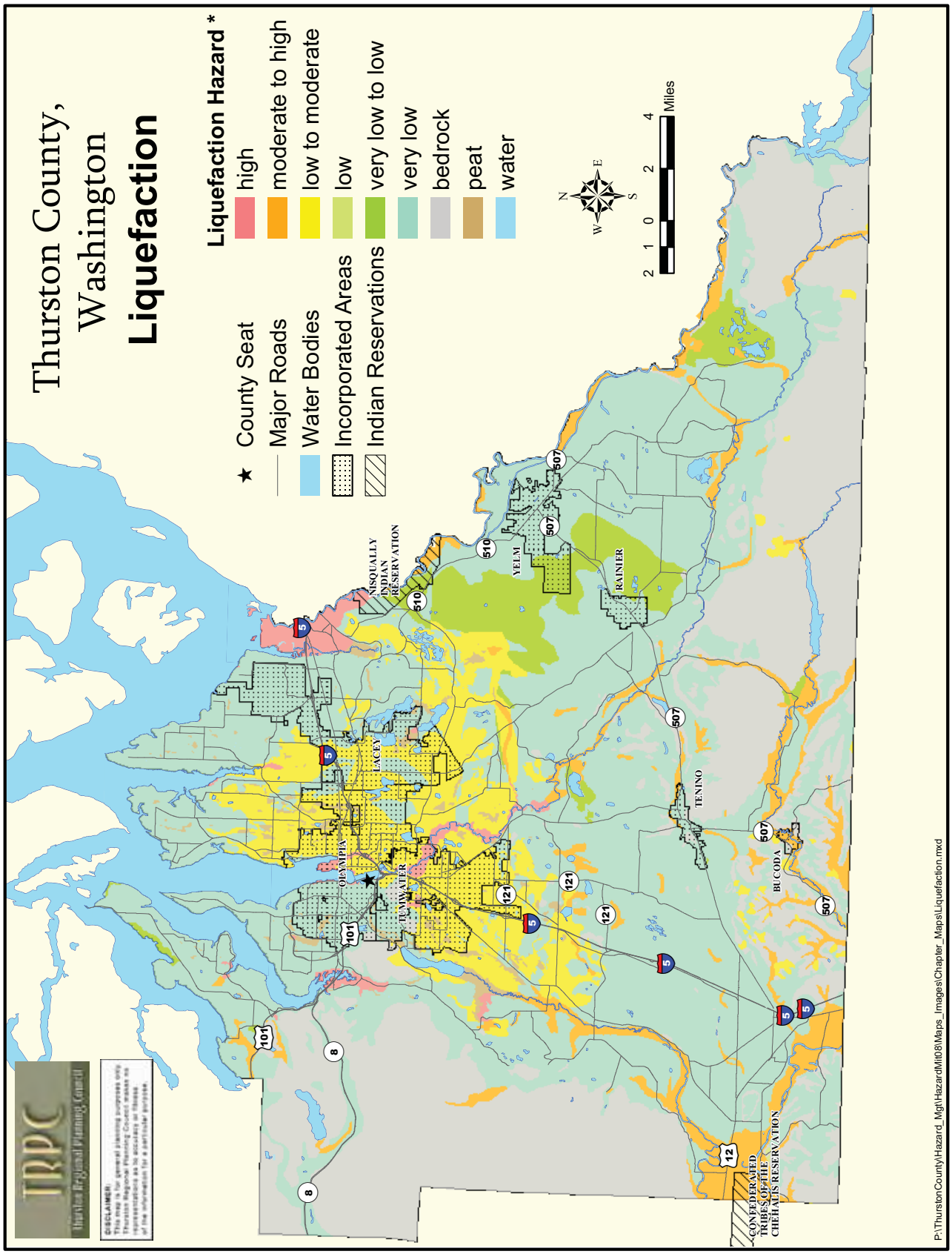
**Table 4.1.13: Earthquake Hazard Area, Valuation of Building and Contents - Non-Profit 2006/2008**

| | Government/Institutional | | |
|---|---|---|---|
| | Total (mil. $) | In Hazard Area | % In Hazard Area |
| **Hospital** | | | |
| Providence St. Peter Hospital | 401 | 401 | 100% |

## Table 4.1.14: Critical Facilities in Earthquake Hazard Zone

| Critical Facility Sector and Subsector | Total | In Hazard Area | % In Hazard Area |
|---|---|---|---|
| **1. AGRICULTURE/FOOD SUPPLY** | **22** | **14** | 63.6% |
| 1.1 PRODUCTION | 2 | 1 | 50.0% |
| 1.2 FOOD DISTRIBUTION/STORAGE | 20 | 13 | 65.0% |
| **2. GOVERNMENT** | **135** | **50** | 37.0% |
| 2.1 FIRE SERVICES | 43 | 10 | 23.3% |
| 2.2 LAW ENFORCEMENT | 9 | 3 | 33.3% |
| 2.3 EMERGENCY OPERATIONS CENTERS | 11 | 5 | 45.5% |
| 2.4 CORONER/MORGUE | 1 | 0 | 0.0% |
| 2.5 SHELTER | 69 | 30 | 43.5% |
| 2.7 AMBULANCE | 3 | 2 | 66.7% |
| **4. MEDICAL CARE** | **84** | **44** | 52.4% |
| 4.1.A HOSPITALS | 4 | 2 | 50.0% |
| 4.1.B LARGE CLINICS | 36 | 22 | 61.1% |
| 4.1.B LARGE CLINICS - RURAL | 5 | 0 | 0.0% |
| 4.1.C URGENT CARE | 6 | 3 | 50.0% |
| 4.1.D SURGICAL SUITES | 6 | 2 | 33.3% |
| 4.2 CHEMICAL DEPENDENCY TREATMENT CENTER | 1 | 0 | 0.0% |
| 4.3A METHADONE | 1 | 0 | 0.0% |
| 4.3B DIALYSIS | 1 | 1 | 100.0% |
| 4.3C MENTAL HEALTH | 2 | 2 | 100.0% |
| 4.3D BIRTHING CENTERS | 2 | 1 | 50.0% |
| 4.4 NURSING HOMES | 7 | 4 | 57.1% |
| 4.5 ASSISTED LIVING FACILITIES | 13 | 7 | 53.8% |
| **5. UTILITIES** | **8** | **2** | 25.0% |
| 5.5 RADIO/TELEVISION | 2 | 1 | 50.0% |
| 5.6 DATA TRANSMISSION LINES | 1 | 1 | 100.0% |
| 5.8 SOLID WASTE MANAGEMENT | 5 | 0 | 0.0% |
| **6. TRANSPORTATION** | **16** | **6** | 37.5% |
| 6.3 ROADS - CENTERLINE MILES | 1951 | 628 | 32.2% |
| 6.4 VEHICLE FUEL | 4 | 1 | 25.0% |
| 6.5 STUDENT TRANSPORTATION | 8 | 1 | 12.5% |
| 6.6 MASS TRANSIT | 2 | 2 | 100.0% |
| 6.7 PORT | 1 | 1 | 100.0% |
| **Grand Total** | **265** | **116** | 43.8% |

**Map 4.1.1**


Thurston County, Washington
Liquefaction
Liquefaction Hazard *
high
moderate to high
low to moderate
low
very low to low
very low
bedrock
peat
water
County Seat
Major Roads
Water Bodies
Incorporated Areas
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Miles
NISQUALLY INDIAN RESERVATION
YELM
RAINIER
LACEY
OLYMPIA
TUMWATER
TENINO
BUCODA
CONFEDERATED TRIBES OF THE CHEHALIS RESERVATION
P:\ThurstonCounty\Hazard_Mgt\HazardMit08\Maps_Images\Chapter_Maps\Liquefaction.mxd

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# Chapter 4.2: Storm Hazard Profile

## Introduction

Of all the natural hazards that occur, storm events are the only hazards that can be readily predicted. Advances in weather forecasting technology allow for relatively accurate predictions of pending storms, their area of impact, and their likely effects three to five days before they occur. This grants populations time to take safety precautions. But even with advance notification, communities remain vulnerable as evidenced by storm impacts that have frequently buffeted this region over the last decade.

Severe weather events are the most frequent source of natural disasters for Thurston County and its communities. Between 1962 and 2009, 19 of 23 Presidential Disaster Declarations for Thurston County were attributed to damage resulting from the effects of winter storms (principally damage from floods). Storms cause injury and sometimes death, but also cause significant property damage and disrupt daily life. In 2007, severe storms killed 19, injured 15, and caused $197 million in damage statewide in Washington.[1] The high reoccurrence rate of Pacific Northwest storms, the record of historical damage, and the repetitive response and recovery costs associated with these destructive events make the region highly vulnerable to storm events. Thus the overall risk rating for severe storms in the Thurston Region is high.

**Heavy rain and snow can cause flooding and landslides**. Floods and landslides frequently result from heavy rain and/or melting snow in Thurston County. These hazards are treated independently in this plan. Refer to the flood and landslide hazard profiles for more information.

## Hazard Identification

A severe storm is a meteorological event generated by atmospheric conditions. The most destructive storms in western Washington occur from October through April delivering sustained high speed directional winds and higher than normal levels of precipitation. These storms cause significant property damage, power loss, and disruption of services across all sectors of local communities. Winter storms are deadly because sustained sub-freezing temperatures pose significant operational problems for transportation. They also greatly increase the risk of hypothermia for elderly, low income and homeless populations, or much larger populations when electrical power is disrupted. Thunderstorms also occur in Thurston County. These storms deliver hail, lightning, and tornados to the region, but thunderstorm events are much less common, shorter lasting, and the impacts and damages are much more isolated than winter storms.

High winds, heavy rain, heavy snow, freezing rain, tornados, hail, and lightning all impact the Thurston Region. Each element poses a threat and merits inclusion in this hazard profile. Winter storms that impact Thurston County usually pack more than one hazardous element at a time or deliver stand alone elements in consecutive blows such as a snow followed by heavy rain followed by a windstorm. This section defines each element, its severity, its impacts, and its probability of occurrence.

# 1. High Winds/Windstorms

## Definition

The National Weather Service defines high winds as "sustained wind speeds of 40 mph or greater lasting for 1 hour or longer, or winds of 58 mph or greater for any duration."[2] Generally, winds above 30 mph can cause widespread damage and those above 50 mph can lead to more serious disasters. Most large windstorms that affect the region are delivered by mid-latitude eastern Pacific cyclones. Northern Hemisphere cyclones are large-scale storms with winds that rotate counterclockwise around a central region of low atmospheric pressure. These cyclones obtain their energy from the large horizontal variation in temperature in the mid-latitudes (30° to 60° north). Mid-latitude cyclones are not as powerful as tropical hurricanes. However they can generate wind speeds in excess of 100 mph and can maintain their strength farther inland and affect a much larger area of land.[3] The Puget Sound Region's most powerful southerly and westerly winds typically come from these storm systems when their low pressure centers move from southwest to northeast and cross the coast between the northern tip of the Olympic Peninsula to central Vancouver Island. Other landfall trajectories from northern Oregon to the central Washington coast are also capable of causing wide spread destruction in Thurston County.

## Severity

The coastal mountains afford Thurston County some protection from severe southerly and westerly winds. The coastal mountain range acts as a buffer and shields the region from extreme winds in excess of 80 mph. Thurston County does not encounter the 100 mph or greater winds that sometimes wreak havoc on Washington's Pacific coast communities. Nevertheless, the entire region is directly or indirectly susceptible to the effects of high winds. Neighborhoods with stands of tall conifer trees are the most vulnerable to property damage. All communities can suffer power outages and be left in the cold and dark for extended periods.

The average monthly wind speed at the Olympia Airport, as recorded over a 49 year period, is between 6 and 7 mph. Fifty-nine winter windstorm events have buffeted the Pacific Northwest from October 1950 to December 2007.[4] Nine of these events produced peak gusts over 58 mph at the Olympia Airport weather station. The most powerful windstorm in the last 100 years occurred on Columbus Day, October 12, 1962. This storm tracked northeast along the Washington coast and produced record peak wind gusts of 78 mph at the Olympia Airport. The Beaufort Scale is provided as reference for damage effects relative to wind speed.

## Impacts

The Thurston Region, like most of western Washington, is vulnerable to high winds because of the climatic conditions and the prevalence of 100 to 150 foot tall conifer trees. High winds weaken standing trees and structures that are weighted with snow or ice. Douglas fir and western hemlock tree species have shallow lateral root systems with top heavy crowns and entire trees are vulnerable to falling when soils are soaked from previous rainfall. Regular autumn rains saturate soils and decrease tree roots' ability to adhere to soil. Sustained high winds and gusts cause trees to sway significantly. Repetitive swaying motion can eventually weaken a tree's root hold in the saturated

ground and force it to topple. These tall columnar trees and their massive branches act like giant hammers and sever electrical transmission lines, crush vehicles, damage homes and buildings, and block transportation routes. Falling tree limbs and other flying debris can injure or cause the death of people and animals. Downed power lines have caused electrocutions elsewhere in the greater Puget Sound Region.

Widespread power outages can take several days to restore. The total mass of downed debris on the transportation network impedes the response capabilities of emergency personnel and utility crews. Electrical blackouts force the closure of government offices, businesses, and schools. Power outages can disrupt traffic operations due to debris road blocks, unpowered traffic signals, and traffic snarls resulting in thousands of motorists seeking few available alternate routes on local arterials and collectors. When power outages occur simultaneously with heavy stormwater flows, public works crews may struggle to provide auxiliary power to sewer lift stations to prevent backups or flooding in suburban and urbanized areas.

People without power may lack backup home heating systems and may suffer from hypothermia if temperatures persist below freezing levels. Out of desperation, some people may resort to heating their homes with BBQ grills unaware of the risks of carbon monoxide poisoning. The risk of home fires increases county-wide as people use candles to light their homes or start wood fires in stoves or fireplaces that are structurally faulty or have excessively dirty or blocked chimneys. Individuals with home powered life support systems, such as oxygen respirators or suction equipment, may be at risk of health complications if backup power systems are not available. Low income populations are particularly impacted by loss of food due to spoilage from lack of refrigeration.

Between 1960 and 2007, 79 windstorms have occurred in western Washington that caused at least $50,000 or more in damage area wide. The combined damages from these wind storms are estimated to have cost the Thurston Region in excess of $27 million dollars (adjusted to 2007 dollar value).[5]

## Probability of Occurrence

The Washington State Natural Hazard Mitigation Plan identified Thurston County and 22 other counties as susceptible to high winds. Counties that were considered most vulnerable to high winds are those with an annual high wind recurrence rate of 100 percent. The State plan indicated that Thurston County's annual high wind recurrence rate is 175 percent. At least 18 notable Pacific Northwest cyclones have impacted the Thurston Region in the last 25 years, thus probability of occurrence is high.

**Beaufort Scale**

| Scale | Wind Speed (mph) | Description | Land conditions |
|---|---|---|---|
| 0 | <1 | Calm | Calm. Smoke rises vertically. |
| 1 | 1 to 3 | Light air | Wind motion visible in smoke. |
| 2 | 3 to 7 | Light breeze | Wind felt on exposed skin. Leaves rustle. |
| 3 | 8 to 12 | Gentle breeze | Leaves and smaller twigs in constant motion. |
| 4 | 13-17 | Moderate breeze | Dust and loose paper raised. Small branches begin to move. |
| 5 | 18-24 | Fresh breeze | Branches of a moderate size move. Small trees begin to sway. |
| 6 | 25-30 | Strong breeze | Large branches in motion. Whistling heard in overhead wires. Umbrella use becomes difficult. Empty plastic garbage cans tip over. |
| 7 | 31-38 | High wind, Moderate Gale, Near Gale | Whole trees in motion. Effort needed to walk against the wind. Swaying of skyscrapers may be felt, especially by people on upper floors. |
| 8 | 39-46 | Fresh Gale | Twigs broken from trees. Cars veer on road. |
| 9 | 47-54 | Strong Gale | Larger branches break off trees, and some small trees blow over. Construction/ temporary signs and barricades blow over. Damage to circus tents and canopies. |
| 10 | 55-63 | Whole Gale/ Storm | Trees are broken off or uprooted, saplings bent and deformed, poorly attached asphalt shingles and shingles in poor condition peel off roofs. |
| 11 | 64-72 | Violent storm | Widespread vegetation damage. More damage to most roofing surfaces, asphalt shingles that have curled up and/or fractured due to age may break away completely. |
| 12 | ≥73 | Hurricane-force | Considerable and widespread damage to vegetation, a few windows broken, structural damage to mobile homes and poorly constructed sheds and barns. Debris may be hurled about. |

## 2. Heavy Rain

### Definition

The quantity of rainfall that constitutes heavy conditions varies by location and season. In general, heavy rainfall is any amount of rain produced in a relatively short period of time that exceed the capacity of natural systems' or infrastructural systems' ability to effectively and safely convey the flow of water. Excess water flows and accumulations can lead to hazardous conditions such as flooding and erosion. Excess rainfall can saturate soils on steep slopes which make them susceptible to mudslides or landslides. (See Flood Hazard Profile for more information on precipitation patterns related to flooding)

### Severity

Prolonged heavy rains typically occur from November through February. The entire region is directly or indirectly affected by heavy rainfall. Properties are at greater risk if they are located in flood plains, areas with high ground water, areas with stormwater drainage problems, or are on or closely adjacent to steep slopes. The region overall is moderately vulnerable to flood.

### Impact

The most common impacts from heavy rainfall are flooding and erosion. Prolonged rain delivered by weather systems north of the Hawaiian Islands dubbed "Pineapple Express" rainstorms, can rapidly melt snow in the Cascade Mountains and lowlands. This precipitation can cause rivers to rise quickly and cause flooding downstream in valleys, and cause widespread landslides both in the uplands and the lowlands. Local rainfall also swells local creeks and streams exacerbating local flood potential. Refer to flood and landslide hazards for more information on these impacts.

### Probability of Occurrence

Considering that 18 of 23 federal disaster declarations, for the period of 1962 to 2009, resulted in major flooding, damaging heavy rain has a 38 percent annual probability of occurrence. Damaging heavy rains have a high probability of occurring.

## 3. Freezing Rain

### Description

Freezing rain occurs when rain descends through a cold air mass, cools and then subsequently freezes on contact with cold surfaces. An ice coat will continue to accumulate on surfaces as long as conditions exist. Ice can accumulate to thicknesses well over one inch.

### Severity

The entire County is susceptible to the effects of an ice storm of the magnitude experienced on December 26, 1996. This storm resulted in ice accumulations of one-quarter to three-quarter inch thick. The December 2008 winter storm delivered freezing rain, but accumulations of ice were less than 1 to 3 mm. Ice can accumulate on nearly every surface including tree branches, power lines, roof tops, motor vehicles, streets, sidewalks, and traffic signals and signs. Transportation networks are especially vulnerable to freezing rain as it coats nearly every exposed paved surface.

### Impacts

The weight of thick ice accumulations can stress structures causing trees and power lines to snap. Downed live power lines can ignite fires. Dangerous driving conditions and power outages almost guarantee the closure of government offices, businesses, and schools. Despite the issuance of sound advice in travel alerts to avoid travel, the demand for emergency assistance to respond to traffic accidents can quickly overwhelm the capacity of local fire and law enforcement personnel.

### Probability of Occurrence

Although trace freezing rain events occasionally occur, the December 26, 1996 event was the most damaging Pacific Northwest ice storm in the last 50 years. The scarcity of an event of this magnitude suggests that the annual recurrence rate may be one to two percent or occur every 50 to 100 years. Therefore the probability of a major destructive freezing rain event in the next 25 years is low.

# 4. Heavy Snow

## Definition

The Washington State Hazard Mitigation Plan defines heavy snow as four inches of snowfall in 12 hours or six inches in 24 hours for non-mountainous areas. This amount is sufficient to disrupt activities in Thurston County. In general, heavy snow is any amount of snowfall that exceeds the ability of communities to maintain relatively normal levels of public and private sector services.

Falling snow mixed with high winds produces a blizzard. According to the National Weather Service, a blizzard occurs with the following conditions "… [Three hours or more of] sustained wind or frequent gusts to 35 miles an hour or greater; and considerable falling and/or blowing snow (i.e., reducing visibility frequently to less than ¼ mile)."

## Severity

Heavy snowfall affects all of Thurston County. Snowfall in the Puget Sound lowlands typically occurs from mid-November through early March, with most accumulations occurring from December through February. Light snow, less than four inches deep, can temporarily disrupt normal traffic operations on roads and streets until public works departments clear priority routes. In general, snow hazards and road clearing abilities become more problematic with decreasing temperatures, increasing snow depth, and increasing length of time that snow remains on the ground. Even when priority routes are clear, numerous neighborhood streets and local collectors can remain impassable for many motorists when snow depths exceed one foot.

The average annual snowfall for Thurston County is 18 inches (Olympia Airport Weather Station 1948-2007). Most periods of snow fall generally do not exceed four to six inches within a 24 hour period. However, accumulations that exceed one foot do occur with the right combination of Pacific moisture and cold arctic air. Weather station records indicate that this has happened at least six times in Thurston County since 1948. December 1968 to January 1969 is the period of record. A total of 81.5 inches of snow fell during the two month period resulting in snow depths likely exceeding the 24 inches officially recorded at the Olympia Airport weather station. Snow remained at least one foot deep through the first two weeks of February. It should be noted that data from the Olympia Airport weather station is limited and more extreme snow conditions are likely to occur elsewhere in the County. Larger snowfalls and greater depths typically occur at higher elevations and distances further away from the Puget Sound.

## Impacts

Blizzard like conditions dramatically reduces motorists' visibility, especially in the dark, and can lead to motor vehicle accidents. Blizzards affect all modes of transportation. Heavy snowfall, even in windless conditions, presents serious hazards. Icy road conditions can lead to vehicle accidents resulting in property damage, injuries, and fatalities. Significant snowfall can disrupt surface transportation networks for several days and overwhelm the snow removal capabilities of public works entities, delay public transit services, as well as delay response times and/or the overall mobility of emergency responders. Truck freight distribution can also be delayed and could result

in shortages of certain goods such as fuel. Deep snow and sustained freezing temperatures can force the suspension or closure of both public and private sector services for several days. Excessive snow loads on structures can cause roofs and utility lines to collapse. Structural collapses are more likely when snow loads gain additional weight from subsequent absorption of rain. Flat roofs, sheds, carports, and awnings are vulnerable to collapse from excessive snow loads. During the melting period, snow can block storm drains and cause localized flooding.

### Probability of Occurrence

Between the period of 1948-1994, 23 snow events with depths greater than four inches and five snow events with depths greater than one foot were recorded at the Olympia Airport weather station (snow data not collected at this station from 1996 to present). The annual recurrence rate for depths greater than four inches is 50 percent and 11 percent for depths greater than one foot. There is a high probability that a heavy snow event will occur in the next 25 years.

## 5. Tornado

### Definition

The National Weather Service defines a tornado as "a violently rotating column of air, usually pendant to a cumulonimbus [cloud], with circulation reaching the ground. It nearly always starts as a funnel cloud and may be accompanied by a loud roaring noise. On a local scale, it is the most destructive of all atmospheric phenomena." Tornadoes are the most unpredictable weather phenomena.

### Severity

The extent and severity of a tornado depends on its location, the length of touchdown time, and the strength or wind speed of the tornado event. The Fujita scale classifies tornados according to their wind speed. In western Washington, tornados have occurred during the months of March, April, May, June, August, September, October, November, and December. A total of 94 tornados have been documented in Washington State between 1950 and 2005.[6] Of these, 46 were F0, 29 were F1, 12 were F2, and 3 were F3. Damaging tornados are rare in Thurston County. No tornados have adversely affected densely populated areas of Thurston County and historic damage was isolated to small areas. Storm records suggest that a tornado could potentially touchdown anywhere in the lowlands of the County, but would not likely exceed a Fujita scale 1 (F1). Between 1950 and 2008, four small tornados (three F0, and one was F1) occurred in Thurston County near Bucoda, Tenino, Yelm and Lacey in 1994, 2003, 2004, and 2006 respectively.[7]

No deaths or serious injuries resulting from tornados have occurred in the County. It is interesting to note that three of the tornados occurred within a three year period for the 58-year period of recorded observations. Although tornados are rare in Thurston County, disastrous tornados have occurred elsewhere in western Washington. On April 5, 1972, an F3 tornado (wind speed 158-206 mph) touched down in Portland, Oregon and created a nine mile path of destruction north to Vancouver. In Vancouver, the tornado ripped through a grocery store, a bowling alley, a shopping mall, and an elementary school. It caused six deaths, 300 injuries, and nearly $50 million in damages.[8]

### Impacts

High speed rotating winds can rip apart buildings, fences, street signs, and vegetation. The tornado and the circulating winds in its vicinity can project debris several hundred feet away from the source of destruction. People and animals can be injured or killed by flying objects.

### Probability of Occurrence

Based on little published data available from the National Climate Data Center, the annual probability of a tornado occurring in Thurston County is seven percent, thus a low probability rating is assigned.

**Fujita Scale**

| F-Scale | Wind Strength | Description of Damage |
|---|---|---|
| F0 | 40-72 mph | **Minimal Damage** - Some damage to chimneys, TV antennas, roof shingles and windows. Breaks branches off trees, pushes over shallow-rooted trees, damages sign boards. |
| F1 | 73-112 mph | **Moderate Damage** - Automobiles overturned, carports destroyed, trees uprooted, peels surface off roofs, mobile homes pushed off foundations or overturned, moving autos pushed off the roads. |
| F2 | 113-157 mph | **Major Damage** - Roofs torn off frame homes, sheds and outbuildings are demolished, mobile homes overturned or destroyed, boxcars pushed over; large trees snapped or uprooted, light object missiles generated. |
| F3 | 158-206 mph | **Severe Damage** - Exterior walls and roofs blown off well-built houses, metal buildings collapsed or are severely damaged, trains overturned, forests and farmland flattened, heavy cars lifted off the ground and thrown. |
| F4 | 207-260 mph | **Devastating Damage** - Few walls, if any, standing in well-built houses, structures with weak foundations blown off some distance, large steel and concrete missiles thrown far distances, cars thrown. |
| F5 | 261-318 mph | **Incredible Damage** - Homes leveled with all debris removed, strong frame houses lifted off foundations and carried considerable distances to disintegrate. Schools, motels, and other larger structures have considerable damage with exterior walls and roofs gone, steel reinforced concrete structures badly damaged. Automobile sized missiles fly through the air in excess of 100 meters, trees debarked. |

## 6. Hail

### Description

Hail is precipitation that takes the form of ice balls or clusters of ice clumps. They can range in size from 5 mm to several inches in diameter. Hail forms in cumulonimbus or thunderstorm clouds that have strong updrafts.

### Severity

Most hail storms in Thurston County produce small non-destructive hail. The records of damaging hail storms are scant and suggest that damage from these events is limited and only small geographical areas are likely to be affected. Although it is possible that a hail storm could unleash destructive hail to any portion of the County, the extent of the damage would likely be limited.

### Impacts

Hail poses the greatest risk during its descent. Large hailstones can cause serious injury by striking people and animals and damage structures and vehicles. Hail storms may damage crops, but the extent or cost estimates of any past agriculture related damage within Thurston County is unknown.

### Probability of Occurrence

Damaging hail storms are rare in Thurston County. Based on the historical information available, a hail storm producing hail greater than 0.75 inches in diameter has a five percent annual recurrence rate. The probability of a damaging hail event is low.

## 7. Lightning

### Description

Lightning is an atmospheric discharge of electricity that typically occurs with thunderstorms. A lightning bolt can travel at 60,000 meters per second and reach temperatures of 54,000°F.

### Severity

Lightning storms in Thurston County are short lived and events generally only affect a small area. However, the entire County is potentially vulnerable to lightning strikes. Lightning has not caused widespread damage and historically it has not posed a serious threat to the region. Historic records indicate that lighting storms in Thurston County are most likely to occur from April through September. This time period coincides with the dry season so it is conceivable that a larger than normal wildfire could result from lightning strikes over Thurston County forest lands.

### Impacts

There are no documented lightning fatalities in Thurston County. Multiple lightning events have resulted in some injuries and damage in various locations throughout the region.[9] Lightning can strike people causing burn injuries, paralysis, or even death. It can also start fires, split trees, and disrupt power transmission. Since 1973 at least 19 wildland fires were ignited by lightning in Thurston County. A total of 17 acres are known to have burned. The largest fire burned 15 acres on private timberland in a remote area of southeast Thurston County in June 2004.[10] Damage estimates for these fires are unknown.

### Probability of Occurrence

Destructive lightning storms are rare in Thurston County. The annual recurrence rate for a lightning related injury is four percent. The annual recurrence rate for a lighting strike resulting in a small fire is 47 percent. The overall probability of a lightning event causing damage or injury is moderate.

## Historical Occurrences and Impacts of Storm Hazards in Thurston County

Several notable storms have impacted the Thurston Region over the last few decades. It is important to highlight the effects and damages of these storms to emphasize the severity, cost, and vulnerabilities associated with these events. Estimates of potential dollars losses for future storm events were not calculated as part of the storm hazard risk assessment. Previous storm events perhaps offer the best indication of the types of future losses that local communities are likely to experience with future storms.

December 12-27, 2008, Federal Disaster1825: Severe Winter Storm[11]

Near record snowfalls, freezing rain, and rain combined with sustained subfreezing temperatures froze the Thurston Region for a period of nearly two weeks making it one of the worst snow-laden winter storms in decades. Successive snowfall over the first week resulted in 18 to 20 inch depths in the Lacey, Olympia, and Tumwater area. Depths of 36 inches were reported by some county residents at higher elevations outside of city limits. Governor Gregoire declared a state of emergency on December 24. On March 2, a Presidential Disaster Declaration was declared for 27 counties, including Thurston County.

Public works crews struggled to keep roads free of daily snow accumulations, resulting in slick roads with deep icy ruts on many road segments throughout the cities and County. Most neighborhood streets never saw a snow plow, making vehicular travel and outings near impossible for many of the region's residents. Blizzard like conditions on Interstate 5 caused about 20 collisions in one hour alone, including a pile up involving three tractor trailers and six cars that closed the interstate near Littlerock Road. By December 18, the Washington State Patrol responded to 54 collisions and assisted 45 drivers with disabled vehicles in Thurston County.

Over 7,000 residents and businesses lost power. Area shelters operated above capacity in an attempt to shelter the region's homeless population. On December 26, fire officials evacuated about 65 seniors from a wing of the Olympics West Retirement Inn in Tumwater due to unstable roof conditions stressed by excessive snow load.

Area schools closed three days prior to Christmas break. Thurston County closed its offices on December 18 and 22. Other local governments and colleges also closed their offices entirely or had delayed openings or early closures due to road conditions.

On December 25, a 2500 square foot section of Capital High School's roof, on Olympia's west side, collapsed from the strain of the snow load. Overhead fire sprinklers were activated and caused water damage to parts of the school's interior including the library. A natural gas pipe rupture contributed to a week delay of the school's reopening after Christmas break. Overall repair costs may exceed $7 million.

Preliminary damage assessment estimates for the damage to public facilities, response costs, and snow removal costs exceed $500,000 for all local agencies region wide (excluding Capitol H.S.).

Private sector structural damage estimates exceed $430,000 and personal damage was estimated around $114,000.

December 1-7, 2007 Federal Disaster 1734: Severe Winter Storm, Landslides, and Flooding

Snow followed by heavy rain and winds caused record flooding on the Chehalis River. The Deschutes and Black rivers rose above their banks. Communities experienced stream and urban flooding and flash flood conditions in the Capital Hills and Capital Forest resulted in washouts, landslides, and urban flooding on major intersections in Olympia's west side. See flood and landslide hazard profiles for more details on this event.

October 18, 2007 Windstorm

The Olympian reported that wind gusts of 44 mph knocked down trees and power lines across Thurston County causing scattered power outages in mostly rural areas. The City of Olympia closed its parks as an emergency measure. A power line fell on an Olympia School District bus en route to pick up students; the driver was not injured.

January 5, 2007 Windstorm

Sustained winds of 22 mph and a peak gust of 40 mph toppled trees and disrupted power for about 9,500 households in Thurston County.

December 14-15, 2006 "The Hanukkah Eve Storm" Federal Disaster 1682: Severe Winter Storm, Landslides, and Mudslides

The December 14-15 storm included snow, rain, and high winds. The windstorm may have produced the most damaging winds to hit the Pacific Northwest since the Columbus Day Storm of October 12, 1962.[12] The Hanukkah eve storm achieved sustained winds of 36 mph and gusts of 53 mph as recorded at the Olympia Airport weather station before it lost power. KGY Radio, located on Budd Inlet, reported wind gust of 78 mph at 12:30 a.m. on the 15th. Wind gusts exceeded 100 mph along parts of the Oregon coast. November rains saturated area soils resulting in significant fallen trees and broken limbs. Strong winds knocked down 85 of Puget Sound Energy's 208 high–voltage transmission lines and 159 of 358 neighborhood substations. 700,000 PSE customers lost power. An estimated 1.5 million customers lost power for all northwest utility customers combined. In Washington, the storm claimed at least 13 lives. The Thurston region experienced the following impacts and losses[13]:

- 9-1-1 received over 5000 calls on the evening of December 14.
- In the City of Olympia, 13 residences were red-tagged and six were yellow-tagged.
- Over 80,000 homes, businesses and critical facilities lost power in Thurston County. Some households were without power for over one week.
- In the urban corridor, entire phone switches went down and the phone service's central offices were either not operational or on battery backup.
- On December 16, the County documented over 70 closed roads. Many more went undocumented.

- The power outage affected gasoline, water, sewage and solid waste disposal facilities. City water and sewage pump stations had to be powered by generators or other means of backup power. Critical environmental instrumentation at the County Waste and Recovery Center operated on backup power.
- Some cable television customers lost service for nearly a week, disrupting a vital news source and internet access.
- Heavy rains produced flooding on the Chehalis, Deschutes, and Skookumchuck Rivers. It also caused flooding from storm water runoff. This resulted in additional road closures and damage to County and private roads and bridges.
- Five Thurston County residents were transported for specialized medical care because of carbon monoxide poisoning; at least one died.
- Downed trees cause multiple vehicle accidents including two fatalities from two separate incidents.
- The storm cost Thurston County $456,000 in response and recovery costs.
- Countywide, a total of $898,000 in damages to local government buildings, facilities, and parks was reported to Thurston County Emergency Management.

November 2-11, 2006 Federal Disaster 1671: Severe Winter Storm, Flooding, Landslides, and Mudslides

On November 6, 3.4 inches of rain fell; a 24 hour rainfall record for the day the year. The Heavy rains caused flooding of urban roads and streets throughout the Thurston Region. Preliminary damage assessments for personal and business property damage exceeded $300,000.

May 27, 2004 F1 Tornado

An F1 tornado touched down four miles southwest of Tenino tearing a metal roof off a barn, splintering the buildings timbers, broke windows in an adjacent building, and snapped a 12 inch diameter Ponderosa pine tree into two pieces. Debris was strewn in an area 200 yards wide by a quarter mile long. The damages estimate was $50,000 to $75,000.[14]

January 6, 2004 Snow Storm

Six to nine inches of snow fell around Thurston County. Area schools and some businesses closed for up to three days.

May 17, 2003 Lightning Strike

A Thurston County woman was temporarily partially paralyzed when lightning struck a nearby tree outside her mobile home.[15]

October 15-23, 2003 Federal Disaster 1499: Severe Storms and Flooding

Thurston County was included in this federal disaster declaration, but storm damage to Thurston County was negligible.

June 17, 2002 Lightning Strike

A 17 year old boy was struck by lightning while he was working outside in Lacey. He sustained minor burns, some hearing loss and a headache. The tree next to him was stripped of its bark.[16]

September 5, 2002 Lightning Strike

Lightning struck a garage in Lacey, a state owned building, and a tree in the Olympia area. The garage, filled with antiques, was destroyed. The state owned building lost power and the tree was split.[17]

December/January 1996/1997 Federal Disaster 1159, Ice, Wind, Snow, Landslides, and Flooding

Snow, ice, and freezing rain crippled Thurston County on December 26. This storm produced the worst freezing rain event to hit the south Puget Sound region in decades. 53,000 electric customers lost power due to snapped power lines and downed trees. Downed power lines ignited four tree fires in the Tumwater Hill neighborhood. Sub-freezing temperatures and power outages persisted for over a week into early January. A family of four suffered carbon monoxide poisoning after using a BBQ grill to heat their home. County-wide, local governments reported $3.14 million in damage and clean up costs. Local residents reported $980,000 in uninsured damages.

September 1, 1997 Hail Storm

Golf ball sized hail was reported to have fallen in the vicinity of Yelm and broke several car windshields. No estimate of damages is available from this event.[18]

December 12, 1995 Windstorm

A windstorm caused widespread destruction from northern California to British Columbia. Wind gust of 57 mph rattled the Thurston Region causing widespread power outages to nearly 45,000 households and businesses. Road closures from fallen trees and limbs forced the closure of many local and state government offices and area businesses. One Mason County woman was killed when a power transformer exploded near her home setting her residence on fire. First responders could not reach her home due to road blocks.

April 6, 1994 F0 Tornado

An F0 tornado touched down near the main street of Bucoda. Several buildings sustained damage. Damage included aluminum sheds blown over or moved, rain gutters torn off buildings, and a twisted street sign. A piece of one aluminum shed was seen 80 feet above the ground caught in a tree. The total damage from this event was estimated at $50,000.[19]

January 20, 1993 Inaugural Day Windstorm, Federal Disaster 981, Windstorm

One of the most powerful windstorm to hit western Washington since the 1962 Columbus Day Storm, caused nearly $130 million in damages state wide, resulted in five deaths, and destroyed 52 residential units statewide. Winds reached gusts of 55 mph at the Olympia Airport weather station.

The Thurston County region suffered near blackout conditions, only a few neighborhoods around the City of Tenino were spared their power. The power outage forced the LOTT Wastewater Treatment Plant in Olympia to discharge nearly 1.3 million gallons of barely treated wastewater into Budd Inlet. Customers flooded local area stores for provisions creating shortages in batteries, candles, and bottled water. The Hawks Prairie BP gas station was one of only two stations in the County able to provide fuel to motorists. Hundreds of people lined up for hours to fuel their vehicles. Lacey Police were called in to control the crowd, no arrests were made.[20]

August 27, 1983 Hail Storm

Two hail storms occurred 30 minutes apart on one evening in Thurston County. Both events reported three quarter inch size hail.[21] No estimate of damage is known for this event.

November 14-15, 1981 Windstorms

Two back to back windstorms brought winds with peak gusts of 64 mph to the region over a two day period resulting in power outages for 60,000 households and businesses in the county. Nearly 150 boats broke loose from marinas in Budd Inlet. An estimated $3.4 million was reported in private property damages.

## Delineation of Storm Hazard Area, Population and Assets Data

Winter storms affect every jurisdiction in the County. As a result, storm hazard area tables were not developed. The "Total" columns in the population, employment, and assets tables provided for the other hazards provide useful information in assessing the population and assets at risk from a countywide hazard.

## Critical Facilities and Infrastructure in Hazard Area

Based on the community impacts which historical occurrences of natural hazards caused, it is clear that natural hazards can destroy or damage facilities that may be critical for responding to the disaster and for maintaining a safe environment and public order. Among these are communications installations; electrical generating and transmission facilities; water storage, purification, and pumping facilities; sewage treatment facilities; hospitals; and police stations. In addition, natural hazards can seriously disrupt the transportation network; bridges can be knocked out, and roads and highways damaged or blocked by debris, further isolating resources. In a major disaster, almost all surface means of transportation within a community may be disrupted, particularly in the initial stages of the hazard event.

All Critical Facilities in Thurston County are located within the storm hazard area. Specific information on the location of critical facilities and infrastructure is housed with the Emergency Management Council of Thurston County.

## Table 4.2.1 Total Critical Infrastructure

| Critical Facility Sector and Subsector | Total | In Hazard Area | % In Hazard Area |
|---|---|---|---|
| 1. AGRICULTURE/FOOD SUPPLY | 59 | 59 | 100.0% |
| 1.1 PRODUCTION | 3 | 3 | 100.0% |
| 1.2 FOOD DISTRIBUTION/STORAGE | 21 | 21 | 100.0% |
| 1.3 ANIMAL FOOD DISTRIBUTION/STORAGE | 35 | 35 | 100.0% |
| 2. GOVERNMENT | 141 | 141 | 100.0% |
| 2.1 FIRE SERVICES | 44 | 44 | 100.0% |
| 2.2 LAW ENFORCEMENT | 9 | 9 | 100.0% |
| 2.3 EMERGENCY OPERATIONS CENTERS | 11 | 11 | 100.0% |
| 2.4 CORONER/MORGUE | 1 | 1 | 100.0% |
| 2.5 SHELTER | 73 | 73 | 100.0% |
| 2.7 AMBULANCE | 3 | 3 | 100.0% |
| 3. FINANCIAL INSTITUTIONS | 7 | 7 | 100.0% |
| 3.1 BANK CUSTOMER SERVICE FACILITIES | 7 | 7 | 100.0% |
| 4. MEDICAL CARE | 84 | 84 | 100.0% |
| 4.1.A HOSPITALS | 4 | 4 | 100.0% |
| 4.1.B LARGE CLINICS | 36 | 36 | 100.0% |
| 4.1.B LARGE CLINICS - RURAL | 5 | 5 | 100.0% |
| 4.1.C URGENT CARE | 6 | 6 | 100.0% |
| 4.1.D SURGICAL SUITES | 6 | 6 | 100.0% |
| 4.2 CHEMICAL DEPENDENCY TREATMENT CENTER | 1 | 1 | 100.0% |
| 4.3A METHADONE | 1 | 1 | 100.0% |
| 4.3B DIALYSIS | 1 | 1 | 100.0% |
| 4.3C MENTAL HEALTH | 2 | 2 | 100.0% |
| 4.3D BIRTHING CENTERS | 2 | 2 | 100.0% |
| 4.4 NURSING HOMES | 7 | 7 | 100.0% |
| 4.5 ASSISTED LIVING FACILITIES | 13 | 13 | 100.0% |
| 5. UTILITIES | 19 | 19 | 100.0% |
| 5.3 COMMUNICATIONS TOWERS | 1 | 1 | 100.0% |
| 5.5 RADIO/TELEVISION | 2 | 2 | 100.0% |
| 5.6 DATA TRANSMISSION LINES | 2 | 2 | 100.0% |
| 5.7 WATER SYSTEMS AND RESERVOIRS | 9 | 9 | 100.0% |
| 5.8 SOLID WASTE MANAGEMENT | 5 | 5 | 100.0% |
| 6. TRANSPORTATION | 30 | 30 | 100.0% |
| 6.2 RAIL | 13 | 13 | 100.0% |
| 6.3 ROADS - CENTERLINE MILES | 1951 | 1951 | 100.0% |
| 6.4 VEHICLE FUEL | 4 | 4 | 100.0% |
| 6.5 STUDENT TRANSPORTATION | 8 | 8 | 100.0% |
| 6.6 MASS TRANSIT | 2 | 2 | 100.0% |
| 6.7 PORT | 1 | 1 | 100.0% |
| **Grand Total** | **340** | **340** | **100.0%** |

## Summary Assessment

The probability of each storm element's occurrence varies, but winter storms frequently pack several hazardous elements across a period of consecutive days or weeks, therefore the overall probability of winter storm occurrence is high. The overall impacts described in both the hazard profile and the brief record of historical occurrences demonstrates that the region's vulnerability is also high. Therefore the overall risk rating for severe winter storms is high.

Thunderstorms do occur in Thurston County, but the probability of occurrence of the storm elements is low. Even thunderstorms that produce a combination of the listed elements rarely cause destruction beyond isolated areas. Therefore the overall probability of occurrence, the vulnerability rating, and the overall risk for thunderstorms are all low.

**Summary Risk Assessment for Winter Storms and Thunderstorms in the Thurston Region**

| Storm Type | Storm Hazard Element | Probability of Occurrence | Vulnerability | Risk |
|---|---|---|---|---|
| Winter Storm | High Winds | High | Moderate | High |
| | Heavy Rain | High | Moderate | High |
| | Freezing Rain | Low | Moderate | Moderate |
| | Heavy Snow | High | Moderate | Moderate |
| Overall | Assessment | High | High | High |
| Thunder Storm | Tornado | Low | Low | Low |
| | Hail | Low | Low | Low |
| | Lightning | Moderate | Low | Low |
| Overall | Assessment | Low | Low | Low |

## Storm Endnotes

[1]National Weather Service. 2009. Natural Hazard Statistics: Washington State, 2007. http://www.weather.gov/os/hazstats.shtml.

[2]National Weather Service. 2008. Weather Glossary. http://www.srh.noaa.gov/fwd/glossarynation.html. All NWS weather element definitions were derived from this source.

[3]Cliff Mass. 2008. The Weather of the Pacific Northwest. The University of Washington Press, Seattle, WA.

[4]Wolf Read. 2004. The Strongest Windstorms in the Western Pacific Northwest 1950-2004. From the "Storm King" Series on: http://www.climate.washington.edu/stormking/. Results derived from tabular data for period of 1950 to 2004, appended with current data 2005-2007) from other storm summaries from Wolf Read's recent "Storm King" reports.

[5]Hazards & Vulnerability Research Institute. 2008. The Spatial Hazard Events and Losses Database for the United States, Version 6.2 [SHELDUS Online Database]. Columbia, SC: University of South Carolina. Available from http://www.sheldus.org.

[6]Cliff Mass. 2008.

[7]National Climatic Data Center. 2008. Storm Event Database. http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwevent~storms

[8]Washington State Emergency Management Division. 2007. Washington State Hazard Mitigation Plan.

[9]Hazards & Vulnerability Research Institute. 2008.

[10]Washington State Department of Natural Resources. 2008. Fire Prevention and Fuel Management Mapping System.

[11]Thurston County Emergency Management. 2009. Supplemental Justification Report.

[12]Cliff Mass. 2008.

[13]Thurston County Emergency Management. 2009.

[14]Barry Ginter. 2004. "Twister Tears Off Barn Roof Near Tenino." The Olympian. May 28, 2004.

[15]Hazards & Vulnerability Research Institute. 2008.

[16]Ibid.

[17]Ibid.

[18]Ibid.

[19]NCDC. 2008.

[20]John Dodge. 1993. "Wild Winds Whip Through South Sound." The Olympian. January 21, 1993.

[21]Ibid.

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# Chapter 4.3: Flood Hazard Profile

## Introduction

Of all natural hazards that affect Thurston County, floods are the most prevalent. Between 1962 and 2009, Thurston County has received 18 Federal Disaster Declarations related in some part to flooding. On average, the region experiences a major river flood event about every two and one-third years. On an annual average basis floods are also the most costly natural disaster in the region. The February 1996 flood cost uninsured private property owners in Thurston County losses in excess of $22 million. Statewide, the Federal Emergency Management Agency (FEMA) has provided over $72 million in aid to flood victims, businesses, and local governments for the December 2007 floods and over $12.8 million in assistance as of April 2009 for the January 2009 floods.

Future floods are inevitable and more research is required to understand fundamentals such as the extent of flood plains and areas that are vulnerable to groundwater flooding. The hydrodynamics of riverine and groundwater flooding in Thurston County are complex and not completely understood. Each flood event is unique. Numerical hydrological models are needed to provide data to better inform land use decisions that will serve to protect environmentally critical areas and protect the public's health. Model forecasts and simulations will enhance Thurston County's understanding of the timing, frequency, duration, and location of riverine and high groundwater flooding.

Comprehensive flood hazard management must address an entire watershed because rivers and their flood plains span multiple administrative boundaries. Activities outside of Thurston County's border such as forestry, development, and stormwater management practices can adversely influence the local flood severity for communities downstream within Thurston County. There are multiple affected stakeholders and a variety of interests must be considered. Flood hazard management is complex process that must balance resource protection, environmental enhancement, flood damage protection, and land use development. The Thurston Region is just beginning to address flood management with such an approach for the Chehalis River Basin. Thurston County, the Confederated Tribes of the Chehalis Reservation, Bucoda, Lewis County, and several other regional stakeholders have formed the Chehalis River Basin Flood Authority in order to begin to address flood issues collectively within the entire Chehalis River Basin.

## Hazard Identification

In general, a flood is a temporary condition in which a normally dry area of land or infrastructure is inundated by excess standing or flowing water. Floods can occur during any season and at any time. Four types of flooding occur in Thurston County and are addressed individually in this hazard profile: riverine flooding, groundwater flooding, tidal flooding, and urban flooding.

# 1. Riverine Flooding

## Definition

Riverine or river and stream flooding is the effect of excess flow and volume of water exceeding a river channel's normal capacity to contain the water. As a consequence, excess water crests over a river's bank and inundates areas within the river's floodway, flood plain, and other low lying areas (may be outside FEMA's mapped floodplains, but are in the river's natural floodplain). An extended period of intense precipitation is the most common cause of riverine floods in Thurston County.

Historically, Thurston County must experience two or three days of rainfall averaging 2-5 inches per day for river and stream flooding to occur.[1] These precipitation events are commonly delivered by storms containing warm moisture laden air originating from the tropics and subtropics of the Pacific Ocean. A low-pressure storm system originating from the Pacific Ocean, north of the Hawaiian Islands, is commonly referred to as a "Pineapple Express" (see storm hazard profile). This storm phenomenon considerably raises surface air temperatures into the upper 50 degrees F and sometimes mid-60 degrees F. It also raises the freezing level above 6,000 feet. All Thurston County rivers are affected by this rapid warming effect and the intense precipitation that falls as storm fronts cross western Washington. The warm rain and air rapidly melts shallow lowland snow accumulation and causes local streams and creeks to crest their banks in a relatively short period of time. This type

**Flood Terminology Used in this Plan**

There is often confusion about flood terms and flood frequency. The following terms are used in this risk assessment:

**Flood Plain**: A strip of relatively smooth land bordering a stream, built of sediment carried by the stream and dropped in the slack water beyond the influence of the swiftest current.

**100-Year Floodplain:** Lands which are subject to a one percent chance of flooding in any year. These areas are mapped as the "A" zone on the Flood Insurance Rate Maps (FIRM) of the Federal Emergency Management Agency.

**500-Year Floodplain:** Lands which are subject to a 0.2 percent chance of flooding in any year. These areas are mapped as the "B" zone on the FIRM of the Federal Emergency Management Agency.

**Flood Stage**: The stage at which overflow of the natural streambanks begins to cause damage in the reach in which the elevation is measured. Flood stages for each USGS gaging station are usually provided by the National Weather Service.

**Floodway:** The portion of the floodplain adjoining and including the river channel which discharges the flood water and flow of the river. It does not include portions of the floodplain where water is just standing. These areas are mapped as "Floodway" on both the Floodway and the FIRM of the Federal Emergency Management Agency.

**Special Flood Hazard Area (SFHA)**: The land area covered by the floodwaters of the base flood is the Special Flood Hazard Area (SFHA) on NFIP maps. The SFHA is the area where the NFIP's floodplain management regulations must be enforced and the area where the mandatory purchase of flood insurance applies. The SFHA includes Zones A, AO, AH, A1-30, AE, A99, AR, AR/A1-30, AR/AE, AR/AO, AR/AH, AR/A, VO, V1-30, VE, and V.

of flooding is concurrent with the wet winter season. Most Pacific Northwest flooding occurs from November through March.

Thurston County precipitation research findings are emerging which reveals that rainfall intensity has increased in the region in the last decade. Thurston County continues to analyze stream flow and precipitation gage data from its own network of gages, National Weather Service data, and USGS data. This research is helping Thurston County to better understand the types of precipitation patterns that trigger small stream and riverine flooding in the county. Initial findings reveal that six precipitation patterns appear to control peak flood flow pulses in small Thurston County streams. These heavy rainfall scenarios have occurred within the last decade (1998-2009) and some more than once. The precipitation patterns also correlate with larger river flood events. The previous five decades of the Olympia rainfall record have only been punctuated by one, two, or three of the identified scenarios per decade. Table 4.3.1 shows the precipitation patterns that cause major stream and riverine flood events.

**Table 4.3.1: Six Rainfall Patterns that influence Puget Sound Stream Flooding in Thurston County**[2]

| Pattern | Description | Example |
|---|---|---|
| 1 | Early heavy rainfall (greater than 3-inch daily storm events) in October (Horton Overland Flow) | October 20, 2003: 4.14” storm event<br>October 2, 1981: 3.56” storm event |
| 2 | Five or six consecutive days of greater than 1-inch storm events punctuated by a greater than 2.5-inch storm event in the same series | November 2, 2006, 1.08”<br>November 3, 2006,1.02”<br>November 4, 2006, 1.5”<br>November 5, 2006, 1.88”<br>November 6, 2006, 4.31”<br>November 7, 2006, 1.02” |
| 3 | Two or more consecutive days of greater than 2.0 inch daily storm events | 2007:<br>December 2, 2.2”;<br>December 3, 3.19” |
| 4 | Greater than 4 inch daily storm events (high landslide potential | January 7, 2009, 4.82 inches<br>November 6, 2006, 4.31 inches<br>October 20, 2003, 4.14 inches<br>November 19, 1962, 4.25 inches |
| 5 | Three or more consecutive months of at or greater than >11 inch monthly totals (larger potential for ground water flooding in key basins) | |
| 6 | A greater than 15 inch monthly total | November, 2006, 19.68”<br>February, 1999, 15.5”<br>November, 1998, 15.28”<br>November, 1990, 15.06”<br>November, 1964, 15.00”<br>November, 1962, 15”<br>January, 1953, 19.84” |

| | Nov | Dec | Jan | Feb |
|---|---|---|---|---|
| 1955 – 1956 | 12.18 | 12.59 | 10.75 | |
| 1973 – 1974 | 12.95 | 11.61 | 10.57 | |
| 1998 – 1999 | 15.28 | 12.99 | 12.25 | 15.5 |
| 2001 – 2002 | 13.01 | 11.86 | 11.42 | |

The condition of 'rain on snow' events which can exacerbate streams to flood flow stage (December 2-3, 2007, flooding) is more anecdotal but clearly remains yet another pattern for peak floods. Initial results suggest that heavy to severe rainfall patterns have increased in number during the last decade over the previous 50 years of record for the Olympia Airport based on simple frequency analysis and despite several drought years.[3] Annual reports of stream flows are currently being developed for all Thurston County monitored streams including Percival Creek, Black River, McLane Creek, Green Cove Creek, Woodard Creek, Woodland Creek, Chambers Creek, and Eaton Creek.

### Thurston County Rivers

There are five major river systems in Thurston County (Map 4.3.1) that experience episodic flooding: the Deschutes, Chehalis, Nisqually, Skookumchuck, and the Black. All of these rivers, with the exception of the Nisqually River, are lowland rivers and are fed primarily by watershed precipitation and groundwater flows. The Federal Emergency Management Agency has mapped the Special Flood Hazard Areas (SFHA) for each of these rivers (Map 4.3.2). Although it is not a major river, Scatter Creek also has a designated high risk flood zone and historically has produced major flood waters in southwest Thurston County. A brief description of each river system is provided as a general reference.

### The Nisqually River

The Nisqually River is the only river system within Thurston County that is fed primarily by melting snow pack and glacial ice. This 80 mile river is located within the Nisqually Watershed (WRIA #11). The river's headwaters begin on the southwestern slope of Mount Rainier at the base of the Nisqually Glacier in Mount Rainier National Park in Pierce County. The River flows west along the Pierce and Lewis County line until its natural flow is constrained by the Alder Dam; nearly halfway (river mile 44.2) on its journey to the Puget Sound. From Alder Reservoir, the Nisqually River forms a natural border for approximately 48 miles between Pierce and Thurston counties.

**What is a watershed?**

A watershed is an area of land where topographic features such as hills and valleys cause water to flow toward a single major river or other body of water

Alder Dam is a 330 feet high concrete arch dam with a crest length of about 1,600 feet. The dam's spillway was designed for a maximum discharge of 85,000 cubic feet per second (cfs). Alder Reservoir is about seven miles in length with a surface area of 3,065 acres and a total storage capacity of 214,500 acre-feet. The LaGrande Dam is located 1.7 miles downstream from Alder Dam. It is a concrete gravity structure 212 feet high and about 710 feet long. The dam's spillway was also designed for a maximum discharge of 85,000 cfs. The LaGrande Reservoir provides a total storage capacity of 2,676 acre-feet. Both dams are operated by Tacoma Power for hydroelectric power generation.[4] The reservoirs of both dams are relatively small and Tacoma Power is not required to provide flood control. Even so, Tacoma Power lowers the elevation of the lake when possible during winter months to enable some capture of high water inflows from rainstorms and snow melt.

The Nisqually River resumes a mostly natural unrestricted flow as it traverses northwest away from the LaGrande Dam. The river passes a diversion dam owned by the City of Centralia. The diversion dam and a canal divert water from the Nisqually River to generate 12 megawatts of hydroelectric

power during peak flows at a plant northwest of the city of Yelm. The dam provides no floodwater storage capacity. The river courses past scattered residences in unincorporated Thurston County before it passes the communities of McKenna, Yelm, the Nisqually Pines neighborhood, the Nisqually Indian Reservation, and the undeveloped range lands of Fort Lewis Military Reservation. Several small farms and residences are located in the Nisqually Valley in the vicinity around Interstate 5 and Old Pacific Highway. The river enters the Puget Sound near the Nisqually National Wildlife Refuge.

Flooding on the Nisqually River is related largely to the amount of water released from LaGrande Dam. This is related to how much water enters Alder Lake and is released from Alder Dam. Feeder streams such as Ohop, Yelm, and Tanwax creeks also influence flooding, as does high tides in the Nisqually Delta.

### The Deschutes River

The Deschutes River is a 53 mile long lowland river that gives rise within Mt. Baker-Snoqualmie National Forest in north Lewis County. The river is located in the Deschutes Watershed (WRIA #13) and locally within the Budd/Deschutes Watershed. The Deschutes lies to the west of the Nisqually River and flows in a parallel pattern to the Nisqually River. The river mostly follows a natural course northwest through unincorporated Thurston County.

The Deschutes is the fastest rising and falling river in Thurston County. It respond quickly to local rainfall and runoff.[5] The river is significant to the region as it is within the watershed which encompasses a great majority of the land area for the cities of Lacey, Olympia, and Tumwater. As the Deschutes River enters the urban growth area and the City of Tumwater, the river bank and surrounding land use becomes more developed. Several residences are located in the Tumwater Valley around the periphery of the Tumwater Golf Course. The river is channeled through a riprap bank through the Tumwater Valley Golf Course and additional hard banking through parts of Tumwater Falls Park before it discharges into Capitol Lake near the Historic Olympia Brewery in Tumwater, just south of Interstate 5.

Capitol Lake is an artificial lake formed by a small dam at the north end of the lake in downtown Olympia. The dam is regulated by the Washington State Department of General Administration and exists to create a freshwater lake to complement the Capitol Campus parks and grounds. Percival Creek joins the Deschutes River in Capitol Lake's central basin, near Marathon Park, just north of Interstate 5. When the tides and lake water level conditions permit the opening of the dam's radial gate, the Deschutes River drains into Budd Inlet.

Sediments that are carried down river are slowly accumulating on the lake bottom and effectively decreasing the lake's capacity. A multi-stakeholder study has been underway to evaluate how the mouth of the Deschutes River will ultimately interface with Budd Inlet and be managed within a heavily developed urban environment. This study is evaluating the environmental, social, and economic implications for variety of long-term management alternatives. Any final decision will certainly have implications for flood management at the lowest end of the Deschutes River.

### The Skookumchuck River

The Skookumchuck River is a 43 mile long river with headwaters that also begin within Mt. Baker-Snoqualmie National Forest in north Lewis County. The river is arch shaped and arcs upward into Thurston County for nearly 26 miles before it returns to Lewis County. The river is located in the Upper Chehalis Watershed (WRIA #23).

The river flows northwest into Thurston County through commercial forest lands with relatively steep forested valley slopes. As the river traverses west, it is constrained by the Skookumchuck Dam. The dam is located about ten miles upstream or east from the town of Bucoda. The dam is a rolled earthfill embankment with a crest length of 1,320 feet and a height above streambed of 160 feet. The spillway is an ungated concrete ogee section 130 feet in length. It is capable of passing the Probable Maximum Flood of 32,500 cfs.[6] The dam provides a gross storage capacity of 35,000 acre-feet. The dam is operated by TransAlta and its primary function is to provide a controlled release of water for use as cooling water at the Centralia Steam Electric Plant in Lewis County.

The Skookumchuck River emerges from the reservoir and passes through a relatively flat open valley that is comprised of scattered small farms and residences. As the River bends south towards Lewis County, the river valley narrows where the river passes through the town of Bucoda. The river winds along the eastern edge of the town's core developed area. From here the river flows southwest and runs roughly parallel with State Route 507 into Lewis County. The river continues south until it enters the more densely populated city of Centralia. The Skookumchuck River drains into the Chehalis River, in Centralia, just west of Interstate 5 and south of Harrison Avenue.

### The Chehalis River

The Chehalis River is a 174 mile long river that emerges from separate forks in remote rugged commercial forest lands in southwestern Lewis County. The river is divided into two watersheds, the Upper Chehalis (WRIA #23) and the Lower Chehalis (WRIA # 22). The Chehalis River grows at the confluence of the West Fork Chehalis River and East Fork Chehalis River. From there the Chehalis flows north and east, collecting tributary streams that drain the Willapa Hills and other lowland mountains in southwestern Lewis County. The South Fork Chehalis River joins the main river a few miles west of the city of Chehalis. The Newaukum River joins the Chehalis River at Chehalis, after which the river turns north, flowing by the city of Centralia, where the Skookumchuck River joins. After Centralia, the Chehalis River flows north and west for a nine mile course through the southwestern corner of Thurston County.

The Chehalis River flows into Thurston County approximately two miles west of Interstate 5 and flows north towards Grand Mound. The river courses west through largely undeveloped rural lowlands scattered with small farms and gentle sloping forested hills. The river continues west and passes through the Confederated Tribes of the Chehalis Reservation before entering Grays Harbor County where it joins the mouth of the Black River.

As the Chehalis River continues northwest, it joins the tributaries of the Satsop River and Wynoochee River. The Wynoochee River joins the Chehalis near Montesano, after which the Chehalis River becomes increasingly affected by tides and widens into Grays Harbor estuary. The city of Aberdeen lies at the mouth of the Chehalis River. Just east of Aberdeen, the Wishkah River

joins the Chehalis, and just west, between Aberdeen and Hoquiam, the Hoquiam River merges. At this point the river has become Grays Harbor. Before the estuary of Grays Harbor empties into the Pacific Ocean, the Humptulips River joins.

Due to its large drainage area, the Chehalis River tends to rise slowly over a long period of time. Thurston County Emergency Management describes the three common scenarios for flooding on the Chehalis River within Thurston County:

- The most predictable scenario for the Chehalis occurs when rains fall over all of southwestern Washington and all regional rivers and streams rise.
- The Chehalis River can also experience flooding when there is little or no rain in Thurston or Grays Harbor counties, but heavy rain in Lewis and Pacific counties. This causes flooding to occur later than normal.
- Flooding also occurs when heavy rain falls in Grays Harbor County, but not in Thurston or Lewis counties. Feeder streams can fill the Chehalis then and cause water to "back up" into Thurston County.

### The Black River

The Black River is a slow moving river that originates in Thurston County at Black Lake just west of Tumwater city limits. This 30 mile river is located in the Upper Chehalis Watershed (WRIA #23) and flows south-southwest through Thurston County for 20 miles before entering Grays Harbor County. Black Lake is heavily residentially developed, but extending south from Black Lake, the river is lined by marshland, and the water table is perennially at or above the ground surface. Little development has occurred near the river for this reason. The river traverses small farms and scattered residential developments through southwest Thurston County. The river is afforded some protection by a series of public properties including Glacier Heritage Preserve, the Black River Habitat Management Area (USFW), and the Mima Mounds Natural Area Preserve. The Black River joins the Chehalis River in the Confederated Tribes of the Chehalis Reservation in Grays Harbor County.

No United States Geological Survey (USGS) gages are located on the Black River and very little published information is available regarding its flood history. The preponderance of flooding along the Black River is caused by back-flow from the Chehalis River. Flood recurrence intervals for the Black River are similar to the Chehalis River.

### Scatter Creek

Scatter Creek is approximately 20 miles long with an additional 9.5 miles of tributaries. It is primarily located in the Upper Chehalis Watershed (WRIA #23). The creek flows west-southwest from McIntosh Lake, east of Tenino, to the Chehalis River near Rochester.

The creek traverses lands which are chiefly composed of glacial outwash materials which are highly porous. After Scatter Creek passes through the City of Tenino. The river flows through mostly undeveloped small farmland with scattered residences through unincorporated Thurston County. The lower end of the creek passes through the Grand Mound Vicinity which is scattered with residences and light industrial plants and businesses.

The lower six miles maintains a flow of water year-round due to pumped groundwater being delivered by effluent from a commercial fish farm. There are significant reaches of the creek up stream that remain dry during the summer. This is likely due to a lowering of the water table from a variety of active water rights within the watershed.

The Scatter Creek Aquifer system is a "propped up bathtub" that feeds into the Chehalis (a high ground water gradient and velocity). Ground water flooding in Scatter Creek impacts the municipal well field which is shallow – only 90 feet below ground surface. Even in years where the Chehalis does not flood, the ground water comes to ground surface at the well field. Also, the LiDAR data is showing the Scatter Creek stream as large ancestral flood channels, so the stream itself does not seem to overbank as dynamically as a normal flood plain in the upgradient areas. The river just follows the larger ancestral 'scours'.[7]

There are no permanent long-term stream flow gages on this creek so little is known about its long-term hydrography. In addition, very little flood history data is published for this riverine system. The Scatter Creek Habitat Conservation Plan states that from 1993 to 1999, the wet season flows typically ranged from 80 to 400 cfs, with less frequent peaks in the range of 400 to 1,400 cfs. The maximum mean daily discharge during this period was 1,362 cfs on February 14, 1996 (which was historically a very wet year and coincided with record flood levels for the Skookumchuck River). The Scatter Creek Habitat Conservation Plan includes the following passage regarding flood flows[8]:

> *...About 50 percent of the basin delivers stormflow runoff to the valley bottom from the hill portions of the basin. This flow is mostly delivered from seven tributary creeks that enter Scatter Creek and elevated groundwater return flow. If stormflow runoff enters from the tributaries after a dry summer, it takes a while to fill the local groundwater and channel areas. Stormflow onto wet basin conditions creates the largest stormflow peaks. There are insufficient years of recorded flows on Scatter Creek to determine the relationship between flood frequency and magnitude.*

In 1996, Scatter Creek experienced major flooding. Floodwaters covered several county roads along its westward flow including Old Highway 99, Sargent Road, 183rd Avenue, State Route 12, and Denmark Street.[9]

## Severity

Many factors influence the severity of riverine flooding such as the pre-existing condition of the ground (saturated from previous rain, covered with snow, or frozen), the topography and size of the watershed, freezing level, and the influence of human activity on the landscape (development and logging practices).

Thurston County has three levels of flood severity:

1. **Minor flooding**: A river exceeds bank-full conditions at one or more locations, generally flooding fields and forests. Some roads may be covered but passable. There may be enhanced erosion of some river banks.

2. **Moderate flooding**: Individual residential structures are threatened and evacuation is recommended for selected properties. Some roads may be closed. Moderate damage may be experienced.
3. **Major flooding**: Neighborhoods and communities are threatened and evacuation is recommended for residents living on specified streets, in specified communities or neighborhoods, or along specified stretches of river. Major thoroughfares may be closed and major damage is expected.

Thurston County Emergency Management has established flood severity thresholds based on stream flow rates or gage heights for the Nisqually, Deschutes, Skookumchuck, and Chehalis rivers for selected gages in the region (no USGS gages are established on the Black River). River gage height and discharge rate thresholds for minor, moderate, and major flood levels are shown for each river and gage location in Table 4.3.2. The National Weather Service flood stage level is also provided. The frequency of flood severity for each river was determined through historic USGS river gage records from 1968 to 2009. It is important to note that rivers are dynamic and all channels are subject to dimensional changes over time due to a variety of factors such as sediment and coarse woody debris deposition and channel migration and braiding. Therefore a direct comparison of flood events between years or decades for any given river based on flood gage heights is subject to scrutiny.

A summary of combined National Weather Service and Thurston County Emergency Management general flood inundation descriptions by gage height is shown in Table 4.3.3 for the Nisqually, Deschutes, Skookumchuck, and Chehalis Rivers. River gage locations for each river are the same as those shown in Table 4.3.2.

**Table 4.3.2: Frequency of Floods by level of Severity for Thurston County Rivers, 1968 to 2009[10]**

| River | NWS Flood Stage (ft) | USGS Gage # | Flood Severity | Gage Height (ft) | Discharge (cfs) | Events since 1968 |
|---|---|---|---|---|---|---|
| Nisqually | 10 | McKenna, 12089500 | Minor | 8.75 | 8,000 | 24 |
| | | | Moderate | 10 | 15,000 | 4 |
| | | | Major | 10.5 | 16,500 | 5 |
| Deschutes | 11 | Rainier, 12079000 | Minor | 9.5 | 3,000 | 20 |
| | | | Moderate | 11.5 | 4,000 | 16 |
| | | | Major | 13.5 | 6,000 | 9 |
| Skookumchuck | 13.5 | Bucoda, 12026400 | Minor | 13.5 | 4,000 | 17 |
| | | | Moderate | 15.5 | 4,900 | 16 |
| | | | Major | 17.5 | 6,500 | 10 |
| Chehalis | 14 | Grand Mound, 12027500 | Minor | 13.2 | 14,000 | 62 |
| | | | Moderate | 15.1 | 26,000 | 23 |
| | | | Major | 17.8 | 45,500 | 9 |
| Black | No Data Available | | | | | |

## Table 4.3.3: Flood Severity and Extent for Thurston County Rivers by River Gage Height

| River | Gage Height (ft) | Flood Extent and Severity |
|---|---|---|
| Nisqually | 10 | Flooding occurs along the Nisqually River at the lower end near the mouth. A high tide could flood the banks at Hayko Lane, 6th Avenue, Riverbend Campground and Riverside Manor Apartments. The River will also spill over its banks between LaGrande and McKenna. Major flooding (widespread threat to communities and major thoroughfares) occurs when the flow rate tops 16,500 cfs or a gage height of 10.5 feet. |
| | 12 | Flood waters will flow over some roads and through farms and residential areas. Erosion may damage some properties. High tidal levels on Puget Sound will cause flooding along the lower reaches threatening homes along riverside drive and Conine avenue. |
| | 13 | Swift waters will flood roads, farms, and some residential areas including the nursing home in McKenna. Erosion is likely to occur and damage properties along river banks. |
| | 14 | Major flooding occurs from LaGrande downstream through McKenna to the mouth. Flooding will occur all along the river including headwaters, tributaries and other streams within and near the Nisqually River Basin. |
| | 16 | Severe near record flooding from LaGrande downstream through McKenna to the mouth. Flooding will occur all along the river including headwaters, tributaries and other streams within and near the Nisqually River Basin. |
| Deschutes | 9 | The Deschutes River locally spills over its banks into low fields and forested lands, mainly along Vail Cutoff Road and Reichel Road (east of the vicinity of Vail). |
| | 11 | The Deschutes River will flood downstream in Tumwater Valley including the golf course. Minor flooding will also occur in several residential areas, mainly Cougar Mountain and Driftwood Valley. Many roads and farm lands will also be flooded. |
| | 13.5 | The Deschutes River will flood residential areas, especially Cougar Mountain, Driftwood Valley, and Falling Horseshoe. Downstream flooding will occur in areas of Tumwater Valley including the golf course. Many roads and farm lands will also be flooded. |
| | 15 | Major flooding occurs with swift and deep water flooding roads, farm lands and the residential areas of Cougar Mountain, Driftwood Valley, Falling Horseshoe and areas downstream in the Tumwater Valley. Flooding will occur all along the river including headwaters, tributaries and other streams within and near the Deschutes River Basin. |
| | 16.5 | Severe near record flooding occurs. Residences in Tumwater valley will be deeply flooded. Flooding will occur all along the river including headwaters, tributaries and other streams within and near the Deschutes River Basin. |
| Skookumchuck | 13.5 | The Skookumchuck river will flood a few roads and low pasture lands near Bucoda. |
| | 15 | Flooding will occur for several residential and business areas around Bucoda. Flood waters will cover many roads. |
| | 17 | Major flooding occurs in the Bucoda area with deep and swift flood waters inundating residential and business areas and numerous roads. Flooding will occur all along the river including headwaters, tributaries and other streams within and near the Skookumchuck River Basin. |
| | 17.6 | Severe near record flooding will occur in the Bucoda area with deep and swift flood waters inundating residential and business areas and numerous roads. Flooding will occur all along the river including headwaters, tributaries and other streams within and near the Skookumchuck River Basin. |

| | | |
|---|---|---|
| Chehalis | 12.5 | The Chehalis River will locally spill out of its banks into nearby fields and over a few roads in Thurston County. |
| | 14 | Flooding will occur over several roads in Independence valley including James Road, Independence Road, and Moon road. Flood waters will also cover nearby farm lands. |
| | 15.5 | Several roads in Independence Valley with be inundated with swift moving water including SR12, James Road, Independence Road, and Moon Road. Flood waters will cut off access to and from the Confederated Tribes of the Chehalis Reservation and inundate nearby farm lands. Some residential structures may be threatened. |
| | 17.5 | Major flooding will inundate roads and farm lands in Independence Valley. Deep and swift flood waters will cover SR12, James Road, Independence Road, and Moon Road. Flooding will occur all along the river including headwaters, tributaries and other streams within and near the Chehalis River Basin. |
| | 19 | Severe near record flooding will occur all along the river including headwaters, tributaries and other streams within and near the Chehalis River Basin. |

## Impacts

River floods kill people in the United States every year. People caught unprepared and isolated by swift moving or flash flood waters can die from drowning, hypothermia, or trauma. The February 1996 flood caused nine deaths in the Pacific Northwest. Fortunately advances in weather forecasting technology and hydrologic modeling are producing more accurate flood forecasts that can serve to provide communities with advance warnings. Radio broadcasts, television, and other tools such as Thurston County's Telephone Alert System can provide residents of flood prone properties critical information to take necessary precautions to safeguard some belongings and evacuate to safer ground.

Although Thurston County has not experienced fatalities caused directly by flooding in recent years, past flood events have revealed lapses in some flood victims judgment regarding the speed, extent, and severity of floods. The 1996 flood required more than 300 people to be rescued. The December 2007 flood necessitated the rescue of at least 63 individuals from the Rochester Area. Some rescue operations are unavoidable due the timing or rapid onset of flooding or the physical ability of the victim (elderly, people with disabilities). However, most rescues can be prevented if people evacuate before anticipated floodwaters place them and rescue personnel at risk.

Fast rising flood waters can also eliminate opportunity to provide for the safety of domestic animals. Floods kill livestock and pets causing both economic and emotional hardship. Carcasses can become a public health problem if not quickly and adequately disposed of.

Major and moderate flooding frequently inundates low lying roads around Thurston County resulting in area-wide transportation disruptions. Major state routes such as State Route 12 and Interstate 5 have both closed multiple times due to floods. As flood waters recede, woody debris and other objects left behind can pose hazards to bridge structures and culverts. Electric, gas, water, and communication utilities are also subject to damage and disruption.

Swift moving flood waters can damage or destroy transportation infrastructure such as bridges, roads, and railroads. Swift flowing water also can cause erosion of stream or river banks, loss of wildlife and habitat. Even slow moving flood waters cause significant damage to buildings and mechanical equipment. Damage caused by inundation and sediment deposit can be extensive and require costly repairs to the framing, flooring, walls, electrical, plumbing, wells, septic, heating, ventilation, and air conditioning systems of homes and buildings. Flood waters also damage or destroy vehicles and mechanical equipment. Homeowners are particularly hard hit due to the loss of personal belongings including furniture, bedding, clothing, household appliances, food, and other personal keepsakes. Subsequent sanitation problems could arise from contaminated potable water supplies, fouled septic tanks, and mold growth if not properly abated.

Flood damage renders homes and businesses unsafe for occupancy and displaces individuals and families from their communities. Alternative housing and shelters are necessary for extended periods of time. The cleanup and recovery period is stressful for flood victims and disrupts their normal activities of daily living. Children miss school days, business owners lose revenue, and homeowners may lose income if they do not have emergency leave available from their employer.

Riverine floods are hazardous to humans when life and property are threatened or destroyed by floodwaters. It is important to recognize that the impacts of river flooding are a natural process that can also benefit a variety of wildlife and natural resources. Flood waters can force rivers to change their course. The effects of erosion, stream braiding, sediment deposits, and channel migration are natural processes that are critical to the long-term viability of fish and wildlife habitat. The formation of oxbow lakes can support native birds, mammals, and amphibians. Deposits of gravel and sediments can foster the growth of alders, willows, and other vegetation and establish new riparian habitat. Trees that fall into rivers from bank erosion can become entangled with other trees and coarse woody debris to form fish habitat. Flood deposition of upland sediments can enhance the fertility of valley floors and further support both native vegetation and agriculture.

## Probability of Occurrence

Riverine floods are the most common form of flooding in Thurston County. Several flood events have occurred on Thurston County Rivers which have exceeded the 100 year flood event. Table 4.3.2 above clearly shows that major floods are a frequent hazard event in Thurston County. Flood probabilities and frequency were calculated using stream gage data and are shown in Table 4.3.4.

Based on the history of the last 41 years (1968 to 2009), the Chehalis, Deschutes, and Skookumchuck Rivers are likely to experience a major flood about every 4 to 4.5 years. The Nisqually River has an estimated 12.2 percent chance of major flooding a year, or about one major flood event every eight years. On average, a major flood event occurs on at least one major river about every two and one-third years within the county (major flood events occurred during fifteen of the last 42 years). Overall, this data clearly indicates that the probability of occurrence of major flood events in the Thurston Region is high.

**Table 4.3.4: Estimated Annual Probability and Rate of Occurrence for Minor, Moderate, and Major Flooding for Major Rivers in Thurston County**

| River | Flood Severity | Events 1968 to 2009 | Annual Probability | Rate of Occurrence (years) |
|---|---|---|---|---|
| Nisqually | Minor | 24 | 58.5% | 1.7 |
| | Moderate | 4 | 9.8% | 10.3 |
| | Major | 5 | 12.2% | 8.2 |
| Deschutes | Minor | 20 | 48.8% | 2.1 |
| | Moderate | 16 | 39.0% | 2.6 |
| | Major | 9 | 22.0% | 4.6 |
| Skookumchuck | Minor | 17 | 41.5% | 2.4 |
| | Moderate | 16 | 39.0% | 2.6 |
| | Major | 10 | 24.4% | 4.1 |
| Chehalis | Minor | 62 | 151.2% | 0.7 |
| | Moderate | 23 | 56.1% | 1.8 |
| | Major | 9 | 22.0% | 4.6 |
| Black | No Data Available | | | |

## 2. Groundwater Flooding

### Definition

Groundwater flooding occurs whenever there is a high water table and persistent heavy rains. The situation is caused in areas where an upper, thin layer of permeable soils overlays an impermeable layer of hard pan. As the ground absorbs more and more rainwater, the groundwater table rises from beneath the ground surface which results in standing water in areas where the land surface is below the water table.

#### Modes of Groundwater Flooding in Thurston County[11]

Two types of groundwater flooding trigger events have been identified by Thurston County using the County's own data, as well as historical data provided by the National Oceanic and Atmospheric Administration. These events are classified by Thurston County as "Type 1" and "Type 2" weather patterns; they are distinguished by intensity and duration. Each type is discussed further detail in the following sections.

**Type 1: Intense - Short Duration Storms That Occur in Succession**

These storms are characterized by a weather phenomenon locally called "Pineapple Express" systems. This is a weather pattern that draws tropical moisture from an area near Hawaii in the Pacific Ocean and conveys it directly to Western Washington and Oregon. These winter patterns, once established, tend to usher a wet winter pattern that usually results in warm temperatures and heavy rainfall for a period of up to a week at a time. These systems

rapidly melt any snow that may have accumulated as well as produce rainfall that generally exceeds six inches per event. The groundwater system that we have in Thurston County can typically handle one of these events if they occur early in the season without much flooding. Groundwater flooding generally occurs when more than one of these systems impacts our region within a month or if an event happens later in the season after normal winter rains have "primed" the groundwater levels to within a few feet of the surface. Normal high groundwater levels occur in mid to late March so if a large storm coincides with this normal peak in groundwater, the capacity of the system is exceeded and groundwater flooding will likely occur in susceptible areas.

It should be noted that this storm pattern has been increasing in frequency over the past decade and it appears that the overall intensity of the events is also increasing based on the collected data. It should also be noted that these types of events also are the driving factors of urban, riverine flooding, and landslides in our region as well as pronounced groundwater flooding.

**Type 2: Persistent Low-intensity Precipitation Pattern**

This type of weather pattern is less common; however, it produces similar flooding results as the Type 1 weather pattern. It is characterized by weeks of low intensity rainfall in which there is some measurable rainfall (generally less than one inch) every day for several weeks. Aside from being excessively dreary, these events gradually overwhelm the groundwater system by saturating the soil column. In most cases, this weather pattern causes more widespread flooding throughout the County, both in areas that routinely flood and in areas that are generally not susceptible to groundwater flooding. There have only been two occurrences of this type of weather pattern identified in the last decade so it is not well understood. It was first identified in the winter of 2006 - 2007. After reviewing the groundwater and precipitation records an occurrence was also found in the winter of 2002 - 2003, albeit to a lesser extent but with similar groundwater flooding patterns. In both of these Type 2 cases, groundwater flooding occurred in a widespread pattern that involved areas not previously identified as being susceptible to routine groundwater flooding. This would imply that a Type 2 event may represent a more widespread groundwater problem than the more common Type 1 event. The Type 2 weather pattern does not appear to have associated riverine flooding and landslides associated with it, although we do not have enough data at this time to be certain of these conclusions.

### Groundwater Flooding, Precipitation Pattern Modeling and Land Use

Thurston County has an extensive network of data collection sites that have been collecting climate, precipitation data, and automated groundwater data for nearly ten years. This data has been instrumental in developing relational models that correlate rainfall to groundwater behavior in the different regions of Thurston County. Thurston County's goal is to collect sufficient high quality data to use in the modeling process. To that end, the County would like to invest in several computer modeling programs and advanced modeling techniques to better understand the effect of these two types of weather patterns have on groundwater flooding.

A numerical modeling effort would allow the county to do better prediction and model various

scenarios both in physical or contaminant hydrology. Such scenarios can range from predicting aquifer and surface water levels (hydraulic head) after a severe storm or prolonged monthly rain or finding the travel times and contaminant concentrations at a municipal wellfield. It can provide outputs in the form of ground water elevations 10 years into the future, and it can incorporate wellfield pumpages, rivers and stormwater pond inputs. With more accurate models, the region could better predict potential flood conditions and convey this information to local Emergency Operations Centers (EOC). This would then allow the EOC's to post very specific and targeted groundwater flooding advisories with instructions to citizens and utilities throughout the region.

In addition to emergency management, the County requires precise data models to assist in long term and short term planning and to aid with designs that would allow people to safely and responsibly build and live in areas that are prone to sporadic groundwater flooding. The County is just beginning to assemble a sufficient period of record to identify discernable patters in the precipitation and groundwater data to identify the nexus between precipitation patterns and groundwater flooding. Thurston County has very complex geologic and climatological conditions that make accurate groundwater flood prediction difficult. Improvements in data collection and data modeling will help to more accurately predict groundwater flooding hazards and predict the potential outcome of any single storm event thus minimizing damage and possible casualties in the future.

## Severity

Groundwater flooding has historically been most severe in the second and subsequent years of consecutive wet years. According to the U.S. Army Corps of Engineer's post event report on the winter storm of 1996-1997, the frequency of a groundwater flooding disaster is probably on the order of every 25 years. This was the first widespread groundwater flood event since 1972 and the worst on record until the winter of 1998-1999, which is now the "event of record." This event set the benchmark for high groundwater flood hazard requirements implemented by Thurston County after the 1999 flood. Although groundwater flooding occurs sporadically throughout Thurston County, the geologic conditions present in an area known as the Salmon Creek Basin south of Tumwater typify the "worst case scenario" for groundwater flooding in Thurston County and is discussed in further detail in the following section.

Since areas of high groundwater are relatively flat, flood waters can remain standing for several months. Flood waters resemble ponds or lake like conditions. Based on current mapped data, there are nearly 54 square miles (34,363 acres) countywide that have experienced groundwater flooding; approximately seven percent of the county. Areas that experience groundwater flooding are scattered throughout the lowlands in Thurston County (Map 4.3.2), but are most concentrated around the Tumwater Urban Growth Area along Littlerock Road and south of Tumwater along Case Road. This area is known as the Salmon Creek Drainage Basin. The Salmon Creek Basin experienced significant flooding in 1999. During this flood event, there were contiguous bodies of standing flood waters that ranged in size from puddles to 113 acres. Depths ranged from near ground surface to over 12 feet deep. The volume of flood water above the surface of the ground in the basin was equivalent to 603 football fields covered with four feet of water. This amount combined with the volume of groundwater below the surface at the septic drain field level would be equal to 977 football fields or 28,655 acre feet.[12] Since 1999 this basin has flooded three more times though none were as severe

as the 1999 event. The combination of increasing storm severity and intensity in the past decade, coupled with population increases in the County, have brought people and floods ever closer together in developing areas of the County. Other areas in the County are located in the Scatter Creek/lower Black system near Grand Mound and Rochester, eastern portions of the Lacey UGA, Beaver Creek, the Spurgeon Creek systems, and in the Yelm UGA.[13]

### Impacts

In general, the damaging effects of groundwater flooding are similar to riverine flooding. Some homes may be inundated if they are not elevated above flood levels. Even if a home is elevated above floodwaters, crawl spaces and basements are subject to flooding. Deep water may surround the properties and make it near impossible to enter and exit the property without a boat or makeshift elevated walkway. Septic tanks can become fouled and wells can be rendered useless from contamination. Underground utilities, drainage facilities and storage tanks are also casualties of groundwater flooding. In many ways groundwater flooding impacts can be worse than surface floods because mitigation is nearly impossible. Sandbagging and pumping have little effect of groundwater flooding and often times the best course of action is temporary relocation or evacuation of affected areas.

### Probability of Occurrence

Statistically, the Corps of Engineers estimates there is approximately a 70 percent chance that the 1996-1997 flooding will be equaled or exceeded at least once during a 30-year mortgage cycle. According to the U.S. Army Corps of Engineers, the frequency of a groundwater flooding disaster in Thurston County is probably on the order of every 25 years. Although not as frequent as riverine flooding, this recurrence rate suggests a high probability of occurrence. Detailed studies of climate trends by the University of Washington and others indicate that the Corps recurrence interval may be overly optimistic. Over the past decade, the incidence of large rainfall events, and increasing frequency of events, has increased and climate models indicate that this trend may be here to stay. The studies that Thurston County has engaged in using data collected by the network of precipitation stations and groundwater monitoring wells has confirmed many of the trends detailed by climate agencies.

## 3. Tidal Flooding

### Definition

Extremely high tides combined with low atmospheric pressure, excessive runoff, or strong northerly winds, can lead to either localized or general tidal flooding in coastal areas. Spring tides, the highest tides during any month, occur with each full and new moon. When these coincide with a northerly wind piling water in south Puget Sound, tidal flooding can occur.

### Severity

Tidal flooding by itself does not produce major flooding in the region. However, tidal flooding will become more severe in the second half of the 21st Century if sea level rise projections, as forecasted by climate change models, occur.

Refer to the Climate Change discussion for more information on the impacts of sea level rise in downtown Olympia and unincorporated Thurston County.

### Impacts

The tides can enhance riverine flooding in delta areas when rivers or creeks are at or near flood stage. The area at greatest risk to tidal flooding is the Olympia waterfront, but it is also a threat to the low lying farm lands in the Nisqually Valley and McLane Creek near Mud Bay. In the county, tidal impact is of most concern in delta areas when rivers are at flood stage and high tide exacerbates the situation.

High tides influence the timing of dam water release from Capitol Lake near 5th Avenue in downtown Olympia. A protective earthen berm was constructed around the north and eastern perimeter of Heritage Park to prevent major flood waters from flowing into downtown from Capitol Lake. However, when the Deschutes River experiences major flooding and a high tide prohibits discharge of lake water into Budd Inlet, it is plausible that floodwaters could crest the lake's bank at the southeast end of the north basin and flow into downtown Olympia along the utility road between the Capitol Campus Steam Plant and Water Street.[14] Such flood conditions have not occurred since the berm was constructed.

### Probability of Occurrence

There is scant documentation available on the history of tidal flooding in Thurston County. The probability of occurrence for tidal flooding in downtown Olympia and portions of unincorporated Thurston County is moderate.

## 4. Urban Flooding

### Definition

Urban flooding occurs when stormwater runoff exceeds the conveyance capacity of natural or infrastructural drainage systems' ability to safely divert water within suburban and urban environments. As a result utilities, streets, parking lots, homes, and businesses may experience localized flooding.

Excess water accumulation flowing off of and over impervious surfaces from heavy rainfall or melting snow over a short period of time is the most common cause of urban flooding in the cities and developed areas of the county. The problem is compounded by leaves, branches, snow or ice, and other debris that clogs stormwater grates and drainage systems. Other forms of urban flooding occur in residential neighborhoods that were constructed with insufficient stormwater conveyance capacity. Deficient drainage systems in newer developments may be unknown to residents or a municipality until flooding reveals the problem. New urban development or neighborhoods with faulty stormwater systems may adversely impact older adjacent neighborhoods that previously did not experience stormwater flooding.

## Severity

In general, properties impacted by urban flooding are not widespread and flood conditions are often highly localized. However, the impacts to transportation networks can be great. Downtown Olympia is vulnerable to urban flooding when extreme high tides coincide with persistent heavy rainfall, and major flooding on the Deschutes River. Some stormwater flooding can be easily mitigated through regular cleaning and maintenance of stormwater conveyance systems.

## Impacts

The impacts of urban flooding on homes, buildings, and utilities are similar to riverine and high groundwater flooding. Excess stormwater flows can overwhelm urban creeks and cause washouts and landslides along steep slopes. Deep standing or flowing water over roads can result in moderate to major traffic disruptions that can affect thousands of motorists during peak daily travel periods. Floodwaters can cause power disruptions or disable traffic signal controllers causing further delays. Motorists can become stranded in their cars in deep water due to engine failure.

## Probability of Occurrence

Some level of minor to moderate urban flooding coincides with major flooding on the Deschutes River; about every four and a half years. This frequency suggests a high probability of occurrence.

### Lake Flooding in Thurston County[15]

Lakes within Thurston County also experience flooding. This flooding may be resulting from many factors including: elevated groundwater tables during extreme precipitation events; increased urbanization around lakes coupled with increased stormwater flow; modifications to surface water runoff that have not been identified; and changes in precipitation patterns. Thurston County is undertaking a series of studies to identify the issues and develop mitigation strategies. The first of these studies is in the Scott lake area.

### Scott Lake

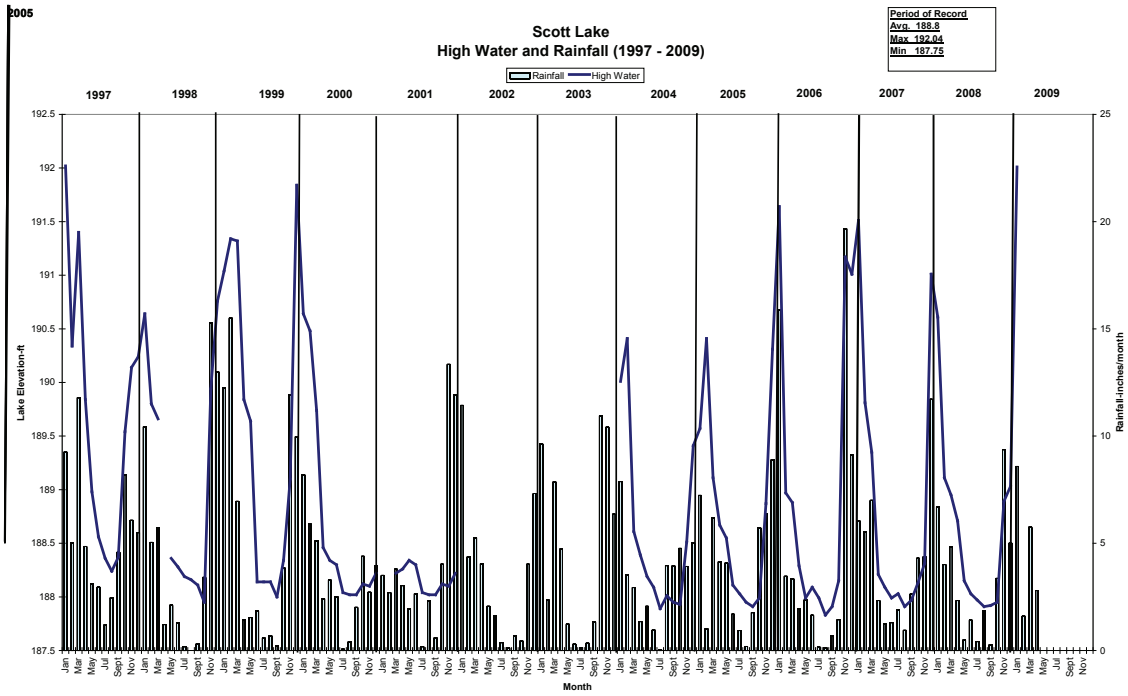
Recent flood events at Scott Lake has led the county to study the geology and hydrogeology of the lake and the surrounding area. During the summer of 2008 a seismic refraction survey was completed by the county to discern depth to ground water and soil-rock stratigraphy. In addition, shallow ground water monitoring wells were installed in the flooded areas (community center and golf course) and water level measurements were made throughout the fall and winter to determine if flooding was from ground water, surface water or both. During August of 2008 ground water levels were only 4 to 6 feet below ground surface and by the January 2009 storm event ground water levels had risen above ground surface (above 192 feet msl).

Historical lake levels are depicted in the updated graph below. Scott Lake has flooded several times in the last decade (above an elevation of 191.5 feet msl). In January of 1997 and January of 2009, however, lake levels were greater than 192 feet msl.

Community members are aggravated that they are now flooding and older citizens of the community never remembered flooding. While some felt it was a culvert issue others felt they were ‘subsiding’.

What is interesting about Scott Lake is that unlike most other lakes in Thurston County it appears to overlie the Oligocene Age McIntosh formation – a hard Tertiary bedrock consisting of volcaniclastics, flow breccias and marine sedimentary sandstones. During the early part of 2009, the WA DNR geologically mapped the Maytown Quadrangle and identified the hills surrounding Scott Lake as the Oligocene McIntosh Formation. So, flooding the Scott Lake basin may be exacerbated by shallow depth to bedrock and intense rainfall patterns exhibited in the last decade.

**Figure 4.3.1 Scott Lake High Water and Rainfall (1997-2009)**




## Flood Historical Occurrences and Impacts

Several major floods have impacted the Thurston Region over the last two decades. It is important to highlight the effects and damages from the most significant events to highlight flood severity and the extent of damages. No comprehensive hypothetical flood scenarios were developed to estimate potential losses for this risk assessment. Past flood events perhaps offer the best indication of future flood losses. The top ten record flood levels for the Nisqually, Deschutes, Skookumchuck, and Chehalis rivers are shown in Table 4.3.5.

<u>January 6-16, 2009, Federal Disaster 1817: Severe Winter Storms, Landslides, Mudslides, and Flooding</u>

A "Pineapple Express" rainstorm raised temperatures and dropped heavy rains throughout western Washington following one of the worst Pacific Northwest snow storms in decades. Severe flooding occurred throughout western Washington. The Chehalis, Skookumchuck, Deschutes, Nisqually, and Black rivers all experienced major flooding. The Skookumchuck River crested at 17.72 feet on January 8, making it the second worst flood level in the River's recorded history. The Chehalis River

crested at 18.18 feet near Grand Mound causing major flooding in the Chehalis River Basin only 13 months after the December 2007 floods.

**Table 4.3.5: Top Ten Record Floods for Thurston County Rivers**

| Record Rank | Nisqually at McKenna Gage Ht | Date | Deschutes near Rainier Gage Ht | Date | Skookumchuck near Bucoda Gage Ht | Date | Chehalis near Grand Mound Gage Ht | Date |
|---|---|---|---|---|---|---|---|---|
| 1 | 17.13 | 02/08/1996 | 17.01 | 01/09/1990 | 17.87 | 02/08/1996 | 20.23 | 12/04/2007 |
| 2 | 13.00 | 01/29/1965 | 15.74 | 02/08/1996 | 17.72 | 01/08/2009 | 19.98 | 02/09/1996 |
| 3 | 12.48 | 11/30/1995 | 15.68 | 01/15/1974 | 17.33 | 01/10/1990 | 19.34 | 01/10/1990 |
| 4 | 12.39 | 12/26/1980 | 15.28 | 01/21/1972 | 17.23 | 11/25/1990 | 18.41 | 11/25/1986 |
| 5 | 12.38 | 12/12/1955 | 14.47 | 01/08/2009 | 16.82 | 01/21/1972 | 18.39 | 12/29/1937 |
| 6 | 11.78 | 11/23/1959 | 14.29 | 12/29/1996 | 16.82 | 04/05/1991 | 18.21 | 01/21/1972 |
| 7 | 11.31 | 01/10/1990 | 13.76 | 04/05/1991 | 16.76 | 12/30/1996 | 18.18 | 01/09/2009 |
| 8 | 11.30 | 02/11/1951 | 13.64 | 12/04/2007 | 16.60 | 02/11/1990 | 18.12 | 11/25/1990 |
| 9 | 11.14 | 04/05/1991 | 13.55 | 11/26/1998 | 16.51 | 03/09/1977 | 17.73 | 12/05/1975 |
| 10 | 11.04 | 12/10/1953 | 13.42 | 12/28/1998 | 16.18 | 12/02/1977 | 17.66 | 04/06/1991 |

Interstate 5 was closed for 20 miles for nearly two days. State Route 12, State Route 8 and Highway 101 were also closed for varying durations, some for multiple days. During the height of the flood event 49 county roads were closed. There were over 200 homes isolated in the Bald Hill Road/ Clearwood area, and likely over 100 homes isolated in the Rochester, Grand Mound and Gate areas, and likely another 50 homes with access issues in the Bucoda vicinity.

Damages to homes throughout Thurston County were estimated at $3 million. Damage was concentrated in and around the town of Bucoda, the Rochester community, and along the Deschutes River outside of Yelm. Damages to public facilities and roads around Thurston County and the overtime cost for city and county officials to respond to the flooding cost $2.5 million.

Volunteer firefighters went door to door in Bucoda warning residents of imminent flooding before floodwaters swallowed a nine-block stretch of the town of Bucoda (the town's worst flood event since 1996). Residents were forced to evacuate and a Thurston County dive team was deployed to assist residents. At least two households required rescue assistance. One home was red-tagged and 12 homes were yellow-tagged. The Intersection of 3rd Avenue and North Nenant Street incurred damages exceeding $12,000. Extensive road damage along five blocks of Market Street also occurred. At least one municipal well was forced to shut down due to possible contamination. The town-owned RV park restroom was also contaminated by floodwaters and required extensive clean up.

On January 8, the City of Lacey shut down two streets for the first time in at least nine years due to urban flooding. Crews closed Rainier Road at the south end of city limits around the Burlington Northern Santa Fe (BNSF) railroad trestle. The City also closed 32nd Avenue Northeast off Marvin Road in the Hawks Prairie area. The heavy rains entering the sewer system in Olympia forced the

LOTT Alliance to discharge 6.3 million gallons of partially treated wastewater from its Budd Inlet Sewer Treatment Plant via its emergency outfall at the Fiddlehead Marina.

December 1-7, 2007, Federal Disaster 1734: Severe Winter Storms, Flooding, Landslides, and Mudslides[16]

Snow followed by a "Pineapple Express" on December 2 and 3 caused major flooding throughout southwest Washington. Heavy rainfall and melting snow resulted in record flooding on the Chehalis River. The Chehalis River crested at 20.23 feet, six feet over flood stage at the Grand Mound gage. Some sites in the Willapa Hills collected 14 to 18 inches of rain over the two-day period. Widespread flooding occurred in southwest Thurston County heavily impacting the Rochester community, Grand Mound, and the Independence Valley area. Lewis County was especially hard hit, particularly around the more densely populated cities of Centralia and Chehalis and the farms around Adna and the Boisfort Valley.

The Deschutes and Black rivers also rose above their banks. The Deschutes River crested 2.75 feet above flood stage near Rainier and flooded residential areas and the Tumwater Valley. The region also experienced stream and urban flooding and flash flood conditions off of the hills of Capital Forest resulting in washouts and landslides (see landslide hazard profile for other details on this event).

On December 4, Rochester Fire Department developed a command post for evacuation and rescue. The Rochester Fire District, the Thurston County Sheriff's Office Dive Team, local search and rescue volunteer groups, and the Washington State National Guard rescued 63 people - 17 by helicopter. Nearly 300 people were rescued or forced to evacuate in Lewis County. Numerous people were forced from their homes to seek refuge in local area shelters. Thurston County opened a flood relief center at the Rochester Community Center to assist affected residents.

Thurston County documented 44 county roads and bridges that closed from storm and flood damage. Round-the-clock road repair and maintenance was carried out by the county and cities. It is estimated there were over 400 homes in the area were affected by the road closures in the southwest Thurston County due to Chehalis River flooding. Interstate 5 closed for 20 miles between Chehalis and Grand Mound for five days. Some portions of Interstate 5 were covered with ten feet of water. The Washington State Department of Transportation estimated that the closure resulted in $47 million in lost of economic output statewide.[17] Additional closures along Highway 101 and Highway 8 disrupted commute patterns for thousands of people who travel through, live, or work in Thurston County. A railroad bridge over the Nisqually River suffered significant damage due to debris collection against the bridge, resulting in a disruption of statewide rail traffic. West coast rail traffic was also shut down for several days due to flooding.

Nearly ten inches of rain fell on the City of Olympia's west side resulting in the worst urban flooding ever experienced on the City's west side. On the morning of December 3, 2007 during the peak commute period, the west side of Olympia experienced major traffic backups for hours due to road closures. One of the highest traffic volume intersections in the region, Cooper Point Road and Black Lake Boulevard off of Highway 101, experienced major flooding resulting in permanent damage to the signal controller. Several motorists attempted to drive through the water only to become stranded

and forced to abandon their vehicles. Some vehicles were eventually completely submerged. The Percival Creek Bridge on Cooper Point Road also experienced inundation forcing its closure. Several businesses on Olympia's west side were affected by floodwaters and power outages. Puget Sound Energy turned off power as a safety precaution requiring businesses to temporarily close their doors. The Woodshed, a furniture retailer, lost their entire inventory to three feet of water. Replacement cost was estimated at $250,000.

On December 3, the LOTT Alliance's Budd Inlet Sewer Treatment Plant was forced to discharge untreated wastewater into Budd Inlet due to the enormous volume of rainfall and runoff. At its peak, an estimated 1 million gallons per hour bypassed treatment processes and was sent through the emergency outfall near Fiddlehead Marina. After the flooding, many wells and water supplies were contaminated and non-functional in the unincorporated areas of the County. Public health advisories were issued to flood affected areas to inform the public to boil their water or consume only bottled water.

Preliminary cost estimates for the response, preventive measures, and the damage to public facilities exceed $4.6 million throughout Thurston County. Many of the local fire districts' response personnel were volunteer firefighters. In many ways the dollar figures reported for response costs only reflect a fraction of the actual response costs to local governments. Damage to Thurston County roads and bridges for non-Federal Highway Administration (FHWA) system roads was $2.7 million. Three sites of FHWA-system roads incurred over $32,000 in damages.

For this disaster, nearly 267 Thurston County residents applied to FEMA for assistance with over $6 million claims in property damages. FEMA awarded $544,928 in aid and the Small Business Administration granted $1.7 million to 30 homeowners and 2 businesses.

October15-23, 2003, Federal Disaster 1499: Severe Storms and Flooding

At least eleven people reported flood damage within Thurston County. At least two structures may have received damage that exceeded their replacement value. Thurston County was not seriously impacted by this storm event and received a disaster declaration because it bordered counties that experienced more severe flooding (Mason, Pierce, and Grays Harbor counties).

February 1999 High Ground Water Flooding

Higher than normal rainfall caused major groundwater flooding and urban stormwater flooding throughout Thurston County and its communities. Although no Federal Disaster was declared, major flooding affected over 200 properties in Lacey, Olympia, Tumwater, and Thurston County. (See landslide hazard profile for more on landslide impacts during this event).

December 1996 (Federal Disaster 1159) to February 1997 Winter Storm and Flooding

The year 1996 was the third wettest year of the 20th Century and December was especially wet, receiving over twice its normal monthly rainfall. During this time period:

- 200 homes countywide were inundated

- 200 drinking water wells became contaminated
- Septic system failures occurred throughout the county
- Response and recovery efforts cost Thurston County government over $340,000
- Response, recovery, and repair costs for other government entities and utilities exceeded $750,000
- Private property owners lost over $1.75 million in uninsured losses.

February 1996, Federal Disaster 1100: Flooding

The February 1996 flood is one of the most devastating floods on record for Thurston County. Every major river and stream crested their banks. Record flooding occurred on the Nisqually River near McKenna when the river crested at 17.13 feet, seven feet over flood stage on February 8, 1996. Record flooding also occurred on the Skookumchuck River near Bucoda when the river crested at 17.87 feet, four feet over flood stage. Major flooding also occurred on the Deschutes and Chehalis rivers. The 1996 flood resulted in the following impacts:

- Over 350 Homes were inspected, 190 were declared uninhabitable
- 47 Homes were destroyed in the Nisqually Valley
- Over two dozen homes were destroyed elsewhere
- Nearly 1,000 people evacuated their homes
- 300 people required rescuing
- More than 300 sections of the county road system were damaged
- Wa He Lut, A contract U.S. Bureau of Indian Affairs School, was destroyed by the Nisqually River
- I-5 was closed at the Lewis County line
- The main north-south railroad line at the Pierce County line was closed
- Response and recovery efforts cost Thurston County government over $2 million
- Response, recovery, and repair costs for other government entities and utilities exceeded $20 million
- Private property owners lost over $22 million in uninsured losses.

January 1990, Federal Disaster 852: Severe Storm and Flooding

The Deschutes River at Rainier crested at 17.01 feet, six feet over flood stage – setting the flood record. Major flooding also occurred on the Nisqually, Deschutes, Skookumchuck, and Chehalis rivers. The Thurston Region experienced the following impacts:

- Two people were killed by flood waters in Lewis County
- I-5 closed for several days between Chehalis and Thurston County
- 83 elderly residents from the Nisqually Valley Care Center in McKenna were evacuated to a Red Cross Shelter at Yelm High School gymnasium
- Floodwaters reached four feet deep on Bucoda streets and prompted nearly 600 residents to

evacuate; one elderly man died from natural causes during the evacuation

- Lowland Nisqually Valley residents were urged to evacuate their homes
- Portions of downtown Olympia experienced urban flooding.

## National Insurance Program and Repetitive Loss Properties

**§201.6(c)(2)(ii): [The risk assessment in all] plans approved after October 1, 2008 must also address National Flood Insurance Program (NFIP) insured structures that have been repetitively damaged by floods.**

### National Flood Insurance Progam

Communities that regulate new development in their floodplains are able to join the National Flood Insurance Program (NFIP). In return, the NFIP provides federally backed flood insurance for properties in participating communities. Table 4.3.6 summarizes the number of NFIP policies, losses, and claims by jurisdiction.

The NFIP's Dwelling Form offers coverage for:

1. Building Property, up to $250,000; and
2. Personal Property (Contents), up to $100,000. The NFIP encourages people to purchase both types of coverage.

**Table 4.3.6: Summary of National Flood Insurance Program Premiums, Policies, and Claims**[18]

| Community | Total Premium | Number of Policies V Zone | A Zone | Total | Total Coverage | Total Claims Since 1978 | Total Paid Since 1978 | Repetitive Losses | Severe Losses |
|---|---|---|---|---|---|---|---|---|---|
| Bucoda | $55,051 | 0 | 64 | 74 | $10,033,700 | 42 | $249,262 | 0 | 0 |
| Lacey | $4,652 | 0 | 0 | 14 | $3,871,000 | 3 | $8,088 | 0 | 0 |
| Olympia | $90,555 | 0 | 31 | 82 | $25,265,400 | 16 | $347,006 | 0 | 0 |
| Rainier | $326 | 0 | 0 | 1 | $280,000 | 0 | $0 | 0 | 0 |
| Tenino | $1,327 | 0 | 0 | 4 | $633,700 | 7 | $105,233 | 0 | 0 |
| Tumwater | $2,707 | 0 | 0 | 6 | $1,482,000 | 2 | $12,515 | 0 | 0 |
| Yelm | $17,617 | 0 | 11 | 28 | $7,313,400 | 2 | $7,603 | 0 | 0 |
| Thurston County | $316,352 | 3 | 281 | 663 | $141,785,400 | 215 | $3,389,280 | 10 | 0 |
| County Total : | $488,587 | 3 | 387 | 872 | $190,664,600 | 287 | $4,118,987 | 10 | 0 |

## Repetitive Loss Properties

The Federal Emergency Management Agency (FEMA) defines a repetitive loss property as, "…those [properties] for which two or more losses of at least $1,000 each have been paid under the National Flood Insurance Program (NFIP) within any 10-year period since 1978." A property is defined as a "severe repetitive loss property" when it meets one of these conditions:

1. Four or more separate flood claim payments have been made and each claim payment exceeds $5,000; or
2. At least two flood claim payments have been made and the cumulative payments exceed the value of the property.

According to FEMA's NFIP Repetitive Loss Update Worksheet (AW-501) Thurston County has 16 residential repetitive loss properties. Six of these properties have already been mitigated, therefore only ten properties are currently classified as repetitive losses.[19] The County does not presently have any properties that meet severe repetitive loss criteria.

All ten repetitive loss properties are located in unincorporated Thurston County. They are located in the Nisqually and Deschutes River Basins and in the high groundwater flood zones in the vicinity of south Tumwater (See Map 4.3.2). All of the properties are residential. The general vicinity of repetitive loss properties, their dates of flooding, and an estimate of the replacement value is shown in Table 4.3.7.

**Table 4.3.7: Thurston County Repetitive Loss Properties**

| General Vicinity | | | Flood Event | | | | Replacement |
|---|---|---|---|---|---|---|---|
| Block | Street | Zip | 1 | 2 | 3 | 4 | Value* |
| 22000 | Paul Bunyon Rd SE | 98597 | Jan-90 | Feb-96 | | | $1,000 |
| 400 | River Bend Lane | 98513 | Dec-95 | Feb-96 | | | $122,000 |
| 11000 | 6th Ave SE | 98513 | Nov-95 | Feb-96 | | | $137,800 |
| 400 | SE River Bend Lane | 98513 | Dec-95 | Feb-96 | | | $149,300 |
| 18000 | Cedar Park Lane SE | 98597 | Jan-90 | Feb-96 | | | $133,200 |
| 18000 | SE Dynamite Drive | 98597 | Jan-99 | Feb-96 | Jan-97 | Dec-07 | $114,300 |
| 8000 | SW Littlerock Rd | 98512 | Mar-97 | Mar-97 | Jan-90 | | $192,200 |
| 17000 | SE Deschutes Dr | 98597 | Jan-90 | Dec-96 | | | $44,800 |
| 17000 | SE Corbin Rd** | 98597 | Jan-99 | Feb-96 | | | $46,600 |
| 8000 | Armstrong Lane SW | 98512 | Mar-96 | Apr-99 | | | $240,000 |

*Note: Estimated Replacement Value is the 2009 Thurston County Assessor's Office assessed structure value
**Note: Cprbom Rd property mitigation in progress with FEMA ICC Funds

Thurston County maintains a database of all flood damage reports. More analysis is required to estimate future or potential repetitive loss properties within the flood hazard areas. In November 2008, Thurston County received a $211,000 Community Block Grant from the Washington State Department of Community Trade and Economic Development. The grant is available to elevate approximately 30 to 47 residences in the Chehalis and Deschutes River Basins that were damaged by the December 2007 Flood. The first floor above the crawlspace must be 24" above the FEMA mapped elevation for the property or the highest known flood level, whichever is greater. The grant will serve to prevent future flood damage to residences in the affected areas and therefore reduce the number of potential repetitive loss structures.

## Delineation of Flood Hazard Area

The flood hazard area consists of those parcels in the county in 100- and 500-year floodplains (FEMA flood zones A and B respectively), and areas of High Groundwater Flooding (Map 4.3.2). No new flood inundation data is available. The flood hazard delineation zone has not changed since the 2003 Natural Hazard Mitigation Plan for the Thurston Region was developed.

## Population and Employment in the Hazard Area

Approximately 17,000 people (7 percent) and 6,500 employees (5 percent) live and work respectively within flood hazard areas. Estimates of the region's population and employment in the flood hazard area are summarized in tables 4.3.10 through 4.3.13. These tables assesses an aspect of current and future vulnerability by providing data on the number of people living and working within the hazard area as compared to total population, by jurisdiction, in the years 2006 and 2030.

No detailed flood hazard scenario analysis of potential losses was conducted during the planning process. Estimates of the region's structures and their contents in the flood hazard area are summarized in tables 4.3.14 through 4.3.20. These tables provide an estimate of the number of existing and future structures which may be potentially affected by the hazard, as well as an estimate of structure and building contents value in order to provide information on potential dollar losses. Tables are provided by jurisdiction, for the years 2006 and 2030.

## Critical Facilities and Infrastructure in Hazard Area

Based on the historical community impact from the effects of flood events, it is clear that floods can destroy or damage facilities that may be critical for responding to the disaster and for maintaining a safe environment and public order. Both the north and south extensions of major thoroughfares and railroad lines cross a floodplain at the county border. This is also true of the eastern extensions. Petroleum pipelines, natural gas pipelines, and the major electricity feeder lines enter the county over a floodplain.

Specific information on the location and ownership of critical facilities and infrastructure is housed with Thurston County Emergency Management. Critical facilities include both public and private facilities. For example, hospitals are critical facilities but are privately owned. Likewise a facility owned by one jurisdiction may be located within the boundaries of another; such as the County Courthouse complex which is located in the City of Olympia. Table 4.3.21 lists the type and number of critical facilities located in the flood hazard area.

## Summary Assessment

The history of major flooding within the Thurston Region clearly demonstrates a high probability of future occurrence. The December 2007 and January 2009 floods were not as costly as the February 1996 flood, but suggest that the region remains vulnerable to flood impacts. Because of the relative land area and population affected, the county is exposed to moderate vulnerability. On a jurisdictional basis, an exception is the Town of Bucoda, which has a high vulnerability to flooding due to its location within a 100-year floodplain. Although the vulnerability is moderate, the frequency of flooding, the potential for simultaneous flooding events, plus the historical record of recurrent flooding and cumulative costs, all lead to the assignment of a high risk rating.

**Summary Risk Assessment for Flood in the Thurston Region**

| Flood Type | Probability of Occurrence | Vulnerability | Risk |
|---|---|---|---|
| Riverine | High | Moderate | High |
| Groundwater | High | Moderate | High |
| Tidal | Moderate | Low | Low |
| Urban/Stormwater | High | Moderate | Moderate |
| Overall Assessment | High | Moderate | High |

## Table 4.3.8: Flood Hazard Area by Jurisdiction

| Jurisdiction | | Total Acres | 100 Year SFHA | | 500 Year SFHA | | High Groundwater | | All Flood Zones | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | In Hazard Area | % In Hazard Area | In Hazard Area | % In Hazard Area | In Hazard Area | % In Hazard Area | In Hazard Area | % In Hazard Area |
| Bucoda | **Total** | **380** | **170** | **45%** | **7** | **2%** | **57** | **15%** | **189** | **50%** |
| Lacey | City | 10,550 | 495 | 5% | 16 | 0% | 804 | 8% | 1,134 | 11% |
| | UGA | 10,645 | 614 | 6% | 5 | 0% | 468 | 4% | 1,019 | 10% |
| | **Total** | **21,195** | **1,109** | **5%** | **20** | **0%** | **1,272** | **6%** | **2,154** | **10%** |
| Olympia | City | 11,859 | 991 | 8% | 4 | 0% | 846 | 7% | 1,601 | 14% |
| | UGA | 4,119 | 198 | 5% | 0 | 0% | 344 | 8% | 538 | 13% |
| | **Total** | **15,978** | **1,189** | **7%** | **4** | **0%** | **1,191** | **7%** | **2,139** | **13%** |
| Rainier | City | 1,105 | 3 | 0% | 0 | 0% | 72 | 6% | 74 | 7% |
| | UGA | 319 | 4 | 1% | 0 | 0% | 16 | 5% | 19 | 6% |
| | **Total** | **1,424** | **7** | **0%** | **0** | **0%** | **87** | **6%** | **94** | **7%** |
| Tenino | City | 924 | 31 | 3% | 10 | 1% | 79 | 9% | 100 | 11% |
| | UGA | 65 | 7 | 11% | 0 | 0% | 0 | 0% | 7 | 11% |
| | **Total** | **989** | **38** | **4%** | **10** | **1%** | **79** | **8%** | **107** | **11%** |
| Tumwater | City | 9,274 | 409 | 4% | 247 | 3% | 1,440 | 16% | 1,848 | 20% |
| | UGA | 5,812 | 522 | 9% | 126 | 2% | 1,503 | 26% | 1,998 | 34% |
| | **Total** | **15,086** | **931** | **6%** | **373** | **2%** | **2,943** | **20%** | **3,845** | **25%** |
| Yelm | City | 3,634 | 134 | 4% | 5 | 0% | 362 | 10% | 399 | 11% |
| | UGA | 2,396 | 79 | 3% | 0 | 0% | 408 | 17% | 424 | 18% |
| | **Total** | **6,030** | **213** | **4%** | **5** | **0%** | **770** | **13%** | **823** | **14%** |
| Ground Mound UGA | **Total** | **983** | **13** | **1%** | **0** | **0%** | **145** | **15%** | **150** | **15%** |
| Chehalis Tribe | **Total** | **833** | **560** | **67%** | **0** | **0%** | **0** | **0%** | **560** | **67%** |
| Nisqually Tribe | **Total** | **1,700** | **420** | **25%** | **0** | **0%** | **0** | **0%** | **420** | **25%** |
| **Total Cities** | | **37,725** | **2,234** | **6%** | **290** | **1%** | **3,660** | **10%** | **5,346** | **14%** |
| **Total UGAs** | | **24,339** | **1,436** | **6%** | **131** | **1%** | **2,884** | **12%** | **4,155** | **17%** |
| **Total Reservations** | | **2,532** | **585** | **23%** | **0** | **0%** | **0** | **0%** | **980** | **23%** |
| **Rural Unincorporated County** | | **406,242** | **30,665** | **8%** | **3,133** | **1%** | **27,819** | **7%** | **55,607** | **14%** |
| **Thurston County Total** | | **470,839** | **35,316** | **8%** | **3,553** | **1%** | **34,363** | **7%** | **66,088** | **14%** |

## Table 4.3.9: Flood Hazard Area, by Special Districts

| | | | 100 Year SFHA | | 500 Year SFHA | | High Groundwater | | All Flood Zones | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Total Acres | In Hazard Area | % in Hazard Area | In Hazard Area | % in Hazard Area | In Hazard Area | % in Hazard Area | In Hazard Area | % in Hazard Area |
| **Fire Districts** | | | | | | | | | | |
| | Bucoda | 379 | 170 | 45% | 7 | 2% | 57 | 15% | 189 | 50% |
| | Olympia | 11,882 | 985 | 8% | 0 | 0% | 840 | 7% | 1,591 | 13% |
| | Tumwater[1] | 10,057 | 588 | 6% | 259 | 3% | 1,647 | 16% | 2,162 | 22% |
| 1,11 | Rochester/Littlerock[2] | 101,349 | 11,448 | 11% | 1,170 | 1% | 9,549 | 9% | 19,849 | 20% |
| 2,4 | Yelm/Rainer[2] | 83,420 | 4,004 | 5% | 362 | 0% | 7,672 | 9% | 11,140 | 13% |
| 3 | Lacey | 45,769 | 3,543 | 8% | 1,057 | 2% | 2,703 | 6% | 6,614 | 14% |
| 6 | East Olympia | 25,108 | 2,268 | 9% | 151 | 1% | 2,643 | 11% | 4,392 | 17% |
| 7 | North Olympia | 7,060 | 321 | 5% | 0 | 0% | 532 | 8% | 823 | 12% |
| 8 | South Bay | 13,113 | 380 | 3% | 0 | 0% | 1,146 | 9% | 1,518 | 12% |
| 9,5 | McLane/Black Lake[2] | 50,984 | 2,525 | 5% | 79 | 0% | 784 | 2% | 3,276 | 6% |
| 12 | Tenino | 44,254 | 2,958 | 7% | 218 | 0% | 2,945 | 7% | 5,398 | 12% |
| 13 | Griffin | 13,953 | 279 | 2% | 0 | 0% | 862 | 6% | 1,132 | 8% |
| 16 | Gibson Valley | 19,081 | 1,949 | 10% | 47 | 0% | 1,532 | 8% | 2,706 | 14% |
| 17 | Bald Hills | 44,962 | 3,731 | 8% | 202 | 0% | 1,457 | 3% | 5,134 | 11% |
| **School Districts** | | | | | | | | | | |
| Centralia | | 12,852 | 1,869 | 15% | 22 | 0% | 1,187 | 9% | 2,273 | 18% |
| Griffin | | 21,768 | 931 | 4% | 0 | 0% | 872 | 4% | 1,792 | 8% |
| North Thurston | | 48,504 | 5,205 | 11% | 967 | 2% | 3,445 | 7% | 8,910 | 18% |
| Olympia | | 51,918 | 4,145 | 8% | 32 | 0% | 1,667 | 3% | 5,618 | 11% |
| Rainier | | 35,550 | 1,447 | 4% | 156 | 0% | 1,929 | 5% | 3,253 | 9% |
| Rochester | | 68,314 | 8,406 | 12% | 1,013 | 1% | 2,820 | 4% | 11,026 | 16% |
| Tenino | | 70,501 | 5,460 | 8% | 347 | 0% | 6,702 | 10% | 10,713 | 15% |
| Tumwater | | 73,848 | 5,141 | 7% | 541 | 1% | 7,685 | 10% | 12,204 | 17% |
| Yelm | | 126,543 | 8,932 | 7% | 1,507 | 1% | 8,078 | 6% | 17,542 | 14% |
| **Other Participating Jurisdictions (Service Area)** | | | | | | | | | | |
| Intercity Transit | | 62,333 | 5,700 | 9% | 379 | 1% | 5,084 | 8% | 10,170 | 16% |
| LOTT* | | 21,160 | 690 | 3% | 80 | 0% | 1,400 | 7% | 1,996 | 9% |
| (*Sewered Area). | | | | | | | | | | |
| **Colleges** | | | | | | | | | | |
| SPSCC-Main Campus | | 92 | 3 | 4% | 0 | 0% | 11 | 12% | 14 | 15% |
| TESC - Main Campus | | 939 | 9 | 1% | 0 | 0% | 4 | 0% | 13 | 1% |
| **Non-Profit** | | | | | | | | | | |
| Providence St. Peter Hospital | | 157 | 22 | 14% | 0 | 0% | 1 | 1% | 23 | 14% |
| Note: The service areas for the following participating jurisdictions are multi-county: Thurston County PUD, Timberland Regional Library (see local annex for details) | | | | | | | | | | |

[1]Munn Lake Fire District 15 contracts services with the City of Tumwater Fire Department; its data is combined with Tumwater's.
[2]Fire Districts 1 and 11, 2 and 4, 5 and 9 have joint operations agreements; therefore the data for the paired districts is combined.

## Table 4.3.10: Flood Hazard Area, Population, 2006 and 2030
## Note: Majority of Parcel

| | | 2006 Population Estimate | | | 2030 Population Forecast | | |
|---|---|---|---|---|---|---|---|
| Jurisdiction | | Total | In Hazard Area | % in Hazard Area | Total | In Hazard Area | % in Hazard Area |
| Bucoda | **Total** | **650** | **435** | **67%** | **1,050** | **565** | **54%** |
| Lacey | City | 34,115 | 1,925 | 6% | 52,015 | 1,990 | 4% |
| | UGA | 32,820 | 1,640 | 5% | 54,740 | 2,220 | 4% |
| | **Total** | **66,935** | **3,565** | **5%** | **106,755** | **4,210** | **4%** |
| Olympia | City | 44,350 | 1,045 | 2% | 64,385 | 2,280 | 4% |
| | UGA | 10,820 | 560 | 5% | 17,710 | 945 | 5% |
| | **Total** | **55,170** | **1,605** | **3%** | **82,095** | **3,225** | **4%** |
| Rainier | City | 1,675 | 80 | 5% | 2,540 | 85 | 3% |
| | UGA | 115 | 10 | 9% | 355 | 10 | 3% |
| | **Total** | **1,790** | **90** | **5%** | **2,895** | **95** | **3%** |
| Tenino | City | 1,525 | 30 | 2% | 3,110 | 165 | 5% |
| | UGA | 20 | 5 | 25% | 475 | 5 | 1% |
| | **Total** | **1,545** | **35** | **2%** | **3,585** | **170** | **5%** |
| Tumwater | City | 15,475 | 820 | 5% | 27,610 | 2,945 | 11% |
| | UGA | 6,180 | 990 | 16% | 13,805 | 2,320 | 17% |
| | **Total** | **21,655** | **1,810** | **8%** | **41,415** | **5,265** | **13%** |
| Yelm | City | 4,570 | 385 | 8% | 21,025 | 710 | 3% |
| | UGA | 1,335 | 140 | 10% | 3,035 | 230 | 8% |
| | **Total** | **5,905** | **525** | **9%** | **24,060** | **940** | **4%** |
| Grand Mound UGA | **Total** | **845** | **25** | **3%** | **2,685** | **20** | **1%** |
| Chehalis Reservation[1] | **Total** | **35** | **30** | **86%** | **175** | **135** | **77%** |
| Nisqually Reservation[1] | **Total** | **635** | **0** | **0%** | **940** | **0** | **0%** |
| **Total Cities** | | **102,360** | **4,720** | **5%** | **171,735** | **8,740** | **5%** |
| **Total UGAs [2]** | | **52,140** | **3,370** | **6%** | **92,810** | **5,750** | **6%** |
| **Total Reservations[1]** | | **670** | **30** | **4%** | **1,115** | **135** | **12%** |
| **Rural Unincorporated County[3]** | | **75,880** | **8,890** | **12%** | **107,285** | **10,634** | **10%** |
| **Thurston County Total** | | **231,100** | **17,000** | **7%** | **372,900** | **25,300** | **7%** |

**Source**: Thurston Regional Planning Council Populaton Forecast, 2007.

**Explanations**: Numbers may not add due to rounding.

[1]Data is for Thurston County portion of reservation only.

[2]UGA - Urban Growth Area. Unincorporated area designated to be annexed into city limits over 20 years time to accommodate urban growth.

[3]Rural unincorporated county is the portion of the unincorporated county that lies outside UGA and Reservation boundaries.

## Table 4.3.11: Flood Hazard Area, Population - Special Districts, 2006 and 2030

| | | 2006 Population Estimate | | | 2030 Population Forecast | | |
|---|---|---|---|---|---|---|---|
| | | Total | In Hazard Area | % in Hazard Area | Total | In Hazard Area | % in Hazard Area |
| **Fire Districts** | | | | | | | |
| | Bucoda | 650 | 435 | 67% | 1,050 | 565 | 54% |
| | Olympia | 44,380 | 1,045 | 2% | 64,505 | 2,280 | 4% |
| | Tumwater[1] | 16,365 | 1,030 | 6% | 29,855 | 3,225 | 11% |
| 1,11 | Rochester/Littlerock[2] | 20,200 | 3,220 | 16% | 33,665 | 4,890 | 15% |
| 2,4 | Yelm/Rainier[2] | 19,390 | 1,910 | 10% | 43,935 | 2,720 | 6% |
| 3 | Lacey | 78,040 | 5,155 | 7% | 121,245 | 5,910 | 5% |
| 6 | East Olympia | 11,815 | 785 | 7% | 17,430 | 1,545 | 9% |
| 7 | North Olympia | 3,920 | 275 | 7% | 4,730 | 300 | 6% |
| 8 | South Bay | 7,165 | 670 | 9% | 11,050 | 725 | 7% |
| 9,5 | McLane/Black Lake[2] | 14,990 | 855 | 6% | 21,420 | 1,070 | 5% |
| 12 | Tenino | 5,425 | 685 | 13% | 10,580 | 925 | 9% |
| 13 | Griffin | 5,075 | 395 | 8% | 6,870 | 440 | 6% |
| 16 | Gibson Valley | 465 | 160 | 34% | 1,430 | 180 | 13% |
| 17 | Bald Hills | 3,170 | 360 | 11% | 5,170 | 460 | 9% |
| **School Districts** | | | | | | | |
| Centralia | | 380 | 170 | 45% | 1,190 | 225 | 19% |
| Griffin | | 5,885 | 415 | 7% | 7,885 | 460 | 6% |
| North Thurston | | 85,305 | 5,675 | 7% | 131,365 | 6,910 | 5% |
| Olympia | | 58,000 | 1,900 | 3% | 83,735 | 4,250 | 5% |
| Rainier | | 4,580 | 525 | 11% | 16,110 | 650 | 4% |
| Rochester | | 12,555 | 1,540 | 12% | 19,380 | 2,110 | 11% |
| Tenino | | 9,175 | 1,595 | 17% | 17,985 | 2,115 | 12% |
| Tumwater | | 34,185 | 3,120 | 9% | 57,795 | 5,665 | 10% |
| Yelm | | 21,040 | 2,055 | 10% | 37,565 | 2,860 | 8% |
| **Other Participating Jurisdictions (Service Area)** | | | | | | | |
| Intercity Transit | | 143,815 | 6,680 | 5% | 236,195 | 12,005 | 5% |
| LOTT* | | 95,525 | 3,685 | 4% | 230,265 | 12,700 | 6% |

(*Sewered Area for 2006; Lacey, Olympia Tumwater UGA for 2030).

Note: The service areas for the following participating jurisdictions are multi-county or county-wide: The Evergreen State College, South Puget Sound Community College, Thurston County PUD, Port of Olympia, Timberland Regional Library

[1]Munn Lake Fire District 15 contracts services with the City of Tumwater Fire Department; its data is combined with Tumwater's.
[2]Fire Districts 1 and 11, 2 and 4, 5 and 9 have joint operations agreements; therefore the data for the paired districts is combined.

## Table 4.3.12: Flood Hazard Area, Employment, 2006 and 2030

| | | 2006 Employment Estimate | | | 2030 Employment Forecast | | |
|---|---|---|---|---|---|---|---|
| Jurisdiction | | Total | In Hazard Area | % in Hazard Area | Total | In Hazard Area | % in Hazard Area |
| Bucoda | **Total** | **35** | **25** | **71%** | **175** | **85** | **49%** |
| Lacey | City | 21,955 | 460 | 2% | 34,120 | 1,640 | 5% |
| | UGA | 5,195 | 115 | 2% | 7,995 | 170 | 2% |
| | **Total** | **27,150** | **575** | **2%** | **42,115** | **1,810** | **4%** |
| Olympia | City | 53,400 | 1,945 | 4% | 70,870 | 3,380 | 5% |
| | UGA | 1,470 | 45 | 3% | 2,550 | 100 | 4% |
| | **Total** | **54,870** | **1,990** | **4%** | **73,420** | **3,480** | **5%** |
| Rainier | City | 375 | 5 | 1% | 1,065 | 5 | 0% |
| | UGA | 10 | 0 | 0% | 20 | 0 | 0% |
| | **Total** | **385** | **5** | **1%** | **1,085** | **5** | **0%** |
| Tenino | City | 810 | 0 | 0% | 2,100 | 65 | 3% |
| | UGA | 35 | 0 | 0% | 45 | 0 | 0% |
| | **Total** | **845** | **0** | **0%** | **2,145** | **65** | **3%** |
| Tumwater | City | 17,775 | 860 | 5% | 28,260 | 1,585 | 6% |
| | UGA | 2,270 | 170 | 7% | 4,850 | 830 | 17% |
| | **Total** | **20,045** | **1,030** | **5%** | **33,110** | **2,415** | **7%** |
| Yelm | City | 3,290 | 90 | 3% | 8,080 | 325 | 4% |
| | UGA | 325 | 45 | 14% | 545 | 50 | 9% |
| | **Total** | **3,615** | **135** | **4%** | **8,625** | **375** | **4%** |
| Grand Mound UGA | **Total** | **445** | **20** | **4%** | **1,110** | **40** | **4%** |
| Chehalis Reservation[1] | **Total** | **860** | **800** | **93%** | **2,450** | **910** | **37%** |
| Nisqually Reservation[1] | **Total** | **720** | **0** | **0%** | **1,650** | **0** | **0%** |
| **Total Cities** | | **97,640** | **3,390** | **3%** | **144,670** | **7,085** | **5%** |
| **Total UGAs [2]** | | **9,750** | **400** | **4%** | **17,120** | **1,190** | **7%** |
| **Total Reservations[1]** | | **1,580** | **800** | **51%** | **4,100** | **910** | **22%** |
| **Rural Unincorporated County[3]** | | **12,370** | **1,955** | **16%** | **18,795** | **3,000** | **16%** |
| **Thurston County Total** | | **121,300** | **6,500** | **5%** | **184,700** | **12,200** | **7%** |

**Source**: Thurston Regional Planning Council Populaton Forecast, 2007.

**Explanations**: Numbers may not add due to rounding.

[1]Data is for Thurston County portion of reservation only.

[2]UGA - Urban Growth Area. Unincorporated area designated to be annexed into city limits over 20 years time to accommodate urban growth.

[3]Rural unincorporated county is the portion of the unincorporated county that lies outside UGA and Reservation boundaries.

## Table 4.3.13: Flood Hazard Area, Employment - Special Districts, 2006 and 2030

| | | 2006 Employment Estimate | | | 2030 Employment Forecast | | |
|---|---|---|---|---|---|---|---|
| | | Total | In Hazard Area | % in Hazard Area | Total | In Hazard Area | % in Hazard Area |
| **Fire Districts** | | | | | | | |
| | Bucoda | 35 | 25 | 71% | 175 | 85 | 49% |
| | Olympia | 53,445 | 1,945 | 4% | 71,015 | 3,385 | 5% |
| | Tumwater[1] | 18,545 | 875 | 5% | 29,290 | 1,610 | 5% |
| 1,11 | Rochester/Littlerock[2] | 5,460 | 1,770 | 32% | 11,570 | 2,885 | 25% |
| 2,4 | Yelm/Rainier[2] | 5,510 | 285 | 5% | 12,030 | 675 | 6% |
| 3 | Lacey | 29,625 | 840 | 3% | 45,875 | 2,135 | 5% |
| 6 | East Olympia | 2,095 | 225 | 11% | 3,400 | 465 | 14% |
| 7 | North Olympia | 450 | 30 | 7% | 615 | 40 | 7% |
| 8 | South Bay | 1,110 | 125 | 11% | 1,645 | 160 | 10% |
| 9,5 | McLane/Black Lake[2] | 2,755 | 165 | 6% | 4,095 | 285 | 7% |
| 12 | Tenino | 1,240 | 80 | 6% | 3,075 | 215 | 7% |
| 13 | Griffin | 765 | 115 | 15% | 1,120 | 140 | 13% |
| 16 | Gibson Valley | 60 | 15 | 25% | 165 | 25 | 15% |
| 17 | Bald Hills | 240 | 45 | 19% | 610 | 90 | 15% |
| **School Districts** | | | | | | | |
| Centralia | | 40 | 10 | 25% | 115 | 25 | 22% |
| Griffin | | 850 | 115 | 14% | 1,230 | 140 | 11% |
| North Thurston | | 37,675 | 1,025 | 3% | 57,820 | 2,550 | 4% |
| Olympia | | 48,130 | 1,985 | 4% | 62,085 | 3,265 | 5% |
| Rainier | | 855 | 50 | 6% | 2,005 | 90 | 4% |
| Rochester | | 3,790 | 1,430 | 38% | 7,600 | 1,945 | 26% |
| Tenino | | 1,755 | 200 | 11% | 4,115 | 455 | 11% |
| Tumwater | | 22,170 | 1,390 | 6% | 36,835 | 2,985 | 8% |
| Yelm | | 6,090 | 335 | 6% | 12,880 | 745 | 6% |
| **Other Participating Jurisdictions (Service Area)** | | | | | | | |
| Intercity Transit | | 104,795 | 3,565 | 3% | 154,615 | 7,470 | 5% |
| LOTT* | | 90,055 | 2,705 | 3% | 148,645 | 7,705 | 5% |
| (*Sewered Area for 2006; Lacey, Olympia Tumwater UGA for 2030). | | | | | | | |

Note: The service areas for the following participating jurisdictions are multi-county or county-wide: The Evergreen State College, South Puget Sound Community College, Thurston County PUD, Port of Olympia, Timberland Regional Library

[1]Munn Lake Fire District 15 contracts services with the City of Tumwater Fire Department; its data is combined with Tumwater's.
[2]Fire Districts 1 and 11, 2 and 4, 5 and 9 have joint operations agreements; therefore the data for the paired districts is combined.

## Table 4.3.14: Flood Hazard Area, Residential Dwellings, 2006 and 2030

| Jurisdiction | | 2006 Dwelling Estimate | | | 2030 Dwelling Forecast | | |
|---|---|---|---|---|---|---|---|
| | | Total | In Hazard Area | % in Hazard Area | Total | In Hazard Area | % in Hazard Area |
| Bucoda | **Total** | **255** | **170** | **67%** | **420** | **225** | **54%** |
| Lacey | City | 14,995 | 830 | 6% | 23,390 | 895 | 4% |
| | UGA | 12,540 | 625 | 5% | 22,045 | 860 | 4% |
| | **Total** | **27,535** | **1,455** | **5%** | **45,435** | **1,755** | **4%** |
| Olympia | City | 20,820 | 455 | 2% | 31,655 | 1,160 | 4% |
| | UGA | 4,365 | 225 | 5% | 7,460 | 385 | 5% |
| | **Total** | **25,185** | **680** | **3%** | **39,115** | **1,545** | **4%** |
| Rainier | City | 610 | 30 | 5% | 1,045 | 35 | 3% |
| | UGA | 45 | 5 | 11% | 155 | 5 | 3% |
| | **Total** | **655** | **35** | **5%** | **1,200** | **40** | **3%** |
| Tenino | City | 700 | 15 | 2% | 1,320 | 70 | 5% |
| | UGA | 5 | 0 | 0% | 195 | 0 | 0% |
| | **Total** | **705** | **15** | **2%** | **1,515** | **70** | **5%** |
| Tumwater | City | 7,370 | 340 | 5% | 12,975 | 1,385 | 11% |
| | UGA | 2,555 | 385 | 15% | 5,785 | 920 | 16% |
| | **Total** | **9,925** | **725** | **7%** | **18,760** | **2,305** | **12%** |
| Yelm | City | 2,000 | 170 | 9% | 9,410 | 310 | 3% |
| | UGA | 515 | 55 | 11% | 1,255 | 95 | 8% |
| | **Total** | **2,515** | **225** | **9%** | **10,665** | **405** | **4%** |
| Grand Mound UGA | **Total** | **325** | **10** | **3%** | **1,125** | **10** | **1%** |
| Chehalis Reservation[1] | **Total** | **15** | **10** | **67%** | **70** | **55** | **79%** |
| Nisqually Reservation[1] | **Total** | **225** | **0** | **0%** | **360** | **0** | **0%** |
| **Total Cities** | | **46,750** | **2,010** | **4%** | **80,215** | **4,080** | **5%** |
| **Total UGAs [2]** | | **20,350** | **1,310** | **6%** | **38,020** | **2,280** | **6%** |
| **Total Reservations[1]** | | **240** | **10** | **4%** | **430** | **55** | **13%** |
| **Rural Unincorporated County[3]** | | **29,795** | **3,425** | **11%** | **44,260** | **4,260** | **10%** |
| **Thurston County Total** | | **97,100** | **6,800** | **7%** | **162,900** | **10,700** | **7%** |

**Source:** Thurston Regional Planning Council Populaton Forecast, 2007.
**Explanations:** Numbers may not add due to rounding.
[1]Data is for Thurston County portion of reservation only.
[2]UGA - Urban Growth Area. Unincorporated area designated to be annexed into city limits over 20 years time to accommodate urban growth.
[3]Rural unincorporated county is the portion of the unincorporated county that lies outside UGA and Reservation boundaries.

## Table 4.3.15: Flood Hazard Area, Residential Dwellings - Special Districts, 2006 and 2030

| | | 2006 Dwelling Estimate | | | 2030 Dwelling Forecast | | |
|---|---|---|---|---|---|---|---|
| | | Total | In Hazard Area | % in Hazard Area | Total | In Hazard Area | % in Hazard Area |
| **Fire Districts** | | | | | | | |
| | Bucoda | 255 | 170 | 67% | 420 | 225 | 54% |
| | Olympia | 20,840 | 455 | 2% | 31,725 | 1,160 | 4% |
| | Tumwater[1] | 7,755 | 420 | 5% | 13,940 | 1,500 | 11% |
| 1,11 | Rochester/Littlerock[2] | 7,525 | 1,135 | 15% | 13,295 | 1,775 | 13% |
| 2,4 | Yelm/Rainier[2] | 7,810 | 780 | 10% | 19,010 | 1,160 | 6% |
| 3 | Lacey | 31,885 | 2,095 | 7% | 51,430 | 2,470 | 5% |
| 6 | East Olympia | 4,550 | 300 | 7% | 7,015 | 615 | 9% |
| 7 | North Olympia | 1,690 | 115 | 7% | 2,150 | 135 | 6% |
| 8 | South Bay | 2,855 | 275 | 10% | 4,610 | 310 | 7% |
| 9,5 | McLane/Black Lake[2] | 6,000 | 350 | 6% | 8,830 | 455 | 5% |
| 12 | Tenino | 2,170 | 260 | 12% | 4,345 | 375 | 9% |
| 13 | Griffin | 2,315 | 175 | 8% | 3,315 | 210 | 6% |
| 16 | Gibson Valley | 175 | 60 | 34% | 580 | 75 | 13% |
| 17 | Bald Hills | 1,320 | 150 | 11% | 2,250 | 200 | 9% |
| **School Districts** | | | | | | | |
| Centralia | | 145 | 65 | 45% | 480 | 90 | 19% |
| Griffin | | 2,680 | 185 | 7% | 3,805 | 220 | 6% |
| North Thurston | | 35,325 | 2,340 | 7% | 56,380 | 2,960 | 5% |
| Olympia | | 25,740 | 780 | 3% | 39,095 | 2,130 | 5% |
| Rainier | | 1,780 | 205 | 12% | 7,180 | 275 | 4% |
| Rochester | | 4,570 | 485 | 11% | 7,515 | 660 | 9% |
| Tenino | | 3,600 | 610 | 17% | 7,335 | 855 | 12% |
| Tumwater | | 14,775 | 1,230 | 8% | 25,220 | 2,255 | 9% |
| Yelm | | 8,550 | 840 | 10% | 15,935 | 1,220 | 8% |
| **Other Participating Jurisdictions (Service Area)** | | | | | | | |
| Intercity Transit | | 62,475 | 2,760 | 4% | 105,855 | 5,360 | 5% |
| LOTT* | | 43,335 | 1,565 | 4% | 103,310 | 5,605 | 5% |

(*Sewered Area for 2006; Lacey, Olympia Tumwater UGA for 2030).

Note: The service areas for the following participating jurisdictions are multi-county or county-wide: The Evergreen State College, South Puget Sound Community College, Thurston County PUD, Port of Olympia, Timberland Regional Library

[1]Munn Lake Fire District 15 contracts services with the City of Tumwater Fire Department; its data is combined with Tumwater's.
[2]Fire Districts 1 and 11, 2 and 4, 5 and 9 have joint operations agreements; therefore the data for the paired districts is combined.

## Table 4.3.16: Flood Hazard Area, Valuation of Building and Contents, 2006/2008

| | | Residential | | | Commercial/Industrial | | | Government/Institutional | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Jurisdiction | | Total (mil. $) | In Hazard Area | % in Hazard Area | Total (mil. $) | In Hazard Area | % in Hazard Area | Total (mil. $) | In Hazard Area | % in Hazard Area |
| Bucoda | **Total** | **19** | **13** | **69%** | **1** | **1** | **94%** | **2** | **2** | **91%** |
| Lacey | City | 1,944 | 135 | 7% | 1,265 | 32 | 3% | 433 | 1 | 0% |
| | UGA | 2,036 | 82 | 4% | 112 | 2 | 2% | 133 | 26 | 20% |
| | **Total** | **3,980** | **217** | **5%** | **1,377** | **34** | **3%** | **567** | **28** | **5%** |
| Olympia | City | 3,062 | 115 | 4% | 1,952 | 59 | 3% | 1,727 | 59 | 3% |
| | UGA | 930 | 51 | 5% | 43 | 0 | 0% | 17 | 0 | 2% |
| | **Total** | **3,993** | **166** | **4%** | **1,994** | **59** | **3%** | **1,745** | **59** | **3%** |
| Rainier | City | 70 | 3 | 4% | 6 | 0 | 0% | 28 | 0 | 0% |
| | UGA | 7 | 1 | 9% | 0 | 0 | 0% | 0 | 0 | 0% |
| | **Total** | **77** | **3** | **4%** | **6** | **0** | **0%** | **28** | **0** | **0%** |
| Tenino | City | 75 | 1 | 1% | 17 | 0 | 0% | 42 | 1 | 3% |
| | UGA | 1 | 0 | 10% | 0 | 0 | 0% | 0 | 0 | 0% |
| | **Total** | **76** | **1** | **2%** | **17** | **0** | **0%** | **42** | **1** | **3%** |
| Tumwater | City | 1,039 | 61 | 6% | 703 | 4 | 1% | 423 | 111 | 26% |
| | UGA | 395 | 75 | 19% | 119 | 6 | 5% | 18 | 1 | 3% |
| | **Total** | **1,434** | **136** | **9%** | **822** | **9** | **1%** | **441** | **111** | **25%** |
| Yelm | City | 266 | 21 | 8% | 127 | 3 | 2% | 140 | 0 | 0% |
| | UGA | 76 | 7 | 9% | 6 | 5 | 84% | 11 | 0 | 0% |
| | **Total** | **342** | **29** | **8%** | **134** | **8** | **6%** | **151** | **0** | **0%** |
| Grand Mound UGA | **Total** | **15** | **1** | **5%** | **16** | **0** | **2%** | **15** | **14** | **96%** |
| Chehalis Reservation[1] | **Total** | **1** | **1** | **91%** | **9** | **0** | **3%** | **0** | **0** | **0%** |
| Nisqually Reservation[1] | **Total** | **11** | **0** | **0%** | **0** | **0** | **0%** | **50** | **0** | **0%** |
| **Total Cities** | | **6,476** | **350** | **5%** | **4,071** | **99** | **2%** | **2,797** | **175** | **6%** |
| **Total UGAs** | | **3,460** | **216** | **6%** | **296** | **13** | **4%** | **194** | **41** | **21%** |
| **Total Reservations** | | **12** | **1** | **8%** | **9** | **0** | **3%** | **50** | **0** | **0%** |
| **Rural Unincorporated County** | | **5,672** | **573** | **10%** | **193** | **36** | **19%** | **755** | **56** | **7%** |
| **Thurston County Total** | | **15,620** | **1,140** | **7%** | **4,569** | **149** | **3%** | **3,796** | **272** | **7%** |

## Table 4.3.17: Flood Hazard Area, Valuation of Building and Contents - Special Districts, 2006/2008

| | | Residential | | | Commercial/Industrial | | | Government/Institutional | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Total (mil. $) | In Hazard Area | % in Hazard Area | Total (mil. $) | In Hazard Area | % in Hazard Area | Total (mil. $) | In Hazard Area | % in Hazard Area |
| **Fire Districts** | | | | | | | | | | |
| | Bucoda | 19 | 13 | 69% | 1 | 1 | 94% | 2 | 2 | 91% |
| | Olympia | 3,064 | 115 | 4% | 1,952 | 59 | 3% | 1,727 | 59 | 3% |
| | Tumwater[1] | 1,091 | 79 | 7% | 755 | 4 | 0% | 424 | 111 | 26% |
| 1,11 | Rochester/Littlerock[2] | 1,114 | 177 | 16% | 126 | 24 | 19% | 135 | 55 | 41% |
| 2,4 | Yelm/Rainier[2] | 1,099 | 120 | 11% | 165 | 10 | 6% | 192 | 0 | 0% |
| 3 | Lacey | 4,783 | 293 | 6% | 1,415 | 39 | 3% | 640 | 30 | 5% |
| 6 | East Olympia | 991 | 54 | 5% | 48 | 1 | 1% | 26 | 7 | 27% |
| 7 | North Olympia | 347 | 24 | 7% | 6 | 1 | 18% | 20 | 0 | 2% |
| 8 | South Bay | 719 | 59 | 8% | 20 | 3 | 14% | 13 | 3 | 19% |
| 9,5 | McLane/Black Lake[2] | 1,313 | 94 | 7% | 39 | 5 | 12% | 550 | 2 | 0% |
| 12 | Tenino | 313 | 38 | 12% | 29 | 0 | 1% | 45 | 1 | 2% |
| 13 | Griffin | 534 | 51 | 10% | 5 | 2 | 41% | 16 | 0 | 0% |
| 16 | Gibson Valley | 22 | 9 | 39% | 0 | 0 | 46% | 0 | 0 | 100% |
| 17 | Bald Hills | 211 | 19 | 9% | 8 | 0 | 3% | 4 | 0 | 0% |
| **School Districts** | | | | | | | | | | |
| Centralia | | 20 | 9 | 46% | 0 | 0 | 100% | 1 | 1 | 100% |
| Griffin | | 606 | 52 | 9% | 5 | 2 | 37% | 16 | 0 | 0% |
| North Thurston | | 5,475 | 333 | 6% | 1,931 | 48 | 2% | 642 | 33 | 5% |
| Olympia | | 4,540 | 219 | 5% | 1,500 | 59 | 4% | 2,151 | 63 | 3% |
| Rainier | | 258 | 31 | 12% | 9 | 0 | 1% | 30 | 0 | 0% |
| Rochester | | 572 | 60 | 10% | 75 | 8 | 11% | 107 | 55 | 51% |
| Tenino | | 536 | 84 | 16% | 42 | 9 | 20% | 49 | 4 | 7% |
| Tumwater | | 2,342 | 225 | 10% | 832 | 13 | 2% | 582 | 117 | 20% |
| Yelm | | 1,275 | 131 | 10% | 175 | 10 | 6% | 219 | 0 | 0% |
| **Other Participating Jurisdictions (Service Area)** | | | | | | | | | | |
| Intercity Transit | | 9,356 | 497 | 5% | 4,208 | 103 | 2% | 3,453 | 197 | 6% |
| LOTT* | | 6,438 | 309 | 5% | 3,604 | 94 | 3% | 2,443 | 120 | 5% |

*Sewered Area.

Note: The service areas for the following participating jurisdictions are multi-county or county-wide: The Evergreen State College, South Puget Sound Community College, Thurston County PUD, Port of Olympia, Timberland Regional Library

[1]Munn Lake Fire District 15 contracts services with the City of Tumwater Fire Department; its data is combined with Tumwater's.
[2]Fire Districts 1 and 11, 2 and 4, 5 and 9 have joint operations agreements; therefore the data for the paired districts is combined.

### Table 4.3.18: Flood Hazard Area, Valuation of Building and Contents - Colleges, 2006/2008

| | Government/Institutional | | |
|---|---|---|---|
| | Total (mil. $) | In Hazard Area | % in Hazard Area |
| **College** | | | |
| The Evergreen State College | 505 | 0 | 0% |
| South Puget Sound Community College | 63 | 0 | 0% |

### Table 4.3.19: Flood Hazard Area, Valuation of Building and Contents - Multi-County Districts, 2006/2008

| | Government/Institutional | | |
|---|---|---|---|
| | Total (1,000 $) | In Hazard Area | % in Hazard Area |
| **Thurston PUD** | | | |
| Thurston County | 1,780 | 552 | 31% |
| Lewis County | 1,046 | 57 | 5% |
| Grays Harbor County | 69 | 0 | 0% |
| Mason County | 63 | 15 | 24% |
| Pierce County | 1,204 | 105 | 9% |
| **Total** | 4,162 | 730 | 18% |
| **Timberland Regional Library** | | | |
| Thurston County | 6,700 | 0 | 0% |
| Lewis County | 4,533 | 886 | 20% |
| Grays Harbor County | 4,277 | 1,532 | 36% |
| Mason County | 5,273 | 0 | 0% |
| Pacific County | 2,698 | 516 | 19% |
| **Total** | 23,481 | 2,934 | 12% |

**Note**: The service areas for these jurisdictions are multi-county-wide

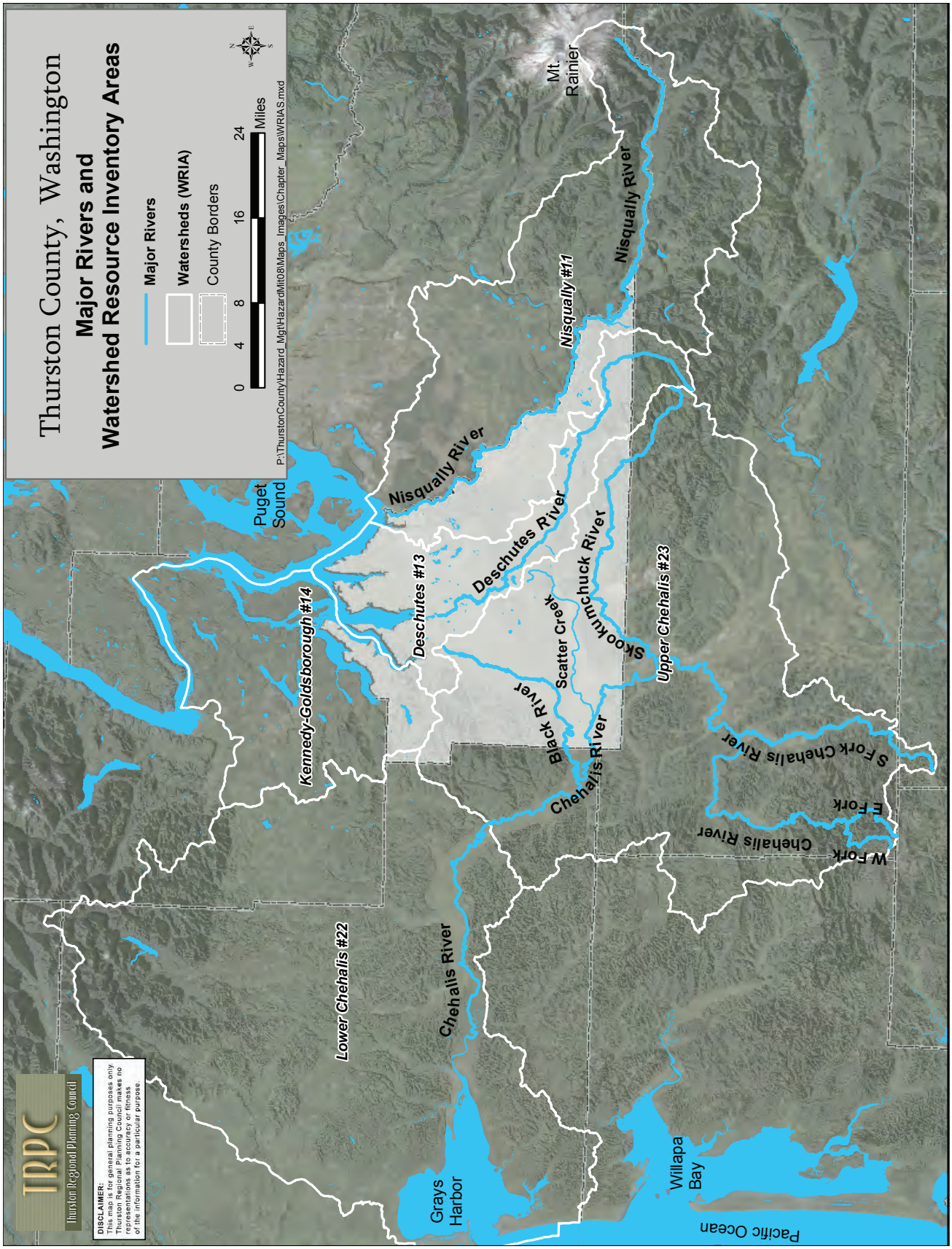
**Table 4.3.20: Flood Hazard Area, Valuation of Building and Contents - Non-Profit 2006/2008**

| | Government/Institutional | | |
|---|---|---|---|
| | Total (mil. $) | In Hazard Area | % in Hazard Area |
| **Hospital** | | | |
| Providence St. Peter Hospital | 401 | 0 | 0% |

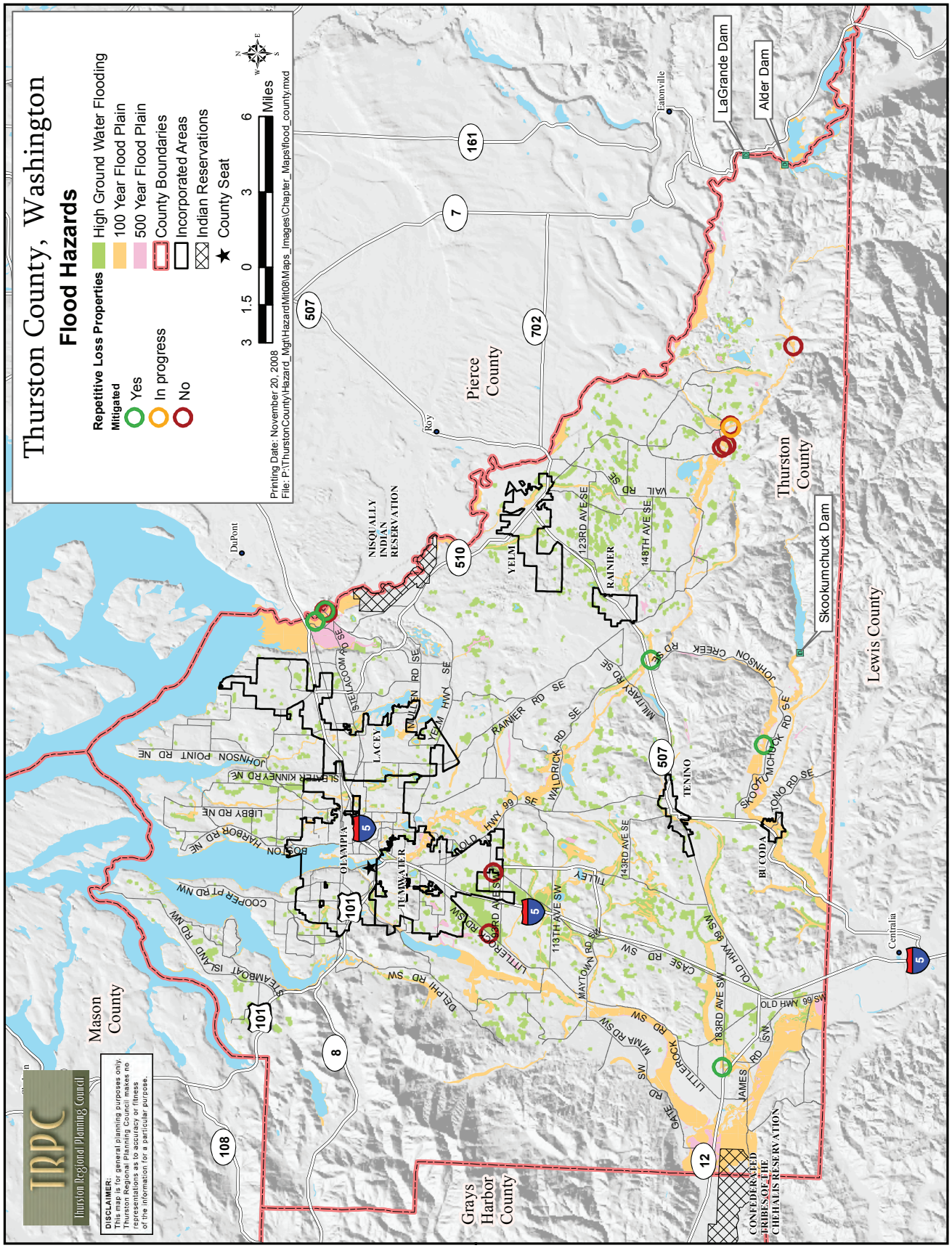
## Table 4.3.21: Critical Facilities in Flood Hazard Zone

| Critical Facility Sector and Subsector | Total | In Hazard Area | % In Hazard Area |
|---|---|---|---|
| **1. AGRICULTURE/FOOD SUPPLY** | **22** | **1** | 4.5% |
| 1.1 PRODUCTION | 2 | 0 | 0.0% |
| 1.2 FOOD DISTRIBUTION/STORAGE | 20 | 1 | 5.0% |
| **2. GOVERNMENT** | **135** | **8** | 5.9% |
| 2.1 FIRE SERVICES | 43 | 4 | 9.3% |
| 2.2 LAW ENFORCEMENT | 9 | 1 | 11.1% |
| 2.3 EMERGENCY OPERATIONS CENTERS | 11 | 1 | 9.1% |
| 2.4 CORONER/MORGUE | 1 | 0 | 0.0% |
| 2.5 SHELTER | 69 | 2 | 2.9% |
| 2.7 AMBULANCE | 3 | 0 | 0.0% |
| **4. MEDICAL CARE** | **84** | **5** | 6.0% |
| 4.1.A HOSPITALS | 4 | 0 | 0.0% |
| 4.1.B LARGE CLINICS | 36 | 4 | 11.1% |
| 4.1.B LARGE CLINICS - RURAL | 5 | 0 | 0.0% |
| 4.1.C URGENT CARE | 6 | 1 | 16.7% |
| 4.1.D SURGICAL SUITES | 6 | 0 | 0.0% |
| 4.2 CHEMICAL DEPENDENCY TREATMENT CENTER | 1 | 0 | 0.0% |
| 4.3A METHADONE | 1 | 0 | 0.0% |
| 4.3B DIALYSIS | 1 | 0 | 0.0% |
| 4.3C MENTAL HEALTH | 2 | 0 | 0.0% |
| 4.3D BIRTHING CENTERS | 2 | 0 | 0.0% |
| 4.4 NURSING HOMES | 7 | 0 | 0.0% |
| 4.5 ASSISTED LIVING FACILITIES | 13 | 0 | 0.0% |
| **5. UTILITIES** | **8** | **0** | 0.0% |
| 5.5 RADIO/TELEVISION | 2 | 0 | 0.0% |
| 5.6 DATA TRANSMISSION LINES | 1 | 0 | 0.0% |
| 5.8 SOLID WASTE MANAGEMENT | 5 | 0 | 0.0% |
| **6. TRANSPORTATION** | **16** | **2** | 12.5% |
| 6.3 ROADS - CENTERLINE MILES | 1951 | 189 | 9.7% |
| 6.4 VEHICLE FUEL | 4 | 0 | 0.0% |
| 6.5 STUDENT TRANSPORTATION | 8 | 2 | 25.0% |
| 6.6 MASS TRANSIT | 2 | 0 | 0.0% |
| 6.7 PORT | 1 | 0 | 0.0% |
| **Grand Total** | **266** | **16** | 6.0% |

**Map 4.3.1**


Thurston County, Washington
Major Rivers and
Watershed Resource Inventory Areas
Major Rivers
Watersheds (WRIA)
County Borders
0 4 8 16 24 Miles
P:\ThurstonCounty\Hazard_MgtHazardMit08\Maps_Images\Chapter_Maps\WRIAS.mxd
TRPC
Thurston Regional Planning Council
DISCLAIMER:
This map is for general planning purposes only. Thurston Regional Planning Council makes no representations as to accuracy or fitness of the information for a particular purpose.
Mt. Rainier
Nisqually River
Nisqually #11
Nisqually River
Puget Sound
Deschutes River
Deschutes #13
Kennedy-Goldsborough #14
Skookumchuck River
Scatter Creek
Upper Chehalis #23
Black River
Chehalis River
S Fork Chehalis River
E Fork
W Fork
Chehalis River
Lower Chehalis #22
Chehalis River
Grays Harbor
Willapa Bay
Pacific Ocean

## Map 4.3.2


Thurston County, Washington
Flood Hazards
Repetitive Loss Properties
Mitigated
Yes
In progress
No
High Ground Water Flooding
100 Year Flood Plain
500 Year Flood Plain
County Boundaries
Incorporated Areas
Indian Reservations
County Seat
3 1.5 0 3 6 Miles
Printing Date: November 20, 2008
File: P:\ThurstonCounty\Hazard_Mgt\HazardMit08\Maps_Images\Chapter_Maps\flood_county.mxd
Mason County
Pierce County
Thurston County
Lewis County
Grays Harbor County
NISQUALLY INDIAN RESERVATION
CONFEDERATED TRIBES OF THE CHEHALIS RESERVATION
LaGrande Dam
Alder Dam
Skookumchuck Dam
DuPont
Roy
Eatonville
Centralia
OLYMPIA
LACEY
TUMWATER
YELM
RAINER
TENINO
BUCODA
TRPC
Thurston Regional Planning Council
DISCLAIMER:
This map is for general planning purposes only. Thurston Regional Planning Council makes no representations as to accuracy or fitness of the information for a particular purpose.

# Flood Endnotes

[1]Thurston County. 1999. Thurston County Flood Hazard Management Plan.

[2]Thurston County Water and Waste Management. 2009. Unpublished Data, Courtesy of Nadine Romero, Hydrogeologist, Thurston County Environmental Health

[3]Ibid

[4]Tacoma Power. 1999. Emergency Action Plan for the Nisqually Hydroelectric Project FERC Project No. 1862.

[5]Thurston County Water and Waste Management, 2009.

[6]TransAlta Centralia Generation LLC. 2007. Emergency Action Plan: Skookumchuck Hydroelectric Project FERC Project No. 4441 NATDAM No. WA00153. Revision H, December 2007.

[7]Contributed by Nadine Romero, Hydrogeologist, Thurston County Environmental Health. April 22, 2009.

Parametrix. 2003. Scatter Creek Habitat Conservation Plan and Associated Reports. Prepared for Thurston Conservation District.

[9]Thurston County Development Services. 2009. Unpublished Data, Thurston County Flood of Record Reference Monument Locations. Courtesy of Joe Butler.

[10]United States Geological Survey. 2009. National Water Information System: Web Interface, USGS Water Data for Washington, Surface Water Data. http://waterdata.usgs.gov/wa/nwis/

[11]Contributed by Mark Biever, Environmental Monitoring Program Supervisor, Thurston County Water and Waste Management. April 29, 2009.

[12]Thurston County. 2004. Salmon Creek Comprehensive Drainage Basin Plan.

[13]Ibid

[14]Personal Communication with Andy Haub, Planning and Engineering Manager, City of Olympia Public Works, Water Resources on September 29, 2008.

[15]Contributed by Andrew Kinney, Emergency Management Coordinator, Thurston County Emergency Management and Nadine Romero, Hydrogeologist, Thurston County.

[16]Thurston County Emergency Management. 2007. Supplemental Justification Report. December 2-7, 2007 Severe Storm.

[17]Washington State Department of Transportation. 2008. Storm-Related Closures of I-5 and I-90: Freight Transportation Economic Impact Assessment Report Winter 2007-2008.

[18]FEMA. 2009. National Flood Insurance Report, Thurston County, WA.

[19]Insurance Services Office. 2008.

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# Chapter 4.4: Landslide Hazard Profile

## Introduction

The views of Puget Sound, Mount Rainier, and the Cascade Mountains attract people to build their homes on the shorelines and hillsides of Thurston County to capture the Pacific Northwest through living room windows. Living on a sloping shoreline or a hillside does present risks. The landscapes of western Washington provides ample evidence that the surface of the earth is indeed constantly being rearranged by geomorphic and climatic processes. The forces of nature that create the beauty also pose hazards to people and communities when homes, utilities, and roads fall victim to the effects of natural hazards such as landslides.

Landslides cause $1 to $2 billion in damages and more than 25 fatalities on average each year in the United States.[1] Local governments' Critical Area Ordinances are intended to prevent the expansion of urban and rural developments into steep hillsides and other landslide hazard areas, but significant residential development, roads, and utilities preceded current environmental regulations. Nearly the entire marine shoreline of Thurston County is dotted with residences. The high probability of occurrence of landslides combined with their destructive, but localized impacts results in an overall moderate risk rating.

## Hazard Identification

### Definition

Landslides are the movement of rock, soil, or other debris, down a slope. In general, the term landslide includes a wide range of ground movement, such as rock falls, deep failure of slopes, and shallow debris flows. Mudflows (or debris flows) are flows of rock, earth, and other debris saturated with water. They develop when water rapidly accumulates in the ground, such as during heavy rainfall or rapid snowmelt, changing the earth into a flowing river of mud or "slurry" which can travel at avalanche speeds, growing in size as it picks up trees, rocks, and other materials along the way. Gravity acting on an overly steep slope is the primary cause of a landslide. However, they are influenced by both natural factors (geology, topography, and hydrology) and human activity (mining and construction of buildings, railroads, and highways). Landslides can be initiated by heavy rain or snow, fires, earthquakes, volcanoes, and various human activities that modify the environment.

The following factors contribute to landslides and the movement of earth:

- Erosion – Erosion caused by rivers, glaciers, or ocean waves.
- Earthquakes – Ground shaking from earthquakes creates stress that makes weak slopes fail.
- Volcanic eruptions – Eruptions produce loose ash deposits and debris flows.
- Increase of load – Weight of rain/snow, fills, vegetation, stockpiling of rock or ore from waste piles or from man-made structures may cause weak slopes to fail.

- Hydrologic factors – Rain, high water tables, little or no ground cover, and numerous freeze/thaw cycles may cause weak slopes to fail.
- Human activity – These include development activities such as poor drainage control, cutting, filling, and grading along roads, and logging practices that remove timber from steep slopes. Such activities can drastically modify landforms and groundwater conditions which can cause weak slopes to fail.
- Removal of lateral and underlying support – Erosion, previous slides, road cuts, and quarries can trigger failure of weak slopes.
- Increase of lateral pressures – Hydraulic pressures, tree roots, crystallization, swelling of clay soil may cause weak slopes to fail.
- Regional tilting – Geological movements can trigger weak slopes to fail.

It is difficult to predict precisely when and where a landslide will occur, however most Puget Sound marine shoreline landslides occur during the wet season, typically from October through April, but peak in December through February. The United States Geological Survey has researched past shoreline landslides and rainfall levels in the Seattle area to identify when these types of landslides are likely to occur. One such measure is a formula called the precipitation threshold. The cumulative precipitation threshold measures precipitation over the previous 18 days and indicates when the ground is saturated enough to be susceptible to landslides. Between 3.5 and 5.3 inches are required to exceed this threshold. Between 1978 and 2003, 85 percent of Seattle area landslides occurred when this threshold was met or exceeded. By comparing recent and forecast rainfall levels, emergency management staff could notify media and at risk communities when to anticipate and take precautions for a potential landslide. The model was developed principally for the east Puget Sound area from Tacoma to Everett, but the USGS states that the threshold can serve as preliminary guidance for other Puget Sound Counties including the northern section of Thurston County.[2]

The Washington State Department of Ecology Shorelands and Environmental Assistance Program summarizes where slides are likely to occur along marine shorelines (used with permission)[3]:

| Where Landslide Occur | Factors |
|---|---|
| Landslides occur where they have occurred before | Large, deep-seated slides tend to be a reactivation of existing landslide complexes. Slope stability maps can provide an excellent indication of unstable areas. A competent geological analysis can usually provide an estimate of stability of problem areas on a site. It cannot reliably provide a probability of failure or an exact map of the area to be affected. |
| Landslides occur on steep slopes | Steep slopes are typically found along shorelines where centuries of wave or river currents have eroded the toe of the slope. Most steep slopes around Puget Sound have experienced sliding in the past one or two hundred years. |

| | |
|---|---|
| Landslides occur on benches | Relatively level benches on an otherwise steep slope often indicate areas of past slope movement. |
| Landslides occur where drainage is causing a problem | Landslides are often triggered by the failure of drainage systems. Large amounts of water flowing from driveways, roof areas, roads and other impermeable surfaces can cause slides. |
| Landslides occur where certain geologic conditions exist | Landslides occur where certain combinations of soils are present. When layers of sand and gravel lie above less permeable silt and clay layers, groundwater can accumulate and zones of weakness can develop. In Puget Sound, this combination is common and widespread. Glacial outwash, often Esperance Sand or gravel overlies the fine-grained Lawton Clay or Whidbey formation. |

Despite the difficulty in predicting landslides, the environment provides visual indicators of where the earth is moving. Discovering sites of prehistoric landslides is difficult as telltale signs are often obscured by vegetation or human development. The Washington State Department of Ecology also provides warning signs of earth movement (used with permission)[4]:

| Environment | Warning Signs |
|---|---|
| Landscape | Head scarps or steep cliffs at the top of a slope<br>Benches, scarps, and large cracks<br>Exposed clays uplifted on the beach<br>Hummocky and uneven terrain<br>Trees or large blocks of clay partially buried in beach, not just drift logs |
| Roads, Utilities, Buildings | Sagging or taut utility lines<br>Separation of foundation from sill plate<br>Growing cracks in walls and window corners<br>Broken or leaking water or sewer lines<br>Doors not closing properly<br>Significant cracking of concrete slabs and pavement |
| Vegetation | Tilted trees<br>Curved trees<br>Split trunks and stretched roots<br>Large clusters of trees of similar age (often alder) |
| Water | Small ponds on otherwise sloping terrain<br>Disrupted natural drainage<br>Unusually heavy or muddy seepage<br>Unusual increase or decrease in flow from springs |

## Severity

There is no standard approach to measure the severity of a landslide. Severity can be measured in total cost of damages, impacts to transportation or utility systems, or in terms of injuries and fatalities. The landslides on Steamboat Island Penninsula in the winter of 1998-1999 cost $24 million in damages and response and recovery costs. It is the most damaging landslide recorded in Thurston County. Fortunately no one was seriously injured or killed in this slow moving landslide, but many residents in the densely developed Carlyon Beach community lost their homes. This incident did not impact the region's residents outside the affected area, but Thurston County staff, other emergency management personnel, and local area residents were significantly challenged by the event.

The severity of a landslide can also be measured in terms of its size and composition: from a thin mass of soil a few yards wide to deep-seated bedrock slides miles across. The travel rate of a landslide can range from a few inches per month to many feet per second depending on the slope, type of material, and moisture content.

## Impacts

The impacts of landslide hazards in Thurston County are numerous. Landslides can injure or kill people caught in the path of rapid moving earth. No deaths have occurred from a landslide in Thurston County. In January 1997 a family of four on Bainbridge Island was buried and killed by 2,000 cubic feet of earth. The fast moving landslide slammed into the back of their home in the early morning hours while the family was still in bed.[5] Past landslides highlight the fact that many homeowners lack insurance covering landslide hazards. Many Thurston County residents have lost their homes due to the damaging effects of landslides. Landslide damage can render the property unstable and permanently uninhabitable. Rebuilding onsite is often not an option, so the financial loss for some homeowners is immense. People can suffer great emotional stress and anguish from losing both their home and their property. Small business owners also face similar financial losses and stress.

Landslides can physically damage or destroy almost any infrastructure including buildings, utilities, streets, rail lines, bridges, and tunnels. Communities at large can face transportation disruptions from the loss of critical travel corridors, like U.S. Highway 101, resulting in lengthy detours. Public health and safety can be compromised from loss of energy, communications, water, and uncontrolled wastewater discharge.

Local governments, public works, building inspectors, and other safety officials can become overwhelmed if a landslide hazard impacts a significant portion of the community. Landslide events necessitate monitoring. Buildings and other infrastructure must be inspected to determine whether they are safe for occupancy or use. If a building is deemed unsafe, law enforcement personnel may need to increase patrols to decrease the risk of theft or criminal trespassing.

## Probability of Occurrence

A review of local newspaper media, internet sources, Department of Natural Resources landslide data, and Federal Disaster Declarations for Thurston County suggest that the incidences of landslides

are concurrent with winter storms, flooding, and earthquakes. The majority of landslides in the region are triggered by heavy precipitation. The Carlyon Beach/Hunter Point landslide represents a large scale, but infrequent event for the region. Many smaller landslides regularly block roads with debris or washout transportation facilities and rupture utility pipes. Between 1997 and 2007, seven Federal Disaster Declarations were declared and all included landslides around the greater south Puget Sound Region (the 1998-1999 winter landslides did not receive a Federal Disasater declaration). Based on this ten year period, destructive landslides have an annual probability of occurrence of around 80 percent. Therefore landslides have a high probability of occurrence and are certain to reoccur within a 25 year period.

## Landslide Historical Occurrences and Impacts

Several landslides have impacted the Thurston Region over the last two decades. It is important to highlight the effects and damages from these hazards to highlight their severity, costs, and point out the region's vulnerabilities. Previous landslide events perhaps offer the best indication of the types of losses that local communities are likely to experience in the future.

December 1-7, 2007, Federal Disaster 1734: Severe Winter Storms, Flooding, Landslides, and Mudslides

December 3, an estimated 97 households were isolated by a complete washout of the Cedar Flats Road in northwestern Thurston County. Washington State Department of Natural Resources' landslide reconnaissance found that heavy "…warm rains rapidly melted snow on the ground, saturating soils that began to slide. Three landslides on the tributary to Swift Creek triggered three debris flows, carrying debris and sediment into Swift Creek and creating a hyperconcentrated flow. By 8:30 a.m., debris appeared to have clogged the culverts where Swift Creek flows under Cedar Flats Road."[6] The clogged culverts impeded creek flow and forced the surrounding embankment under the road to blowout. By the following day, the McLane Fire Department was able to shuttle residents who needed to move in and out on a footpath and logging road. By Thursday, the County Road Department opened a temporary one and a half mile detour route road that served residents for several months until a temporary bridge was constructed. The emergency construction of the detour route cost nearly $135,000 and construction of the temporary and new bridge cost $891,000.

On December 3, a mudslide on Kennedy Creek Road in northwestern Thurston County destroyed the Ranch House BBQ restaurant and surrounding structures. Damage was estimated at $1 million. The owners received a $914,000 Small Business Administration loan to rebuild. Slides also caused at least two homes to be tagged as uninhabitable off of Sunset Beach Road.

February 28, 2001, Federal Disaster 1361: Nisqually Earthquake

The 2001 Nisqually Earthquake resulted in a landslide that wiped out the northbound lanes of U.S. Highway 101 near Mud Bay. This landslide caused nearly $1 million in damages. Area commuters were forced to use a 30 mile detour through the town of McCleary which caused two and one-half mile backups through the small Grays Harbor County community.

The earthquake caused substantial ground movement all along Deschutes Parkway north of Lakeridge Drive. Over $22 million in damages occurred to the road, sewer lines, and park facilities. Deschutes Parkway experienced similar damages from the 1965 earthquake.

Winter 1998-1999, South Puget Sound Landslides

Sixty-two inches of rain fell between November 1998 and March 1999. Several landslides occurred during this time period along several south Puget Sound shorelines in north Thurston County. Landslides in Sunrise Beach, Sunset Beach, Gravelly Beach, Carlyon Beach, and Hunter Point forced many families out of their homes. A total of 55 homes were initially deemed uninhabitable or condemned by County inspectors. In the end, 39 homes were condemned and 113 properties had their values significantly reduced or zeroed by the Thurston County Assessor's Office. The northeastern corner of Carlyon Beach was the hardest hit area with thirty-seven homes declared unsafe for habitation. This landslide occurred on relatively flat to gentle sloping ground. Pencil cracks in driveways slowly expanded from inches to several feet causing slumping and subsidence, destroying the foundations of many residents' homes. Geologists determined that the landslide was a reactivation of an ancient slide likely caused by the heavy winter rains. The 66 acre slide caused substantial damage to the private community which maintains its own streets and water treatment system.[7]

The landslides resulted in $15 million in uninsured losses to homeowners and businesses and $9.5 million in costs to county government.[8] Despite declarations of emergency and requests for Federal aid from both Thurston County and Washington State Governor Gary Locke, no Federal Disaster Declaration was issued, however Federal Small Business Administration Loans were provided to some families to rebuild new homes. Some families were able to have their mortgages dismissed, others were less fortunate.

The landslide hazard persists for the Carlyon Beach/Hunter Point area although movement has ceased. Thurston County has subsequently identified 54 parcels in this area as a designated landslide hazard area. The County's Critical Areas Ordinance prohibits substantial improvements to these properties.

December 1996 to March 1997 Rainstorms

Following the December 1996 and March 1997 rain storms, sections of the coastal bluff near Hunter Point across from Squaxin Island slid a few feet resulting in two residences being declared unsafe to occupy. These storms also caused a slide south of the City of Rainier which threatened a section of the Northwest Pipeline and the disruption of natural gas distribution. A 26 inch diameter line was shut down, but gas was diverted to a 30 inch line. Two explosions occurred on the same pipeline in Everson and Kalama, near the Canada and Oregon borders respectively, days earlier.

February 1996, Federal Disaster 1100: Flooding

On February 8, Nisqually River flooding and groundwater under heavy pressure from near record rains caused a 70 feet deep, 50 feet long, by 40 feet wide landslide. Nearly 100 dump trucks worth of material disappeared into the river in the Nisqually Pines neighborhood on Thuja Avenue west of

Yelm. Although no homes were destroyed, the landslide threatened area residences. Thurston County declared seven homes unsafe for occupancy.[9]

On February 10, heavy rains caused a mudslide on the steep slope below Capitol Way, just west of Carlyon Avenue. It broke two sewer lines that served nearly two-thirds of Tumwater and the Olympia Brewing Company. The mudslide also tore out 50 feet of Burlington Northern rail line. It is possible that the pipes leaked prior to heavy rains and contributed to the weakening of the slope. The damaged pipes leaked over five million gallons of untreated waste water into Capitol Lake before they were repaired. Public health notices were posted around the lake to warn residents not to come into contact with lake waters. Tumwater residents were asked to curtail their water use until the line was repaired. Emergency repairs took nearly two weeks and cost nearly $1 million.[10]

The February floods caused nearly $2.5 million in damages to Thurston County Roads. Heavy rains triggered a landslide on a steep slope over Flumerfelt Road, southwest of Bucoda. The road was closed for several months. A Burlington Northern railroad tunnel collapsed onto Durgin Road SE. A 20 feet wide by 100 feet deep pothole closed Old Pacific Highway just before the Nisqually River bridge.

## Delineation of Landslide Hazard Area

In general, landslide hazards occur throughout the county, especially all along the marine shoreline of northern Thurston County. For the purposes of the landslide hazard risk analysis, the landslide hazard area has been defined as those parcels in the county on which slopes of 40 percent or more occur. Slope was calculated using LIDAR (light detection and ranging) data using grid analysis tools within a geographic information system. This geographical delineation was then related to parcel data that was used to estimate the region's population, employment, and the assets that fall into the hazard area. This delineation likely understates the hazard for the marine shoreline and overstates the hazard zone for areas outside of the marine shoreline, but the delineation is consistent with Thurston County's current Critical Areas Ordinance definition. Map 4.4.1 shows the landslide hazard area for Thurston County.

### Communities Most Vulnerable to Landslides

The Washington State Department of Natural Resources Division of Geology and Earth Resources has mapped shallow and deep seated landslide occurrences and landslide landforms along the entire Thurston County marine shoreline zone and the shorelines of Capitol Lake. Though useful, the data is not a comprehensive summary of all landslide events and hazards. Geologists mapped data based on interpretation of aerial photos, LIDAR data, topography, and field visits. The unpublished data is intended to be used as a reconnaissance-level screening tool. The data is no substitute for site-specific geological evaluation of local conditions. Coarse GIS analysis suggests that virtually the entire marine shoreline of Thurston County is moderate to highly vulnerable to landslides (Map 4.4.1), especially wherever bluffs are located.[11,12] The steep slopes around Capitol Lake in downtown Olympia are also vulnerable. The shoreline has moderate residential development densities. Approximately 3,017 parcels along Thurston County's shoreline have experienced some form of landslide activity either before or after properties were developed. Over 6,000 parcels along

Thurston County's shoreline or creeks draining to the inlets have a moderate to high landslide hazard rating. In many instances, only a portion of a parcel is at risk, but in some areas, entire parcels are potentially vulnerable.

## Population and Employment in the Hazard Area

Approximately 18,700 residents (8 percent) and 12,800 employees (11 percent) live and work on or near steep slopes that are greater than or equal to forty percent. Estimates of the region's population and employment in the landslide hazard area are summarized in tables 4.4.3 through 4.4.6. These tables assesses an aspect of current and future vulnerability by providing data on the number of people living and working within the hazard area as compared to total population, by jurisdiction, in the years 2006 and 2030.

## Inventory of Assets and Dollar Value in the Hazard Area

No detailed landslide hazard scenario analysis of potential losses was conducted during the planning process. Estimates of the region's structures and their contents in the landslide hazard area is summarized in tables 4.4.7 through 4.4.13. These tables provide an estimate of the number of existing and future structures which may be potentially affected by the hazard, as well as an estimate of structure and building contents value in order to provide information on potential dollar losses. Tables are provided by jurisdiction, for the years 2006 and 2030.

## Critical Facilities and Infrastructure in Hazard Area

Based on the historical community impact from the effects of landslide events, it is clear that landslides can destroy or damage facilities that may be critical for responding to the disaster and for maintaining a safe environment and public order. Among these are communications installations; electrical generating and transmission facilities; water storage, purification, and pumping facilities; sewage treatment facilities; hospitals; and police stations. In addition, natural hazards such as landslides can seriously disrupt the transportation network; bridges can be knocked out, and roads and highways damaged or blocked by debris, further isolating resources.

Specific information on the location and ownership of critical facilities and infrastructure is housed with Thurston County Emergency Management. Critical facilities include both public and private facilities. For example, hospitals are critical facilities but are privately owned. Likewise a facility owned by one jurisdiction may be located within the boundaries of another; such as the County Courthouse complex which is located in the City of Olympia. Table 4.4.14 lists the type and number of critical facilities located in the landslide hazard area.

## Summary Assessment

Because landslides are frequently triggered by heavy rains and are almost guaranteed to occur with destructive earthquakes, landslides are assigned a high probability of occurrence. Although there are exceptions, such as the Carlyon Beach landslide, landslides tend to occur in isolated, sparsely developed areas threatening individual structures and remote sections of the transportation, energy, and communications infrastructure suggesting low vulnerability. Because of the high probability of occurrence and the trend to more frequent landslides, the region has assigned a moderate risk rating.

**Summary Risk Assessment for Landslide in the Thurston Region**

| Landslide | Probability of Occurrence | Vulnerability | Risk |
|---|---|---|---|
| | High | Low | Moderate |

## Table 4.4.1: Landslide Hazard Area, by Jurisdiction

| Jurisdiction | | Total Acres | Landslide Hazard Area: In Hazard Area | Landslide Hazard Area: % In Hazard Area |
|---|---|---|---|---|
| Bucoda | **Total** | **379.6** | **13.8** | **3.6%** |
| Lacey | City | 10549.7 | 40.2 | 0.4% |
| | UGA | 10645.1 | 58.1 | 0.5% |
| | **Total** | **21194.9** | **98.3** | **0.5%** |
| Olympia | City | 11858.8 | 306.4 | 2.6% |
| | UGA | 4119.2 | 49.1 | 1.2% |
| | **Total** | **15978.0** | **355.5** | **2.2%** |
| Rainier | City | 1104.8 | 9.3 | 0.8% |
| | UGA | 319.5 | 3.7 | 1.1% |
| | **Total** | **1424.2** | **13.0** | **0.9%** |
| Tenino | City | 924.0 | 24.2 | 2.6% |
| | UGA | 65.2 | 3.1 | 4.8% |
| | **Total** | **989.3** | **27.3** | **2.8%** |
| Tumwater | City | 9274.2 | 140.4 | 1.5% |
| | UGA | 5811.5 | 58.8 | 1.0% |
| | **Total** | **15085.7** | **199.2** | **1.3%** |
| Yelm | City | 3633.7 | 27.8 | 0.8% |
| | UGA | 2395.9 | 3.2 | 0.1% |
| | **Total** | **6029.6** | **31.1** | **0.5%** |
| Ground Mound UGA | **Total** | **982.9** | **1.2** | **0.1%** |
| Chehalis Tribe | **Total** | **832.6** | **0.1** | **0.0%** |
| Nisqually Tribe | **Total** | **1699.5** | **113.3** | **6.7%** |
| **Total Cities** | | **37724.9** | **562.2** | **1.5%** |
| **Total UGAs** | | **24339.4** | **177.2** | **0.7%** |
| **Total Reservations** | | **2532.1** | **113.4** | **4.5%** |
| **Rural Unincorporated County** | | **406242.4** | **39563.6** | **7.5%** |
| **Thurston County Total** | | **470838.8** | **40416.4** | **8.6%** |

## Table 4.4.2: Landslide Hazard Area, by Special Districts

| | | | Landslide Hazard | |
|---|---|---|---|---|
| | | Total Acres | In Hazard Area | % in Hazard Area |
| **Fire Districts** | | | | |
| | Bucoda | 379 | 14 | 4% |
| | Olympia | 11,882 | 312 | 3% |
| | Tumwater[1] | 10,057 | 148 | 1% |
| 1,11 | Rochester/Littlerock[2] | 101,349 | 7,664 | 8% |
| 2,4 | Yelm/Rainer[2] | 83,420 | 7,138 | 9% |
| 3 | Lacey | 45,769 | 893 | 2% |
| 6 | East Olympia | 25,108 | 226 | 1% |
| 7 | North Olympia | 7,060 | 190 | 3% |
| 8 | South Bay | 13,113 | 193 | 1% |
| 9,5 | McLane/Black Lake[2] | 50,984 | 9,583 | 19% |
| 12 | Tenino | 44,254 | 4,009 | 9% |
| 13 | Griffin | 13,953 | 760 | 5% |
| 16 | Gibson Valley | 19,081 | 1,546 | 8% |
| 17 | Bald Hills | 44,962 | 7,748 | 17% |
| **School Districts** | | | | |
| Centralia | | 12,852 | 1,052 | 8% |
| Griffin | | 21,768 | 2,212 | 10% |
| North Thurston | | 48,504 | 836 | 2% |
| Olympia | | 51,918 | 5,829 | 11% |
| Rainier | | 35,550 | 3,408 | 10% |
| Rochester | | 68,314 | 4,238 | 6% |
| Tenino | | 70,501 | 4,083 | 6% |
| Tumwater | | 73,848 | 6,882 | 9% |
| Yelm | | 126,543 | 12,006 | 9% |
| **Other Participating Jurisdictions (Service Area)** | | | | |
| Intercity Transit | | 62,333 | 1,063 | 2% |
| LOTT* | | 21,160 | 280 | 1% |
| (*Sewered Area). | | | | |
| **Colleges** | | | | |
| SPSCC-Main Campus | | 92 | 0 | 0% |
| TESC - Main Campus | | 939 | 14 | 2% |
| **Non-Profit** | | | | |
| Providence St. Peter Hospital | | 157 | 1 | 0% |
| Note: The service areas for the following participating jurisdictions are multi-county: Thurston County PUD, Timberland Regional Library (see local annex for details) | | | | |

[1]Munn Lake Fire District 15 contracts services with the City of Tumwater Fire Department; its data is combined with Tumwater's.

[2]Fire Districts 1 and 11, 2 and 4, 5 and 9 have joint operations agreements; therefore the data for the paired districts is combined.

## Table 4.4.3: Landslide Hazard Area, Population by Jurisdiction, 2006 and 2030

| Jurisdiction | | 2006 Population Estimate | | | 2030 Population Forecast | | |
|---|---|---|---|---|---|---|---|
| | | Total | In Hazard Area | % in Hazard Area | Total | In Hazard Area | % in Hazard Area |
| Bucoda | **Total** | **650** | **10** | **2%** | **1,050** | **217** | **21%** |
| Lacey | City | 34,115 | 380 | 1% | 52,015 | 1,540 | 3% |
| | UGA | 32,820 | 470 | 1% | 54,740 | 4,755 | 9% |
| | **Total** | **66,935** | **850** | **1%** | **106,755** | **6,295** | **6%** |
| Olympia | City | 44,350 | 3,330 | 8% | 64,385 | 6,431 | 10% |
| | UGA | 10,820 | 455 | 4% | 17,710 | 1,722 | 10% |
| | **Total** | **55,170** | **3,785** | **7%** | **82,095** | **8,153** | **10%** |
| Rainier | City | 1,675 | 50 | 3% | 2,540 | 456 | 18% |
| | UGA | 115 | 5 | 4% | 355 | 84 | 24% |
| | **Total** | **1,790** | **55** | **3%** | **2,895** | **540** | **19%** |
| Tenino | City | 1,525 | 10 | 1% | 3,110 | 1,009 | 32% |
| | UGA | 20 | 5 | 25% | 475 | 409 | 86% |
| | **Total** | **1,545** | **15** | **1%** | **3,585** | **1,418** | **40%** |
| Tumwater | City | 15,475 | 1,680 | 11% | 27,610 | 5,701 | 21% |
| | UGA | 6,180 | 180 | 3% | 13,805 | 2,633 | 19% |
| | **Total** | **21,655** | **1,860** | **9%** | **41,415** | **8,334** | **20%** |
| Yelm | City | 4,570 | 20 | 0% | 21,025 | 8,841 | 42% |
| | UGA | 1,335 | 20 | 1% | 3,035 | 76 | 3% |
| | **Total** | **5,905** | **40** | **1%** | **24,060** | **8,916** | **37%** |
| Grand Mound UGA | **Total** | **845** | **5** | **1%** | **2,685** | **2** | **0%** |
| Chehalis Reservation[1] | **Total** | **35** | **0** | **0%** | **175** | **40** | **23%** |
| Nisqually Reservation[1] | **Total** | **635** | **235** | **37%** | **940** | **276** | **29%** |
| **Total Cities** | | **102,360** | **5,480** | **5%** | **171,735** | **24,194** | **14%** |
| **Total UGAs [2]** | | **52,140** | **1,140** | **2%** | **92,810** | **9,680** | **10%** |
| **Total Reservations[1]** | | **670** | **235** | **35%** | **1,115** | **316** | **28%** |
| **Rural Unincorporated County[3]** | | **75,880** | **11,810** | **16%** | **107,285** | **27,900** | **26%** |
| **Thurston County Total** | | **231,100** | **18,700** | **8%** | **372,900** | **62,100** | **17%** |

**Source:** Thurston Regional Planning Council Populaton Forecast, 2007.

**Explanations:** Numbers may not add due to rounding.

[1]Data is for Thurston County portion of reservation only.

[2]UGA - Urban Growth Area. Unincorporated area designated to be annexed into city limits over 20 years time to accommodate urban growth.

[3]Rural unincorporated county is the portion of the unincorporated county that lies outside UGA and Reservation boundaries.

## Table 4.4.4: Landslide Hazard Area, Population - Special Districts, 2006 and 2030

| | | 2006 Population Estimate | | | 2030 Population Forecast | | |
|---|---|---|---|---|---|---|---|
| | | Total | In Hazard Area | % in Hazard Area | Total | In Hazard Area | % in Hazard Area |
| **Fire Districts** | | | | | | | |
| | Bucoda | 650 | 10 | 2% | 1,050 | 215 | 20% |
| | Olympia | 44,380 | 3,325 | 7% | 64,505 | 6,430 | 10% |
| | Tumwater[1] | 16,365 | 1,735 | 11% | 29,855 | 6,715 | 22% |
| 1,11 | Rochester/Littlerock[2] | 20,200 | 1,905 | 9% | 33,665 | 6,785 | 20% |
| 2,4 | Yelm/Rainier[2] | 19,390 | 835 | 4% | 43,935 | 12,155 | 28% |
| 3 | Lacey | 78,040 | 2,430 | 3% | 121,245 | 7,625 | 6% |
| 4 | Rainier | 4,705 | 425 | 9% | 8,095 | 2,125 | 26% |
| 6 | East Olympia | 11,815 | 735 | 6% | 17,430 | 3,225 | 19% |
| 7 | North Olympia | 3,920 | 1,090 | 28% | 4,730 | 1,290 | 27% |
| 8 | South Bay | 7,165 | 1,020 | 14% | 11,050 | 2,865 | 26% |
| 9,5 | McLane/Black Lake[2] | 14,990 | 3,080 | 21% | 21,420 | 6,295 | 29% |
| 12 | Tenino | 5,425 | 390 | 7% | 10,580 | 3,790 | 36% |
| 13 | Griffin | 5,075 | 1,380 | 27% | 6,870 | 2,210 | 32% |
| 16 | Gibson Valley | 465 | 210 | 45% | 1,430 | 1,120 | 78% |
| 17 | Bald Hills | 3,170 | 485 | 15% | 5,170 | 1,315 | 25% |
| **School Districts** | | | | | | | |
| Centralia | | 380 | 170 | 45% | 1,190 | 940 | 79% |
| Griffin | | 5,885 | 1,705 | 29% | 7,885 | 2,705 | 34% |
| North Thurston | | 85,305 | 2,965 | 3% | 131,365 | 9,495 | 7% |
| Olympia | | 58,000 | 6,865 | 12% | 83,735 | 13,210 | 16% |
| Rainier | | 4,580 | 340 | 7% | 16,110 | 10,305 | 64% |
| Rochester | | 12,555 | 1,340 | 11% | 19,380 | 4,660 | 24% |
| Tenino | | 9,175 | 880 | 10% | 17,985 | 6,215 | 35% |
| Tumwater | | 34,185 | 2,990 | 9% | 57,795 | 10,745 | 19% |
| Yelm | | 21,040 | 1,380 | 7% | 37,565 | 3,760 | 10% |
| **Other Participating Jurisdictions (Service Area)** | | | | | | | |
| Intercity Transit | | 143,815 | 7,255 | 5% | 236,195 | 28,065 | 12% |
| LOTT* | | 95,525 | 4,825 | 5% | 230,265 | 22,780 | 10% |

(*Sewered Area for 2006; Lacey, Olympia Tumwater UGA for 2030).

Note: The service areas for the following participating jurisdictions are multi-county or county-wide: The Evergreen State College, South Puget Sound Community College, Thurston County PUD, Port of Olympia, Timberland Regional Library

**Source:** Thurston Regional Planning Council Populaton Forecast, 2007.
**Explanations**: Numbers may not add due to rounding.

[1]Munn Lake Fire District 15 contracts services with the City of Tumwater Fire Department; its data is combined with Tumwater's.

[2]Fire Districts 1 and 11, 2 and 4, 5 and 9 have joint operations agreements; therefore the data for the paired districts is combined.

[3]Rural unincorporated county is the portion of the unincorporated county that lies outside UGA and Reservation boundaries.

## Table 4.4.5: Landslide Hazard Area, Employment, 2006 and 2030

| Jurisdiction | | 2006 Employment Estimate | | | 2030 Employment Forecast | | |
|---|---|---|---|---|---|---|---|
| | | Total | In Hazard Area | % in Hazard Area | Total | In Hazard Area | % in Hazard Area |
| Bucoda | **Total** | **35** | **0** | **0%** | **175** | **15** | **9%** |
| Lacey | City | 21,955 | 655 | 3% | 34,120 | 1,580 | 5% |
| | UGA | 5,195 | 175 | 3% | 7,995 | 485 | 6% |
| | **Total** | **27,150** | **830** | **3%** | **42,115** | **2,065** | **5%** |
| Olympia | City | 53,400 | 7,520 | 14% | 70,870 | 10,850 | 15% |
| | UGA | 1,470 | 65 | 4% | 2,550 | 130 | 5% |
| | **Total** | **54,870** | **7,585** | **14%** | **73,420** | **10,980** | **15%** |
| Rainier | City | 375 | 15 | 4% | 1,065 | 45 | 4% |
| | UGA | 10 | 0 | 0% | 20 | 0 | 0% |
| | **Total** | **385** | **15** | **4%** | **1,085** | **45** | **4%** |
| Tenino | City | 810 | 0 | 0% | 2,100 | 310 | 15% |
| | UGA | 35 | 0 | 0% | 45 | 5 | 11% |
| | **Total** | **845** | **0** | **0%** | **2,145** | **315** | **15%** |
| Tumwater | City | 17,775 | 960 | 5% | 28,260 | 1,730 | 6% |
| | UGA | 2,270 | 55 | 2% | 4,850 | 230 | 5% |
| | **Total** | **20,045** | **1,015** | **5%** | **33,110** | **1,960** | **6%** |
| Yelm | City | 3,290 | 0 | 0% | 8,080 | 350 | 4% |
| | UGA | 325 | 85 | 26% | 545 | 85 | 16% |
| | **Total** | **3,615** | **85** | **2%** | **8,625** | **435** | **5%** |
| Grand Mound UGA | **Total** | **445** | **15** | **3%** | **1,110** | **40** | **4%** |
| Chehalis Reservation[1] | **Total** | **860** | **0** | **0%** | **2,450** | **0** | **0%** |
| Nisqually Reservation[1] | **Total** | **720** | **490** | **68%** | **1,650** | **505** | **31%** |
| **Total Cities** | | **97,640** | **9,150** | **9%** | **144,670** | **14,880** | **10%** |
| **Total UGAs [2]** | | **9,750** | **400** | **4%** | **17,120** | **980** | **6%** |
| **Total Reservations[1]** | | **1,580** | **490** | **31%** | **4,100** | **505** | **12%** |
| **Rural Unincorporated County[3]** | | **12,370** | **2,715** | **22%** | **18,795** | **5,055** | **27%** |
| **Thurston County Total** | | **121,300** | **12,800** | **11%** | **184,700** | **21,400** | **12%** |

**Source:** Thurston Regional Planning Council Populaton Forecast, 2007.

**Explanations:** Numbers may not add due to rounding.

[1]Data is for Thurston County portion of reservation only.

[2]UGA - Urban Growth Area. Unincorporated area designated to be annexed into city limits over 20 years time to accommodate urban growth.

[3]Rural unincorporated county is the portion of the unincorporated county that lies outside UGA and Reservation boundaries.

## Table 4.4.6: Landslide Hazard Area, Employment - Special Districts, 2006 and 2030

| | | 2006 Employment Estimate | | | 2030 Employment Forecast | | |
|---|---|---|---|---|---|---|---|
| | | Total | In Hazard Area | % in Hazard Area | Total | In Hazard Area | % in Hazard Area |
| **Fire Districts** | | | | | | | |
| | Bucoda | 35 | 0 | 0% | 175 | 15 | 9% |
| | Olympia | 53,445 | 7,520 | 14% | 71,015 | 10,850 | 15% |
| | Tumwater[1] | 18,545 | 965 | 5% | 29,290 | 1,765 | 6% |
| 1,11 | Rochester/Littlerock[2] | 5,460 | 685 | 13% | 11,570 | 1,290 | 11% |
| 2,4 | Yelm/Rainier[2] | 5,510 | 205 | 4% | 12,030 | 830 | 7% |
| 3 | Lacey | 29,625 | 1,455 | 5% | 45,875 | 2,765 | 6% |
| 4 | Rainier | 835 | 85 | 10% | 1,825 | 260 | 14% |
| 6 | East Olympia | 2,095 | 255 | 12% | 3,400 | 540 | 16% |
| 7 | North Olympia | 450 | 105 | 23% | 615 | 145 | 24% |
| 8 | South Bay | 1,110 | 95 | 9% | 1,645 | 210 | 13% |
| 9,5 | McLane/Black Lake[2] | 2,755 | 1,180 | 43% | 4,095 | 1,890 | 46% |
| 12 | Tenino | 1,240 | 55 | 4% | 3,075 | 590 | 19% |
| 13 | Griffin | 765 | 170 | 22% | 1,120 | 265 | 24% |
| 16 | Gibson Valley | 60 | 30 | 50% | 165 | 120 | 73% |
| 17 | Bald Hills | 240 | 35 | 15% | 610 | 135 | 22% |
| **School Districts** | | | | | | | |
| Centralia | | 40 | 20 | 50% | 115 | 85 | 74% |
| Griffin | | 850 | 215 | 25% | 1,230 | 325 | 26% |
| North Thurston | | 37,675 | 1,000 | 3% | 57,820 | 2,405 | 4% |
| Olympia | | 48,130 | 8,170 | 17% | 62,085 | 11,655 | 19% |
| Rainier | | 855 | 70 | 8% | 2,005 | 420 | 21% |
| Rochester | | 3,790 | 595 | 16% | 7,600 | 1,000 | 13% |
| Tenino | | 1,755 | 125 | 7% | 4,115 | 890 | 22% |
| Tumwater | | 22,170 | 1,840 | 8% | 36,835 | 3,505 | 10% |
| Yelm | | 6,090 | 730 | 12% | 12,880 | 1,130 | 9% |
| **Other Participating Jurisdictions (Service Area)** | | | | | | | |
| Intercity Transit | | 104,795 | 10,800 | 10% | 154,615 | 16,970 | 11% |
| LOTT* | | 90,055 | 8,500 | 9% | 148,645 | 15,005 | 10% |

(*Sewered Area for 2006; Lacey, Olympia Tumwater UGA for 2030).

Note: The service areas for the following participating jurisdictions are multi-county or county-wide: The Evergreen State College, South Puget Sound Community College, Thurston County PUD, Port of Olympia, Timberland Regional Library

**Source:** Thurston Regional Planning Council Populaton Forecast, 2007.

**Explanations:** Numbers may not add due to rounding.

[1]Munn Lake Fire District 15 contracts services with the City of Tumwater Fire Department; its data is combined with Tumwater's.

[2]Fire Districts 1 and 11, 2 and 4, 5 and 9 have joint operations agreements; therefore the data for the paired districts is combined.

## Table 4.4.7: Landslide Hazard Area, Residential Dwellings, 2006 and 2030

| Jurisdiction | | 2006 Dwelling Estimate | | | 2030 Dwelling Forecast | | |
|---|---|---|---|---|---|---|---|
| | | Total | In Hazard Area | % in Hazard Area | Total | In Hazard Area | % in Hazard Area |
| Bucoda | **Total** | **255** | **5** | **2%** | **420** | **85** | **20%** |
| Lacey | City | 14,995 | 130 | 1% | 23,390 | 565 | 2% |
| | UGA | 12,540 | 180 | 1% | 22,045 | 1,840 | 8% |
| | **Total** | **27,535** | **310** | **1%** | **45,435** | **2,405** | **5%** |
| Olympia | City | 20,820 | 1,480 | 7% | 31,655 | 2,695 | 9% |
| | UGA | 4,365 | 185 | 4% | 7,460 | 720 | 10% |
| | **Total** | **25,185** | **1,665** | **7%** | **39,115** | **3,415** | **9%** |
| Rainier | City | 610 | 20 | 3% | 1,045 | 190 | 18% |
| | UGA | 45 | 0 | 0% | 155 | 35 | 23% |
| | **Total** | **655** | **20** | **3%** | **1,200** | **225** | **19%** |
| Tenino | City | 700 | 5 | 1% | 1,320 | 415 | 31% |
| | UGA | 5 | 0 | 0% | 195 | 170 | 87% |
| | **Total** | **705** | **5** | **1%** | **1,515** | **585** | **39%** |
| Tumwater | City | 7,370 | 905 | 12% | 12,975 | 2,840 | 22% |
| | UGA | 2,555 | 70 | 3% | 5,785 | 1,045 | 18% |
| | **Total** | **9,925** | **975** | **10%** | **18,760** | **3,885** | **21%** |
| Yelm | City | 2,000 | 10 | 1% | 9,410 | 4,120 | 44% |
| | UGA | 515 | 5 | 1% | 1,255 | 30 | 2% |
| | **Total** | **2,515** | **15** | **1%** | **10,665** | **4,150** | **39%** |
| Grand Mound UGA | **Total** | **325** | **0** | **0%** | **1,125** | **0** | **0%** |
| Chehalis Reservation[1] | **Total** | **15** | **0** | **0%** | **70** | **15** | **21%** |
| Nisqually Reservation[1] | **Total** | **225** | **85** | **38%** | **360** | **105** | **29%** |
| **Total Cities** | | **46,750** | **2,560** | **5%** | **80,215** | **10,910** | **14%** |
| **Total UGAs [2]** | | **20,350** | **440** | **2%** | **38,020** | **3,840** | **10%** |
| **Total Reservations[1]** | | **240** | **85** | **35%** | **430** | **120** | **28%** |
| **Rural Unincorporated County[3]** | | **29,795** | **4,405** | **15%** | **44,260** | **10,990** | **25%** |
| **Thurston County Total** | | **97,100** | **7,500** | **8%** | **162,900** | **25,900** | **16%** |

**Source:** Thurston Regional Planning Council Populaton Forecast, 2007.

**Explanations:** Numbers may not add due to rounding.

[1]Data is for Thurston County portion of reservation only.

[2]UGA - Urban Growth Area. Unincorporated area designated to be annexed into city limits over 20 years time to accommodate urban growth.

[3]Rural unincorporated county is the portion of the unincorporated county that lies outside UGA and Reservation boundaries.

## Table 4.4.8: Landslide Hazard Area, Residential Dwellings - Special Districts, 2006 and 2030

| | | 2006 Dwelling Estimate | | | 2030 Dwelling Forecast | | |
|---|---|---|---|---|---|---|---|
| | | Total | In Hazard Area | % in Hazard Area | Total | In Hazard Area | % in Hazard Area |
| **Fire Districts** | | | | | | | |
| | Bucoda | 255 | 5 | 2% | 420 | 85 | 20% |
| | Olympia | 20,840 | 1,480 | 7% | 31,725 | 2,690 | 8% |
| | Tumwater[1] | 7,755 | 925 | 12% | 13,940 | 3,230 | 23% |
| 1,11 | Rochester/Littlerock[2] | 7,525 | 480 | 6% | 13,295 | 2,270 | 17% |
| 2,4 | Yelm/Rainier[2] | 7,810 | 330 | 4% | 19,010 | 5,515 | 29% |
| 3 | Lacey | 31,885 | 925 | 3% | 51,430 | 2,970 | 6% |
| 4 | Rainier | 1,825 | 170 | 9% | 3,400 | 895 | 26% |
| 6 | East Olympia | 4,550 | 280 | 6% | 7,015 | 1,285 | 18% |
| 7 | North Olympia | 1,690 | 485 | 29% | 2,150 | 600 | 28% |
| 8 | South Bay | 2,855 | 400 | 14% | 4,610 | 1,175 | 25% |
| 9,5 | McLane/Black Lake[2] | 6,000 | 1,100 | 18% | 8,830 | 2,390 | 27% |
| 12 | Tenino | 2,170 | 150 | 7% | 4,345 | 1,535 | 35% |
| 13 | Griffin | 2,315 | 625 | 27% | 3,315 | 1,070 | 32% |
| 16 | Gibson Valley | 175 | 80 | 46% | 580 | 455 | 78% |
| 17 | Bald Hills | 1,320 | 205 | 16% | 2,250 | 570 | 25% |
| **School Districts** | | | | | | | |
| Centralia | | 145 | 65 | 45% | 480 | 380 | 79% |
| Griffin | | 2,680 | 770 | 29% | 3,805 | 1,310 | 34% |
| North Thurston | | 35,325 | 1,130 | 3% | 56,380 | 3,755 | 7% |
| Olympia | | 25,740 | 2,810 | 11% | 39,095 | 5,495 | 14% |
| Rainier | | 1,780 | 135 | 8% | 7,180 | 4,745 | 66% |
| Rochester | | 4,570 | 265 | 6% | 7,515 | 1,415 | 19% |
| Tenino | | 3,600 | 335 | 9% | 7,335 | 2,515 | 34% |
| Tumwater | | 14,775 | 1,400 | 9% | 25,220 | 4,650 | 18% |
| Yelm | | 8,550 | 555 | 6% | 15,935 | 1,585 | 10% |
| **Other Participating Jurisdictions (Service Area)** | | | | | | | |
| Intercity Transit | | 62,475 | 3,095 | 5% | 105,855 | 12,125 | 11% |
| LOTT* | | 43,335 | 2,265 | 5% | 103,310 | 9,705 | 9% |

(*Sewered Area for 2006; Lacey, Olympia Tumwater UGA for 2030).

Note: The service areas for the following participating jurisdictions are multi-county or county-wide: The Evergreen State College, South Puget Sound Community College, Thurston County PUD, Port of Olympia, Timberland Regional Library

**Source:** Thurston Regional Planning Council Populaton Forecast, 2007.

**Explanations:** Numbers may not add due to rounding.

[1]Munn Lake Fire District 15 contracts services with the City of Tumwater Fire Department; its data is combined with Tumwater's.

[2]Fire Districts 1 and 11, 2 and 4, 5 and 9 have joint operations agreements; therefore the data for the paired districts is combined.

[3]Rural unincorporated county is the portion of the unincorporated county that lies outside UGA and Reservation boundaries.

## Table 4.4.9: Landslide Hazard Area, Valuation of Building and Contents, 2006/2008

| Jurisdiction | | Residential | | | Commercial/Industrial | | | Government/Institutional | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Total (mil. $) | In Hazard Area | % in Hazard Area | Total (mil. $) | In Hazard Area | % in Hazard Area | Total (mil. $) | In Hazard Area | % in Hazard Area |
| Bucoda | **Total** | **19** | **0** | **0%** | **1** | **0** | **0%** | **2** | **0** | **0%** |
| Lacey | City | 1,944 | 9 | 0% | 1,265 | 90 | 7% | 433 | 11 | 3% |
| | UGA | 2,036 | 41 | 2% | 112 | 0 | 0% | 133 | 36 | 27% |
| | **Total** | **3,980** | **50** | **1%** | **1,377** | **91** | **7%** | **567** | **48** | **8%** |
| Olympia | City | 3,062 | 173 | 6% | 1,952 | 89 | 5% | 1,727 | 769 | 45% |
| | UGA | 930 | 51 | 5% | 43 | 0 | 0% | 17 | 0 | 1% |
| | **Total** | **3,993** | **224** | **6%** | **1,994** | **89** | **4%** | **1,745** | **769** | **44%** |
| Rainier | City | 70 | 2 | 3% | 6 | 0 | 0% | 28 | 1 | 4% |
| | UGA | 7 | 0 | 4% | 0 | 0 | 0% | 0 | 0 | 0% |
| | **Total** | **77** | **3** | **3%** | **6** | **0** | **0%** | **28** | **1** | **4%** |
| Tenino | City | 75 | 1 | 1% | 17 | 0 | 0% | 42 | 1 | 3% |
| | UGA | 1 | 0 | 21% | 0 | 0 | 0% | 0 | 0 | 0% |
| | **Total** | **76** | **1** | **1%** | **17** | **0** | **0%** | **42** | **1** | **3%** |
| Tumwater | City | 1,039 | 100 | 10% | 703 | 46 | 7% | 423 | 44 | 10% |
| | UGA | 395 | 10 | 3% | 119 | 9 | 7% | 18 | 0 | 0% |
| | **Total** | **1,434** | **110** | **8%** | **822** | **55** | **7%** | **441** | **44** | **10%** |
| Yelm | City | 266 | 2 | 1% | 127 | 0 | 0% | 140 | 0 | 0% |
| | UGA | 76 | 1 | 2% | 6 | 3 | 49% | 11 | 11 | 100% |
| | **Total** | **342** | **3** | **1%** | **134** | **3** | **2%** | **151** | **11** | **7%** |
| Grand Mound UGA | **Total** | **15** | **0** | **1%** | **16** | **0** | **2%** | **15** | **14** | **96%** |
| Chehalis Reservation[1] | **Total** | **1** | **0** | **0%** | **9** | **0** | **0%** | **0** | **0** | **0%** |
| Nisqually Reservation[1] | **Total** | **11** | **0** | **0%** | **0** | **0** | **0%** | **50** | **40** | **81%** |
| **Total Cities** | | **6,476** | **287** | **4%** | **4,071** | **225** | **6%** | **2,797** | **827** | **30%** |
| **Total UGAs [2]** | | **3,460** | **104** | **3%** | **296** | **13** | **4%** | **194** | **62** | **32%** |
| **Total Reservations[1]** | | **12** | **0** | **0%** | **9** | **0** | **0%** | **50** | **40** | **81%** |
| **Rural Unincorporated County[3]** | | **5,672** | **1,037** | **18%** | **193** | **41** | **21%** | **755** | **583** | **77%** |
| **Thurston County Total** | | **15,620** | **1,428** | **9%** | **4,569** | **279** | **6%** | **3,796** | **1,512** | **40%** |

**Source:** Thurston Regional Planning Council Populaton Forecast, 2007.

**Explanations:** Numbers may not add due to rounding.

[1]Data is for Thurston County portion of reservation only.

[2]UGA - Urban Growth Area. Unincorporated area designated to be annexed into city limits over 20 years time to accommodate urban growth.

[3]Rural unincorporated county is the portion of the unincorporated county that lies outside UGA and Reservation boundaries.

## Table 4.4.10: Landslide Hazard Area, Valuation of Building and Contents - Special Districts, 2006/2008

| | | Residential | | | Commercial/Industrial | | | Government/Institutional | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Total (mil. $) | In Hazard Area | % in Hazard Area | Total (mil. $) | In Hazard Area | % in Hazard Area | Total (mil. $) | In Hazard Area | % in Hazard Area |
| **Fire Districts** | | | | | | | | | | |
| | Bucoda | 19 | 0 | 0% | 1 | 0 | 0% | 2 | 0 | 0% |
| | Olympia | 3,064 | 173 | 6% | 1,952 | 89 | 5% | 1,727 | 769 | 45% |
| | Tumwater[1] | 1,091 | 106 | 10% | 755 | 46 | 6% | 424 | 44 | 10% |
| 1,11 | Rochester/Littlerock[2] | 1,114 | 82 | 7% | 126 | 14 | 11% | 135 | 73 | 54% |
| 2,4 | Yelm/Rainier[2] | 1,099 | 57 | 5% | 165 | 4 | 2% | 192 | 12 | 6% |
| 3 | Lacey | 4,783 | 137 | 3% | 1,415 | 97 | 7% | 640 | 98 | 15% |
| 4 | Rainier | 270 | 30 | 11% | 9 | 0 | 0% | 30 | 1 | 4% |
| 6 | East Olympia | 991 | 62 | 6% | 48 | 6 | 12% | 26 | 1 | 4% |
| 7 | North Olympia | 347 | 108 | 31% | 6 | 1 | 26% | 20 | 0 | 2% |
| 8 | South Bay | 719 | 124 | 17% | 20 | 4 | 20% | 13 | 0 | 2% |
| 9,5 | McLane/Black Lake[2] | 1,313 | 325 | 25% | 39 | 10 | 26% | 550 | 508 | 92% |
| 12 | Tenino | 313 | 28 | 9% | 29 | 1 | 3% | 45 | 4 | 9% |
| 13 | Griffin | 534 | 180 | 34% | 5 | 0 | 2% | 16 | 0 | 0% |
| 16 | Gibson Valley | 22 | 11 | 48% | 0 | 0 | 0% | 0 | 0 | 0% |
| 17 | Bald Hills | 211 | 33 | 16% | 8 | 7 | 89% | 4 | 0 | 0% |
| **School Districts** | | | | | | | | | | |
| Centralia | | 1 | 0 | 0% | 0 | 0 | 0% | 1 | 0 | 0% |
| Griffin | | 16 | 0 | 0% | 5 | 0 | 4% | 16 | 0 | 0% |
| North Thurston | | 642 | 54 | 8% | 1,931 | 96 | 5% | 642 | 54 | 8% |
| Olympia | | 2,151 | 1,174 | 55% | 1,500 | 98 | 7% | 2,151 | 1,174 | 55% |
| Rainier | | 30 | 1 | 4% | 9 | 0 | 4% | 30 | 1 | 4% |
| Rochester | | 107 | 73 | 69% | 75 | 11 | 14% | 107 | 73 | 69% |
| Tenino | | 49 | 5 | 10% | 42 | 2 | 5% | 49 | 5 | 10% |
| Tumwater | | 582 | 149 | 26% | 832 | 56 | 7% | 582 | 149 | 26% |
| Yelm | | 219 | 55 | 25% | 175 | 15 | 9% | 219 | 55 | 25% |
| **Other Participating Jurisdictions (Service Area)** | | | | | | | | | | |
| Intercity Transit | | 9,356 | 419 | 4% | 4,208 | 234 | 6% | 3,453 | 1,416 | 41% |
| LOTT* | | 6,438 | 260 | 4% | 3,604 | 163 | 5% | 2,443 | 817 | 33% |

*Sewered Area.

Note: The service areas for the following participating jurisdictions are multi-county or county-wide: The Evergreen State College, South Puget Sound Community College, Thurston County PUD, Port of Olympia, Timberland Regional Library

**Source:** Thurston Regional Planning Council Populaton Forecast, 2007.

**Explanations:** Numbers may not add due to rounding.

[1]Munn Lake Fire District 15 contracts services with the City of Tumwater Fire Department; its data is combined with Tumwater's.

[2]Fire Districts 1 and 11, 2 and 4, 5 and 9 have joint operations agreements; therefore the data for the paired districts is combined.

[3]Rural unincorporated county is the portion of the unincorporated county that lies outside UGA and Reservation boundaries.

**Table 4.4.11: Landslide Hazard Area, Valuation of Building and Contents - Colleges, 2006 and 2008**

| | Government/Institutional | | |
|---|---|---|---|
| | Total (mil. $) | In Hazard Area | % in Hazard Area |
| **College** | | | |
| South Puget Sound Community College | 63 | 0 | 0% |
| The Evergreen State College | 505 | 0 | 0% |

**Table 4.4.12: Landslide Hazard Area, Valuation of Building and Contents - Multi-County Districts, 2006 and 2008**

| | Government/Institutional | | |
|---|---|---|---|
| | Total (1,000 $) | In Hazard Area | % in Hazard Area |
| **Thurston PUD** | | | |
| Thurston County | 1,780 | 43 | 2% |
| Lewis County | 1,046 | 219 | 21% |
| Grays Harbor County | 69 | 0 | 0% |
| Mason County | 63 | 0 | 0% |
| Pierce County | 1,204 | 15 | 1% |
| **Total** | 4,162 | 278 | 7% |
| **Timberland Regional Library** | | | |
| Thurston County | 6,700 | 0 | 0% |
| Lewis County | 4,533 | 0 | 0% |
| Grays Harbor County | 4,277 | 0 | 0% |
| Mason County | 5,273 | 0 | 0% |
| Pacific County | 2,698 | 0 | 0% |
| **Total** | 23,481 | 0 | 0% |

**Note**: The service areas for these jurisdictions are multi-county-wide

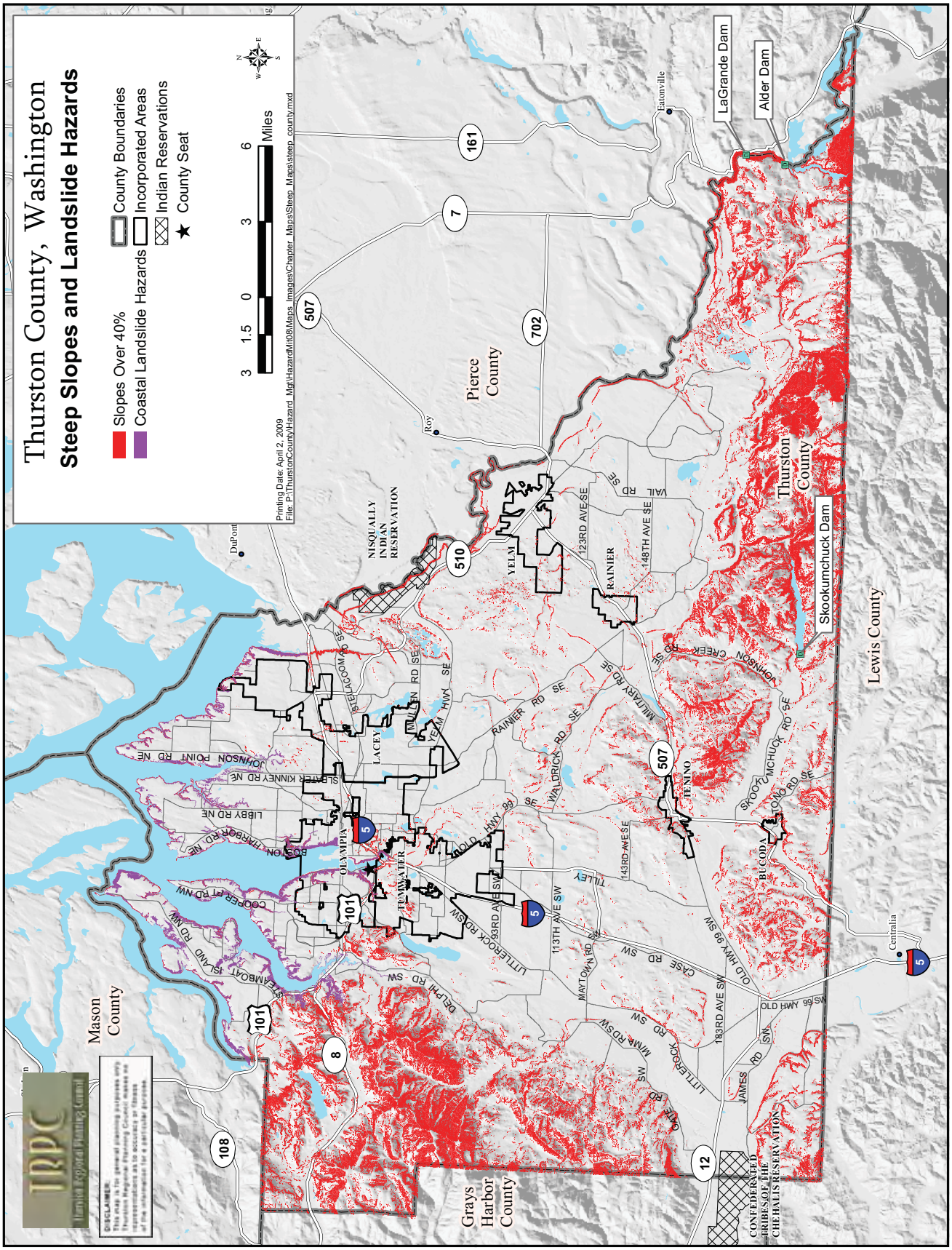
**Table 4.4.13: Landslide Hazard Area, Valuation of Building and Contents - Non-Profit 2006/2008**

| | Government/Institutional | | |
|---|---|---|---|
| | Total (mil. $) | In Hazard Area | % in Hazard Area |
| **Hospital** | | | |
| Providence St. Peter Hospital | 401 | 0 | 0% |

## Table 4.4.14: Critical Infrastructure in the Landslide Hazard Area

| Critical Facility Sector and Subsector | Total | In Hazard Area | % In Hazard Area |
|---|---|---|---|
| **1. AGRICULTURE/FOOD SUPPLY** | **22** | **0** | 0.0% |
| 1.1 PRODUCTION | 2 | 0 | 0.0% |
| 1.2 FOOD DISTRIBUTION/STORAGE | 20 | 0 | 0.0% |
| **2. GOVERNMENT** | **135** | **0** | 0.0% |
| 2.1 FIRE SERVICES | 43 | 0 | 0.0% |
| 2.2 LAW ENFORCEMENT | 9 | 0 | 0.0% |
| 2.3 EMERGENCY OPERATIONS CENTERS | 11 | 0 | 0.0% |
| 2.4 CORONER/MORGUE | 1 | 0 | 0.0% |
| 2.5 SHELTER | 69 | 0 | 0.0% |
| 2.7 AMBULANCE | 3 | 0 | 0.0% |
| **4. MEDICAL CARE** | **84** | **0** | 0.0% |
| 4.1.a HOSPITALS | 4 | 0 | 0.0% |
| 4.1.B LARGE CLINICS | 36 | 0 | 0.0% |
| 4.1.B LARGE CLINICS - RURAL | 5 | 0 | 0.0% |
| 4.1.C URGENT CARE | 6 | 0 | 0.0% |
| 4.1.D SURGICAL SUITES | 6 | 0 | 0.0% |
| 4.2 CHEMICAL DEPENDENCY TREATMENT CENTER | 1 | 0 | 0.0% |
| 4.3A METHADONE | 1 | 0 | 0.0% |
| 4.3B DIALYSIS | 1 | 0 | 0.0% |
| 4.3C MENTAL HEALTH | 2 | 0 | 0.0% |
| 4.3D BIRTHING CENTERS | 2 | 0 | 0.0% |
| 4.4 NURSING HOMES | 7 | 0 | 0.0% |
| 4.5 ASSISTED LIVING FACILITIES | 13 | 0 | 0.0% |
| **5. UTILITIES** | **8** | **0** | 0.0% |
| 5.5 RADIO/TELEVISION | 2 | 0 | 0.0% |
| 5.6 DATA TRANSMISSION LINES | 1 | 0 | 0.0% |
| 5.8 SOLID WASTE MANAGEMENT | 5 | 0 | 0.0% |
| **6. TRANSPORTATION** | **16** | **0** | 0.0% |
| 6.3 ROADS - CENTERLINE MILES | 1951 | 2.3 | 0.1% |
| 6.4 VEHICLE FUEL | 4 | 0 | 0.0% |
| 6.5 STUDENT TRANSPORTATION | 8 | 0 | 0.0% |
| 6.6 MASS TRANSIT | 2 | 0 | 0.0% |
| 6.7 PORT | 1 | 0 | 0.0% |
| **Grand Total** | **266** | **0** | 0.0% |

**Map 4.4.1**


Thurston County, Washington
Steep Slopes and Landslide Hazards
Slopes Over 40%
Coastal Landslide Hazards
County Boundaries
Incorporated Areas
Indian Reservations
County Seat
3 1.5 0 3 6 Miles
Printing Date: April 2, 2009
File: P:\ThurstonCounty\Hazard_Mgt\HazardMit08\Maps_Images\Chapter_Maps\Steep_Maps\steep_county.mxd
Mason County
Grays Harbor County
Pierce County
Lewis County
Thurston County
NISQUALLY INDIAN RESERVATION
CONFEDERATED TRIBES OF THE CHEHALIS RESERVATION
LaGrande Dam
Alder Dam
Skookumchuck Dam
Eatonville
Roy
DuPont
Centralia
OLYMPIA
TUMWATER
LACEY
YELM
RAINIER
TENINO
BUCODA
Thurston Regional Planning Council
DISCLAIMER:
This map is for general planning purposes only. Thurston Regional Planning Council makes no representations as to accuracy or fitness of the information for a particular purpose.

## Landslide Endnotes

[1]United States Geological Survey. 2009. Landslides Hazard Program. http://landslides.usgs.gov/

[2]Rex Baum, et al. 2007. Landslide Hazards in the Seattle, Washington, Area. United States Geological Survey Fact Sheet 2007-3005.

[3]Washington State Department of Ecology. 2009. Puget Sound Landslides: Signs of Movement. http://www.ecy.wa.gov/programs/sea/landslides/signs/signs.html

[4]Ibid

[5]Linda Ashton. 1997. Bainbridge Mudslide Kills Family. The Associated Press. Published in The Olympian, January 20, 1997.

[6]Washington State Department of Natural Resources. 2009. Landslide Reconnaissance Following the December 3, 2007 Storm - Thurston County.
http://www.dnr.wa.gov/ResearchScience/Topics/GeologicHazardsMapping/Pages/landslides_thurstonslide2.aspx

[7]Lorrine Thompson. 2001. Struggle To Recover Continues After Slide. The Olympian, December 17, 2001.

[8]Jennifer Olson. 1999. Landslide Victims Won't Get Aid. The Olympian, August 27, 1999.

[9]Joel Coffidis. 1996. Nisqually Rips Yard From Homeowners. The Olympian, February 17, 1996.

[10]John Dodge. 1996. Sewage Flow Into Lake Halted. The Olympian, February 23, 1996.

[11]Michael Polentz, Gabriel Legorreta Paulin, Isabelle Sarikhan,, et al. 2008. Thurston County Marine Shore Landslides and Landforms Data. Unpublished Data. Washington Geological Survey Division of Geology and Earth Resources, Washington Department of Natural Resources.

[12]Personal Communication with Michael Polenz and Tim Walsh, Geologists, Washington Geological Survey Division of Geology and Earth Resources, Washington Department of Natural Resources, March 9, 2009.

# Chapter 4.5: Wildland Fire Hazard Profile

## Introduction

A wildland fire, also known as a wildfire, can damage or destroy open space and natural resource lands. Although wildland fires can be ignited by natural means such as lightning, they are more frequently the result of ignition due to poor judgment or a lack of understanding of fire hazard potential, such as residential debris burns left unattended. Large uncontrollable fires can destroy timberlands, recreational areas, habitat, watersheds, and cherished scenic views. The Washington State Hazard Mitigation Plan reports that approximately 17,000 acres of state-owned or protected land is burned annually at the cost of $28 million in combined damages and suppression activities.[1]

The Thurston Region has been spared the destructive force of a major wildfire, but numerous wildland fires occur annually throughout the entire region. Areas of human development interface with extensive forest lands, prairies, and other open space areas throughout the County. As the region's population grows and the potential for drought from warmer, drier, and longer lasting summers (due to the effects of climate change), the risk for hazardous wildland fires is likely to increase. Under the right conditions, it is conceivable that a large wildland fire could consume more forest, grasslands, homes, and other public and private owned assets within the Thurston Region than previously documented. Due to the high probability of occurrence, the number of urban interface communities that are moderately vulnerable, the overall wildland fire risk rating for the region is moderate.

## Hazard Identification

The wildland fire hazard is unique from other hazards in Thurston County in that:

- It is the most frequent occurring hazard; approximately 71 wildland fires start per year
- It can be prevented; over 99 percent of fires are started due to poor human judgment or accidental ignition
- It is the only hazard that can be actively contained or suppressed in real time. To date local fire districts and the Washington State Department of Natural Resources have effectively extinguished fires prior to becoming larger scale hazards

### Definition

A wildland fire hazard is an uncontrolled fire that spreads through areas in which development is typically limited. These areas may include infrastructure such as roads, railroads, power lines, and similar facilities, but population and employment density are typically low. Wildfires can begin unnoticed and spread quickly.

Indeed, ecologists, foresters, and other natural resource land managers view wildland fires as a natural process necessary to sustain the health of forest, woodland, or grassland ecosystems. Nevertheless, when a fire threatens managed natural resources, property, and human life, the natural process transforms to a hazard.

Wildland Urban Interface (WUI) communities are geographical area where human development meets or mixes with wildlands such as grass lands, shrub lands, woodlands and forest. These communities and the adjacent wildlands are at risk because the fire hazard can spread bi-directionally. Fires may originate in the wildland area and spread to structures and dwellings and vice versa. People understandably are attracted to less developed areas and seek to build homes in undisturbed natural settings for the aesthetic and scenic value. The desired landscaping, consisting of tall large native trees and shrubs that are prolific on properties throughout rural (and urban) Thurston County, can serve as a conduit for wildfire if not properly spaced or maintained at defensible distances away from structures.

Source and Factors of Wildland Fires

All fires require fuel, oxygen, and an ignition source. Less than one percent of all recorded wildland fires in Thurston County have occurred from natural occurrences such as lightning strikes. In Thurston County, fires are predominantly ignited by human activities such as: debris burning (32 percent); miscellaneous activities such as fireworks, sparks from engines, and electric fences (28 percent); children (16 percent); and recreational activities such as camping and hunting (11 percent). Other lesser causes include arson, smoking, and railroad operations.

The Washington State Hazard Mitigation Plan identifies fuel, weather, and terrain as essential elements that influence the behavior of a wildland fire. The following excerpt from the State plan succinctly summarizes these factors:[2]

*Fuel:*

- *Lighter fuels such as grasses, leaves, and needles quickly expel moisture and burn rapidly, while heavier fuels such as tree branches, logs, and trunks take longer to warm and ignite.*
- *Snags and hazard trees – those that are diseased, dying, or dead – are larger west of the Cascades, but more prolific east of the Cascades. In 2005, about 2.4 million acres of the state's 21 million acres of forestland contained trees killed or defoliated by forest insects and diseases.*

*Weather:*

- *West of the Cascades, strong, dry, east winds in late summer and early fall produce extreme fire conditions. East wind events can persist up to 48 hours with wind speed reaching 60 miles-per-hour; these winds generally reach peak velocities during the night and early morning hours.*
- *East of the Cascades, summer drying typically starts in mid June and runs through early September, with drought conditions extending this season….*
- *Thunderstorm activity, which typically begins in June with wet storms, turns dry with little or no precipitation reaching the ground, as the season progresses into July and August.*

*Terrain:*

- *Topography of a region or a local area influences the amount and moisture of fuel.*
- *Barriers, such as highways and lakes, can affect the spread of fire.*
- *Elevation and the slope of the land allows a fire to spread more easily as it moves uphill than downhill.*

## Severity

The severity of a wildland fire depends upon the extremity of the factors listed above, the extent of the fire, the size of the population, the value of structures that are at risk, and the ability of firefighters to effectively mobilize and suppress the fire. In general, the cooler, wetter climate of western Washington is less prone to wildland fires because fuel sources have higher moisture content and are less susceptible to ignition. Eastern Washington has a longer and drier fire season and is more vulnerable to lightning strikes than the west of the Cascades.

On June 23, 1993, Thurston County adopted a county wide burn permit program for yard waste. In this program a permit is required that provides safe guidelines for burning. The use of burn barrels and burning of prohibitive materials state wide was included. A burn ban period is effective each year from July 15 to October 15. This measure has resulted in significant reductions in wildland fires in Thurston County.

Although a major wildland fire has not affected Thurston County in modern times, wildland fires are a common occurrence. They have been documented to occur during every month of the year, particularly during prolonged dry periods due to drought or near-drought conditions. Wildfires are common during the local dry season, mid-May through mid-October, but 75 percent of all wildfires occur between July and September when temperatures are higher.

In the Thurston region, the following conditions influence the extent and severity of wildland fires:

1. **Soil Conditions** - The Thurston Region has a large area of glacial outwash prairie. Prairies are typically vegetated with grasses and other low growing herbaceous plants and shrubs. Prairie soils drain quickly and the vegetation quickly dries out during the summer months. Several Thurston County prairies also interface with encroaching Douglas-fir stands, making these areas particularly vulnerable to wildland fires. Map 4.5.1 illustrates the Natural Resource Conservation Service (NRCS) designation of Category 1 soil types, which are referred to as excessively-drained, glacial-outwash soils. The map clearly illustrates that almost all fire districts contain some glacial-outwash soils and are therefore rich with tinder during the dry season.
2. **Slope** - In general, the steeper the slope of the terrain, the faster a fire can spread up the slope. Map 4.5.1 also shows areas in Thurston County with steep slopes. Steep slopes are located throughout the county, but are more pronounced in fire districts 1, 4, 9, 11, 12, 13, 16, and 17.
3. **Vegetation Type** - The severity of a fire is influenced by the composition and extent of fuels available. Vegetation is the primary source of fuels. In 2001, the Thurston Regional Planning Council (TRPC) developed a detailed data layer of the land coverage based on satellite data. Map 4.5.2 shows the land cover for Thurston County. The map identifies areas of forest, dry grasses, soils, and non-forest vegetation with an overlay of the fire districts. Vegetative ground cover varies widely in Thurston County. For example, the forest vegetation type in the Griffin, McLane and Black Lake Fire District is characterized by a large amount of salal and Oregon grape, whereas the Tenino Fire District is chiefly composed of grasses and Scotch broom. In a wildfire, many times the ground cover or understory layer of vegetation burns, leaving the timber. But with extremely dry conditions, fires can consume a significant portion of the

overstory and thereby destroy a forest. Capitol State Forest, Fort Lewis Military Reservation, and private timberlands in the southeastern and Bald Hills areas of Thurston County comprise the largest, albeit fragmented, continuous stands of coniferous-mixed forests in the region. Dry grasses are prolific, burn rapidly once ignited, and are capable of generating flames up to 40 feet tall.

4. **Access -** Road access and mobility for emergency vehicles is mission critical in wildfire suppression efforts. Limited access delays response time or limits the ability to successfully fight a fire when the necessary equipment and apparatuses cannot make contact with the affected area. Map 4.5.2 also shows roads and streets in Thurston County, which are less than 24 feet wide and may potentially hinder access. There are residential communities in Thurston County that have only one road in and out. Limited access poses challenges for both evacuation of residents and the ability of firefighters to mobilize to the affected area. Examples of these communities include the Clear Lake community in Fire District 17 and the Summit Lake community in Fire District 9.
5. **Size -** Wildland fires are a common occurrence in Thurston County. Between 1972 and 2007, Washington State Department of Natural Resources has documented 2,473 fires (about 70 fires per year) in the County.[3] It should be noted that the number of wildland fires that actually occur likely exceeds the totals presented here, as many fires may go unreported to DNR. A total of 2,266 acres have burned with an average of 0.9 acres burned per fire. The largest wildland fire recorded in Thurston County burned 140 acres. The location of wildland fires is shown on Map 4.5.3. Table 4.5.1 summarizes wildland fire events in Thurston County from 1972 to 2007.

An examination of Table 4.5.1 reveals that Lacey Fire District 3 has a higher annual rate of wildland fires (20.5 per year) compared to other districts (nearly four times higher than the mean 5 acres per year). But the average acres burned does not exceed the county-wide average of 0.9 acres per fire. The high rate of annual fires is likely related to the district's population which is five times higher than the mean population of all fire districts. The larger population likely yields more fire risk related activities. This combined with the widespread coverage of Category 1 soil type, likely contributes to the District's higher rate of wildland fires.

**Table 4.5.1: Wildland Fires in Thurston County – 1972 to 2007**

| Fire District | Row Labels | Total Fires | Fires/Year | Total Acres Burned | Max Acres Burned | Mean Acres Burned |
|---|---|---|---|---|---|---|
| | BUCODA | 7 | 0.2 | 0.9 | 0.5 | 0.1 |
| | OLYMPIA | 24 | 0.7 | 7.9 | 4 | 0.3 |
| | TUMWATER | 41 | 1.2 | 27.9 | 4 | 0.7 |
| *1,11 | ROCHESTER/LITTLEROCK | 436 | 12.5 | 531.7 | 50 | 1.2 |
| *2,4 | YELM/RAINIER | 370 | 10.6 | 360.1 | 59 | 1.0 |
| 3 | LACEY | 719 | 20.5 | 383.2 | 54 | 0.5 |
| *9,5 | MCLANE/BLACKLAKE | 184 | 5.3 | 122.0 | 14 | 0.7 |
| 6 | EAST OLYMPIA | 199 | 5.7 | 144.2 | 13 | 0.7 |
| 7 | NORTH OLYMPIA | 14 | 0.4 | 1.7 | 0.3 | 0.1 |
| 8 | SOUTH BAY | 164 | 4.7 | 41.6 | 3 | 0.3 |
| 12 | TENINO | 100 | 2.9 | 350.2 | 140 | 3.5 |
| 13 | GRIFFIN | 65 | 1.9 | 118.4 | 96 | 1.8 |
| 16 | GIBSON VALLEY | 33 | 0.9 | 50.2 | 25 | 1.5 |
| 17 | BALD HILLS | 117 | 3.3 | 126.5 | 23 | 1.1 |
| | **Grand Total** | **2473** | **70.7** | **2266.4** | **140** | **0.9** |

*Note: Fire districts 1 and 11, 2 and 4, and 5 and 9 are grouped as they operate under joint operation agreements.

## Impacts

The impacts of a wildland fire varies depending upon the size and location of the fire. The heat from intense wind driven flames can destroy virtually any combustible material in its path. People caught off guard by a rapidly spreading fire could suffer burn injuries or other non-burn injuries trying to escape a fire, or possibly be killed. People recreating in remote roadless forest or range lands are especially at risk. The loss of a loved one or the loss of a home or a business is a traumatic experience and fire victims are likely to suffer post traumatic stress disorder following a fire-related loss.

Physical damages include loss of valuable timber, wildlife habitat, and recreational areas such as trails, parks, and campground facilities. Smaller rural communities can suffer economic losses from destroyed natural resource lands because their economies are dependent on the timber industry or tourism. Buildings and their contents, utility lines, and parked vehicles are also destroyed. Power and communication disruptions can occur, even in areas unaffected by fires, if major transmission lines are damaged or destroyed. The loss of vegetation on steep slopes increases the risk for mudslides or landslides during the fall and winter months. Stream and creek channels could fill with sediment and debris increasing flood risks. It could take years for fish habitat to recover.

Firefighting can consume significant local and state resources. Even a small wildland fire in Thurston County requires rapid containment or suppression in order to protect property. Local fire districts often rely on DNR assets such as helicopters to reach remote areas or provide rapid response. Should multiple wildland fires occur simultaneously in different areas during an extremely warm and dry season, local capabilities could quickly become overwhelmed. This is particularly more problematic

when major wildland fires on federal lands require the mobilization of firefighting assets across the western U.S., further stretching local firefighting capacity.

Firefighting is strenuous work and extended firefights can result in fatigue and equipment wear. Fire chiefs and commanders strive to protect the safety of their crews, but large scale wildland fires sometimes result in the injury or death of firefighters.

Temporary disruptions to transportation networks can occur during the suppression and recovery stages. Local area residents may need to seek detour routes. Some local area residents may not be able to reach their homes until local authorities indicate it is safe to reopen restricted areas.

### Probability of Occurrence

The documented record of wildland fires in Thurston County suggests that approximately 97 percent of future fires will be five acres or less (see Table 4.5.2). The region can expect at least one fire exceeding 100 acres over the next 25 years. A warmer and drier future climate may create more suitable conditions for more frequent or larger fires.

A size distribution of the fires occurring within the Thurston Region from 1972 to 2007 is shown in Table 4.5.2 below. Assuming that the region continues to average 71 fires per year, (see Table 4.5.1) there may be a total of 1775 future fires over the next 25 years; therefore, the number and size of future fires may be very similar to those that occurred in the past. Despite the projections for numerous small fires, the frequency indicates that wildland fires have a high probability of occurrence.

**Table 4.5.2: Historical and Predicted Number of Fires by Size[4]**

| Fire Size (acres) | Historical # of Fires 1972-2007 | Probability | Proportion | Predicted # of Fires 2009-2034 |
|---|---|---|---|---|
| Less than 1 | 2143 | 61.23 | 86.66% | 1538 |
| 1 to 2 | 155 | 4.43 | 6.27% | 111 |
| 2 to 5 | 110 | 3.14 | 4.45% | 79 |
| 5 to 10 | 35 | 1.00 | 1.42% | 25 |
| 10 to 50 | 26 | 0.74 | 1.05% | 19 |
| 50 to 100 | 3 | 0.09 | 0.12% | 2 |
| Greater than 100 | 1 | 0.03 | 0.04% | 1 |
| Total | **2473** | **-** | **-** | **1775** |

## Wildfire/Forest Fire Historical Occurrences and Impacts

Thurston County has not experienced a major wildfire with complete destruction of timber, structures, personal property, wildlife habitat, recreational areas, and watershed areas coupled with

a substantial negative impact of commerce and infrastructure. Major wildland fires also have not occurred in modern times for the surrounding Pierce, Lewis, Grays Harbor, and Mason counties.

Native American Indian Prairie Wildfire Management in Thurston County

Prior to the formation of the county, which occurred in the 1850s, it was common practice for Native American Tribes to set fires, which burned the prairies to rejuvenate grasslands for food production and to control invasive shrubs and trees. These prairies can be seen in a band across the county extending from the northeast to the southwest ranging from Hawks Prairie to the north, Yelm Prairie in the east, Smith and Frost Prairies across the middle part of the county, with Barker and Grand Mound Prairies to the southwest. The geological formation of the "Mima Mounds" is a prominent feature of the Mima and Rocky Prairies located in the middle part of the county.

August 31, 2006 Sweetbriar Loop Neighborhood Brush Fire

A nine acre brush fire came within 20 feet of homes in the Sweetbriar Loop neighborhood of Thurston County off Marvin Road in Fire District 3. Firefighters from five fire districts and DNR plus two helicopters were deployed to suppress the fire. No injuries or structural damage was reported with this fire. The cause of the fire remains unknown.[5]

July 3, 2003, Littlerock Woodland Blaze[6]

A hazardous mix of fireworks and dry conditions resulted in a brush fire that grew to consume four acres of woodland west of the community of Littlerock. A helicopter, 44 firefighters from DNR, firefighters from fire districts 1, 5, and 11, and 20 inmates from the Cedar Creek Corrections Facility responded to the fire. Fire trucks quickly deployed to defensive positions to protect homes from the blaze. No structures were affected.

April 4, 2002, Lacey Brush Fire[7]

Thirty firefighters from fire districts 3, 5, and DNR extinguished a 15 acre brush fire possibly started by children. The fire occurred on the site of a former farm that was overgrown with Scotch broom. No structural damage occurred.

August 20, 2001, Littlerock Grassfire[8]

A ten acre grassfire threatened eleven homes west of the community of Littlerock. The fire was ignited by sparks during a welding task. Nearly 20 firefighters from eight districts as well as home owners and neighbors joined to fight the fire which came within 20 to 30 feet from some homes.

August 5, 1998, Offut Lake Vicinity Grassfire[9]

At 4:30 p.m. a truck dragging an unhitched trailer on Old highway 99 generated sparks, igniting nearby grass in the vicinity of Offut Lake, just north of the City of Tenino. Twenty mile per hour winds fanned 40 foot flames and caused the fire to spread east. The fire was located at the border of East Olympia Fire District 6 and Tenino Fire District 12. Firefighters from eight fire districts and DNR, plus two helicopters put the flames to rest before it threatened nearly 100 homes. The fires

prompted some local residents to prepare to evacuate. By the time the fire was suppressed, it burned 140 acres (nearly a quarter square mile) of grasslands. No injuries were reported and no structures were damaged. Fire crews continued to extinguish hot spots into the next day. Two days after this fire started (and several other small fires in the south sound region in the same time period), Thurston County fire districts issued burn bans countywide.

Historic Western Washington Wildfires

While major forest fires are not common in Western Washington, the Yacolt Fire in Clark and Skamania Counties are the largest known Washington fires in recorded history. In 1902, the Yacolt Fire burned 238,900 acres (373 square miles) resulting in 38 deaths.[10] More recently, the Jordan Creek Fire occurred near Marblemount in Skagit County and burned 1,162 acres of forest land and threatened several homes in 1998. The cost to fight the Jordan Creek Fire was reported to be in excess of $3 million dollars.[11]

## Delineation of Wildland Fire Hazard Area

The location of past fires (Map 4.5.3) combined with the fact that there is sufficient open space with fuels throughout the County suggests that wildland fires can occur anywhere. However some areas within the county are at greater risk than others. Washington State has identified 181 high risk urban interface communities in the State. The Washington State Department of Natural Resources in partnership with federal and local stakeholders delineated wildland urban interface communities throughout Washington. These geographical areas were evaluated for fire behavior potential, fire protection capability, and risk to social, cultural and community resources. Risk factors included area fire history, type and density of vegetative fuels, extreme weather potential, topography, number and density of structures and their distance from fuels, location of municipal watersheds, and potential for loss of housing or businesses. The evaluation used the criteria in the wildfire hazard severity analysis of the National Fire Protection Association's NFPA 299 Standard for Protection of Life and Property Wildfire (now NFPA 1144). Map 4.5.4 shows those communities at greatest risk of a wildland urban interface fire in Thurston County. Tables 4.5.3 through 4.5.4 show the size of the wildland fire hazard area by jurisdiction.

The Washington State Hazard Mitigation Plan has identified these communities as the most vulnerable to wildland fire. The Thurston County Association of Fire Chiefs recommended to the hazard mitigation plan workgroup that the Natural Hazard Mitigation Plan for the Thurston Region use the same geographies for delineating high risk wildland urban interface communities within Thurston County. This geography serves to assess population, employment, assets, and critical infrastructure in the hazard area. Local fire district chiefs believed that this data is perhaps the best data available, but indicated that a more detailed local wildland urban interface risk assessment is warranted in the future.

### Communities Most Vulnerable to Wildland Fires

The following areas are classified as high risk urban interface communities in the Thurston Region based on the criteria listed above (refer to Map 4.5.4):

- Steamboat Island Peninsula
- Boston Harbor/Fishtrap Loop/Woodard Bay/South Bay Peninsula
- Johnson Point Peninsula
- Nisqually River valley, south of Yelm and east of McKenna
- Lake Lawrence, western shore vicinity
- Tenino (upland vicinity south of city limits)
- Grand Mound/Rochester/Confederated Tribes of the Chehalis Reservation vicinity
- Capitol State Forest vicinity

## Population and Employment in the Hazard Area

Approximately 30,900 residents (13 percent) and 5,700 employees (5 percent) live and work in the area designated as a high risk for wildland fires. Estimates of the region's population and employment in the wildland fire hazard area is summarized in tables 4.5.4 through 4.5.8. These tables assesses an aspect of current and future vulnerability by providing data on the number of people living and working within the hazard area as compared to total population, by jurisdiction, in the years 2006 and 2030.

Estimates of the region's structures and their contents in the wildland fire hazard area is summarized in tables 4.5.9 through 4.5.15. These tables provide an estimate of the number of existing and future structures which are potentially impacted by the hazard, as well as an estimate of structure and building contents value in order to provide information on potential dollar losses. Tables are provided by jurisdiction, for the years 2006 and 2030.

## Critical Facilities and Infrastructure in Hazard Area

Although Critical Facilities are located within the wildland fire hazard area, many of the buildings have sufficient defensible space and are unlikely to be damaged or destroyed by fire. However services and operations that are based from these facilities are likely to be indirectly affected due to power outages and or closed roads. Table 4.5.16 lists the type and number of critical facilities located in the wildland fire hazard area.

## Summary Assessment

Numerous wildland fires will reoccur over the next 25 years, therefore this hazard receives a high probability of occurrence rating. The vulnerability of the county to this hazard is also believed to be of a moderate level. Despite the relatively diminutive size of Thurston County wildland fires, they have great potential to destroy multiple homes or businesses. Past fires have threatened to damage or quite possibly destroy 10 to 20 or more homes in a single event. Although this type of incident may seem small relative to a county wide hazard such as a flood, flood events have not resulted in the condemnation of this number of dwelling units at one time. A moderate vulnerability rating is assigned because even small fires have the potential to impact multiple properties with devastating results in a very short period of time. Finally, the subjective estimate of the probability of occurrence and vulnerability threat are combined to classify the wildland fire hazard as a moderate risk.

**Summary Risk Assessment for Wildland Fire in the Thurston Region**

| Wildland Fire Hazard | Probability of Occurrence | Vulnerability | Risk |
|---|---|---|---|
| | High | Moderate | Moderate |

## Table 4.5.3: Wildland Fire Hazard Area, by Jurisdiction

| Jurisdiction | | Total Acres | Wildland Urban Interface Fire Hazard: In Hazard Area | Wildland Urban Interface Fire Hazard: % In Hazard Area |
|---|---|---|---|---|
| Bucoda | **Total** | **379.6** | **0.0** | **0.0%** |
| Lacey | City | 10549.7 | 2.2 | 0.0% |
| | UGA | 10645.1 | 61.1 | 0.6% |
| | **Total** | **21194.9** | **63.3** | **0.3%** |
| Olympia | City | 11858.8 | 306.8 | 2.6% |
| | UGA | 4119.2 | 875.7 | 21.3% |
| | **Total** | **15978.0** | **1182.4** | **7.4%** |
| Rainier | City | 1104.8 | 0.0 | 0.0% |
| | UGA | 319.5 | 0.0 | 0.0% |
| | **Total** | **1424.2** | **0.0** | **0.0%** |
| Tenino | City | 924.0 | 14.0 | 1.5% |
| | UGA | 65.2 | 46.3 | 71.0% |
| | **Total** | **989.3** | **60.3** | **6.1%** |
| Tumwater | City | 9274.2 | 0.0 | 0.0% |
| | UGA | 5811.5 | 194.1 | 3.3% |
| | **Total** | **15085.7** | **194.1** | **1.3%** |
| Yelm | City | 3633.7 | 0.0 | 0.0% |
| | UGA | 2395.9 | 0.0 | 0.0% |
| | **Total** | **6029.6** | **0.0** | 0.0% |
| Ground Mound UGA | **Total** | **982.9** | **250.1** | **25.4%** |
| Chehalis Tribe | **Total** | **832.6** | **788.7** | **94.7%** |
| Nisqually Tribe | **Total** | **1699.5** | **0.0** | **0.0%** |
| **Total Cities** | | **37724.9** | **323.0** | **0.9%** |
| **Total UGAs** | | **24339.4** | **1427.3** | **5.9%** |
| **Total Reservations** | | **2532.1** | **788.7** | **31.1%** |
| **Rural Unincorporated County** | | **406242.4** | **87939.0** | **7.5%** |
| **Thurston County Total** | | **470838.8** | **90477.9** | **19.2%** |

## Table 4.5.4: Wildland Fire Hazard Area, by Special Districts

| | | Total Acres | Wildland Urban Interface Fire Hazard | |
|---|---|---|---|---|
| | | | In Hazard Area | % in Hazard Area |
| **Fire Districts** | | | | |
| | Bucoda | 379 | 0 | 0% |
| | Olympia | 11,882 | 285 | 2% |
| | Tumwater[1] | 10,057 | 0 | 0% |
| 1,11 | Rochester/Littlerock[2] | 101,349 | 26,420 | 26% |
| 2,4 | Yelm/Rainer[2] | 83,420 | 2,509 | 3% |
| 3 | Lacey | 45,769 | 2 | 0% |
| 6 | East Olympia | 25,108 | 0 | 0% |
| 7 | North Olympia | 7,060 | 6,298 | 89% |
| 8 | South Bay | 13,113 | 8,601 | 66% |
| 9,5 | McLane/Black Lake[2] | 50,984 | 21,734 | 43% |
| 12 | Tenino | 44,254 | 9,564 | 22% |
| 13 | Griffin | 13,953 | 13,273 | 95% |
| 16 | Gibson Valley | 19,081 | 1,858 | 10% |
| 17 | Bald Hills | 44,962 | 33 | 0% |
| **School Districtsz** | | | | |
| Centralia | | 12,852 | 165 | 1% |
| Griffin | | 21,768 | 14,169 | 65% |
| North Thurston | | 48,504 | 8,508 | 18% |
| Olympia | | 51,918 | 20,799 | 40% |
| Rainier | | 35,550 | 0 | 0% |
| Rochester | | 68,314 | 24,089 | 35% |
| Tenino | | 70,501 | 9,564 | 14% |
| Tumwater | | 73,848 | 18,065 | 24% |
| Yelm | | 126,543 | 9,555 | 8% |
| **Other Participating Jurisdictions (Service Area)** | | | | |
| Intercity Transit | | 62,333 | 2,292 | 4% |
| LOTT* | | 21,160 | 309 | 1% |
| (*Sewered Area). | | | | |
| **Colleges** | | | | |
| SPSCC-Main Campus | | 92 | 0 | 0% |
| TESC - Main Campus | | 939 | 497 | 53% |
| **Non-Profit** | | | | |
| Providence St. Peter Hospital | | 157 | 0 | 0% |
| Note: The service areas for the following participating jurisdictions are multi-county: Thurston County PUD, Timberland Regional Library (see local annex for details) | | | | |

[1]Munn Lake Fire District 15 contracts services with the City of Tumwater Fire Department; its data is combined with Tumwater's
[2]Fire Districts 1 and 11, 2 and 4, 5 and 9 have joint operations agreements; therefore the data for the paired districts is combined.

## Table 4.5.5: Fire Hazard Area, Population by Jurisdiction, 2006 and 2030

| Jurisdiction | | 2006 Population Estimate | | | 2030 Population Forecast | | |
|---|---|---|---|---|---|---|---|
| | | Total | In Hazard Area | % in Hazard Area | Total | In Hazard Area | % in Hazard Area |
| Bucoda | **Total** | **650** | **0** | **0%** | **1,050** | **0** | **0%** |
| Lacey | City | 34,115 | 0 | 0% | 52,015 | 0 | 0% |
| | UGA | 32,820 | 215 | 1% | 54,740 | 365 | 1% |
| | **Total** | **66,935** | **215** | **0%** | **106,755** | **365** | **0%** |
| Olympia | City | 44,350 | 385 | 1% | 64,385 | 1,715 | 3% |
| | UGA | 10,820 | 2,475 | 23% | 17,710 | 3,800 | 21% |
| | **Total** | **55,170** | **2,860** | **5%** | **82,095** | **5,515** | **7%** |
| Rainier | City | 1,675 | 0 | 0% | 2,540 | 0 | 0% |
| | UGA | 115 | 0 | 0% | 355 | 0 | 0% |
| | **Total** | **1,790** | **0** | **0%** | **2,895** | **0** | **0%** |
| Tenino | City | 1,525 | 5 | 0% | 3,110 | 40 | 1% |
| | UGA | 20 | 5 | 25% | 475 | 430 | 91% |
| | **Total** | **1,545** | **10** | **1%** | **3,585** | **470** | **13%** |
| Tumwater | City | 15,475 | 0 | 0% | 27,610 | 0 | 0% |
| | UGA | 6,180 | 105 | 2% | 13,805 | 1,195 | 9% |
| | **Total** | **21,655** | **105** | **0%** | **41,415** | **1,195** | **3%** |
| Yelm | City | 4,570 | 0 | 0% | 21,025 | 0 | 0% |
| | UGA | 1,335 | 0 | 0% | 3,035 | 0 | 0% |
| | **Total** | **5,905** | **0** | **0%** | **24,060** | **0** | **0%** |
| Grand Mound UGA | **Total** | **845** | **390** | **46%** | **2,685** | **980** | **36%** |
| Chehalis Reservation[1] | **Total** | **35** | **35** | **100%** | **175** | **150** | **86%** |
| Nisqually Reservation[1] | **Total** | **635** | **0** | **0%** | **940** | **0** | **0%** |
| **Total Cities** | | **102,360** | **390** | **0%** | **171,735** | **1,755** | **1%** |
| **Total UGAs [2]** | | **52,140** | **3,190** | **6%** | **92,810** | **6,770** | **7%** |
| **Total Reservations[1]** | | **670** | **35** | **5%** | **1,115** | **150** | **13%** |
| **Rural Unincorporated County[3]** | | **75,880** | **27,240** | **36%** | **107,285** | **37,917** | **35%** |
| **Thurston County Total** | | **231,100** | **30,900** | **13%** | **372,900** | **46,600** | **12%** |

**Source**: Thurston Regional Planning Council Populaton Forecast, 2007.

**Explanations**: Numbers may not add due to rounding.

[1]Data is for Thurston County portion of reservation only.

[2]UGA - Urban Growth Area. Unincorporated area designated to be annexed into city limits over 20 years time to accommodate urban growth.

[3]Rural unincorporated county is the portion of the unincorporated county that lies outside UGA and Reservation boundaries.

## Table 4.5.6: Fire Hazard Area, Population - Special Districts, 2006 and 2030

| | | 2006 Population Estimate | | | 2030 Population Forecast | | |
|---|---|---|---|---|---|---|---|
| | | Total | In Hazard Area | % in Hazard Area | Total | In Hazard Area | % in Hazard Area |
| **Fire Districts** | | | | | | | |
| | Bucoda | 650 | 0 | 0% | 1,050 | 0 | 0% |
| | Olympia | 44,380 | 385 | 1% | 64,505 | 1,715 | 3% |
| | Tumwater[1] | 16,365 | 0 | 0% | 29,855 | 0 | 0% |
| 1,11 | Rochester/Littlerock[2] | 20,200 | 4,225 | 21% | 33,665 | 8,210 | 24% |
| 2,4 | Yelm/Rainer[2] | 19,390 | 1,405 | 7% | 43,935 | 1,655 | 4% |
| 3 | Lacey | 78,040 | 0 | 0% | 121,245 | 40 | 0% |
| 4 | Rainier | 4,705 | 145 | 3% | 8,095 | 220 | 3% |
| 6 | East Olympia | 11,815 | 0 | 0% | 17,430 | 0 | 0% |
| 7 | North Olympia | 3,920 | 3,620 | 92% | 4,730 | 4,360 | 92% |
| 8 | South Bay | 7,165 | 4,240 | 59% | 11,050 | 5,355 | 48% |
| 9,5 | McLane/Black Lake[2] | 14,990 | 11,660 | 78% | 21,420 | 16,625 | 78% |
| 12 | Tenino | 5,425 | 320 | 6% | 10,580 | 1,495 | 14% |
| 13 | Griffin | 5,075 | 4,960 | 98% | 6,870 | 6,740 | 98% |
| 16 | Gibson Valley | 465 | 10 | 2% | 1,430 | 295 | 21% |
| 17 | Bald Hills | 3,170 | 0 | 0% | 5,170 | 50 | 1% |
| **School Districts** | | | | | | | |
| Centralia | | 380 | 5 | 1% | 1,190 | 95 | 8% |
| Griffin | | 5,885 | 5,070 | 86% | 7,885 | 6,890 | 87% |
| North Thurston | | 85,305 | 4,190 | 5% | 131,365 | 5,335 | 4% |
| Olympia | | 58,000 | 12,075 | 21% | 83,735 | 17,375 | 21% |
| Rainier | | 4,580 | 0 | 0% | 16,110 | 0 | 0% |
| Rochester | | 12,555 | 2,430 | 19% | 19,380 | 5,920 | 31% |
| Tenino | | 9,175 | 320 | 3% | 17,985 | 1,495 | 8% |
| Tumwater | | 34,185 | 5,330 | 16% | 57,795 | 7,740 | 13% |
| Yelm | | 21,040 | 1,405 | 7% | 37,565 | 1,705 | 5% |
| **Other Participating Jurisdictions (Service Area)** | | | | | | | |
| Intercity Transit | | 143,815 | 3,705 | 3% | 236,195 | 6,705 | 3% |
| LOTT* | | 95,525 | 1,615 | 2% | 230,265 | 7,075 | 3% |

(*Sewered Area for 2006; Lacey, Olympia Tumwater UGA for 2030).

Note: The service areas for the following participating jurisdictions are multi-county or county-wide: The Evergreen State College, South Puget Sound Community College, Thurston County PUD, Port of Olympia, Timberland Regional Library

[1]Munn Lake Fire District 15 contracts services with the City of Tumwater Fire Department; its data is combined with Tumwater's
[2]Fire Districts 1 and 11, 2 and 4, 5 and 9 have joint operations agreements; therefore the data for the paired districts is combined.

## Table 4.5.7: Fire Hazard Area, Employment, 2006 and 2030

| Jurisdiction | | 2006 Employment Estimate | | | 2030 Employment Forecast | | |
|---|---|---|---|---|---|---|---|
| | | Total | In Hazard Area | % in Hazard Area | Total | In Hazard Area | % in Hazard Area |
| Bucoda | **Total** | **35** | **0** | **0%** | **175** | **0** | **0%** |
| Lacey | City | 21,955 | 0 | 0% | 34,120 | 0 | 0% |
| | UGA | 5,195 | 10 | 0% | 7,995 | 30 | 0% |
| | **Total** | **27,150** | **10** | **0%** | **42,115** | **30** | **0%** |
| Olympia | City | 53,400 | 80 | 0% | 70,870 | 215 | 0% |
| | UGA | 1,470 | 285 | 19% | 2,550 | 485 | 19% |
| | **Total** | **54,870** | **365** | **1%** | **73,420** | **700** | **1%** |
| Rainier | City | 375 | 0 | 0% | 1,065 | 0 | 0% |
| | UGA | 10 | 0 | 0% | 20 | 0 | 0% |
| | **Total** | **385** | **0** | **0%** | **1,085** | **0** | **0%** |
| Tenino | City | 810 | 0 | 0% | 2,100 | 0 | 0% |
| | UGA | 35 | 0 | 0% | 45 | 5 | 11% |
| | **Total** | **845** | **0** | **0%** | **2,145** | **5** | **0%** |
| Tumwater | City | 17,775 | 0 | 0% | 28,260 | 0 | 0% |
| | UGA | 2,270 | 10 | 0% | 4,850 | 105 | 2% |
| | **Total** | **20,045** | **10** | **0%** | **33,110** | **105** | **0%** |
| Yelm | City | 3,290 | 0 | 0% | 8,080 | 0 | 0% |
| | UGA | 325 | 0 | 0% | 545 | 0 | 0% |
| | **Total** | **3,615** | **0** | **0%** | **8,625** | **0** | **0%** |
| Grand Mound UGA | **Total** | **445** | **20** | **4%** | **1,110** | **110** | **10%** |
| Chehalis Reservation[1] | **Total** | **860** | **860** | **100%** | **2,450** | **2,450** | **100%** |
| Nisqually Reservation[1] | **Total** | **720** | **0** | **0%** | **1,650** | **0** | **0%** |
| **Total Cities** | | **97,640** | **80** | **0%** | **144,670** | **215** | **0%** |
| **Total UGAs [2]** | | **9,750** | **330** | **3%** | **17,120** | **740** | **4%** |
| **Total Reservations[1]** | | **1,580** | **860** | **54%** | **4,100** | **2,450** | **60%** |
| **Rural Unincorporated County[3]** | | **12,370** | **4,400** | **36%** | **18,795** | **6,805** | **36%** |
| **Thurston County Total** | | **121,300** | **5,700** | **5%** | **184,700** | **10,200** | **6%** |

**Source**: Thurston Regional Planning Council Populaton Forecast, 2007.

**Explanations**: Numbers may not add due to rounding.

[1]Data is for Thurston County portion of reservation only; includes Great Wolf Lodge in Chehalis Reservation.

[2]UGA - Urban Growth Area. Unincorporated area designated to be annexed into city limits over 20 years time to accommodate urban growth.

[3]Rural unincorporated county is the portion of the unincorporated county that lies outside UGA and Reservation boundaries.

## Table 4.5.8: Fire Hazard Area, Employment - Special Districts, 2006 and 2030

| | | 2006 Employment Estimate | | | 2030 Employment Forecast | | |
|---|---|---|---|---|---|---|---|
| | | Total | In Hazard Area | % in Hazard Area | Total | In Hazard Area | % in Hazard Area |
| **Fire Districts** | | | | | | | |
| | Bucoda | 35 | 0 | 0% | 175 | 0 | 0% |
| | Olympia | 53,445 | 80 | 0% | 71,015 | 215 | 0% |
| | Tumwater[1] | 18,545 | 0 | 0% | 29,290 | 0 | 0% |
| 1,11 | Rochester/Littlerock[2] | 5,460 | 1,555 | 28% | 11,570 | 4,025 | 35% |
| 2,4 | Yelm/Rainer[2] | 5,510 | 170 | 3% | 12,030 | 260 | 2% |
| 3 | Lacey | 29,625 | 0 | 0% | 45,875 | 5 | 0% |
| 4 | Rainier | 835 | 20 | 2% | 1,825 | 30 | 2% |
| 6 | East Olympia | 2,095 | 0 | 0% | 3,400 | 0 | 0% |
| 7 | North Olympia | 450 | 410 | 91% | 615 | 570 | 93% |
| 8 | South Bay | 1,110 | 540 | 49% | 1,645 | 700 | 43% |
| 9,5 | McLane/Black Lake[2] | 2,755 | 2,130 | 77% | 4,095 | 3,170 | 77% |
| 12 | Tenino | 1,240 | 45 | 4% | 3,075 | 150 | 5% |
| 13 | Griffin | 765 | 715 | 93% | 1,120 | 1,065 | 95% |
| 16 | Gibson Valley | 60 | 10 | 17% | 165 | 35 | 21% |
| 17 | Bald Hills | 240 | 0 | 0% | 610 | 5 | 1% |
| **School Districts** | | | | | | | |
| Centralia | | 40 | 5 | 13% | 115 | 15 | 13% |
| Griffin | | 850 | 730 | 86% | 1,230 | 1,085 | 88% |
| North Thurston | | 37,675 | 530 | 1% | 57,820 | 690 | 1% |
| Olympia | | 48,130 | 2,280 | 5% | 62,085 | 3,455 | 6% |
| Rainier | | 855 | 0 | 0% | 2,005 | 0 | 0% |
| Rochester | | 3,790 | 1,325 | 35% | 7,600 | 3,640 | 48% |
| Tenino | | 1,755 | 45 | 3% | 4,115 | 150 | 4% |
| Tumwater | | 22,170 | 580 | 3% | 36,835 | 900 | 2% |
| Yelm | | 6,090 | 170 | 3% | 12,880 | 265 | 2% |
| **Other Participating Jurisdictions (Service Area)** | | | | | | | |
| Intercity Transit | | 104,795 | 1,235 | 1% | 154,615 | 1,990 | 1% |
| LOTT* | | 90,055 | 85 | 0% | 148,645 | 835 | 1% |

(*Sewered Area for 2006; Lacey, Olympia Tumwater UGA for 2030).

Note: The service areas for the following participating jurisdictions are multi-county or county-wide: The Evergreen State College, South Puget Sound Community College, Thurston County PUD, Port of Olympia, Timberland Regional Library

[1]Munn Lake Fire District 15 contracts services with the City of Tumwater Fire Department; its data is combined with Tumwater's
[2]Fire Districts 1 and 11, 2 and 4, 5 and 9 have joint operations agreements; therefore the data for the paired districts is combined.

## Table 4.5.9: Fire Hazard Area, Residential Dwellings, 2006 and 2030

| Jurisdiction | | 2006 Dwelling Estimate | | | 2030 Dwelling Forecast | | |
|---|---|---|---|---|---|---|---|
| | | Total | In Hazard Area | % in Hazard Area | Total | In Hazard Area | % in Hazard Area |
| Bucoda | **Total** | **255** | **0** | **0%** | **420** | **0** | **0%** |
| Lacey | City | 14,995 | 0 | 0% | 23,390 | 0 | 0% |
| | UGA | 12,540 | 95 | 1% | 22,045 | 160 | 1% |
| | **Total** | **27,535** | **95** | **0%** | **45,435** | **160** | **0%** |
| Olympia | City | 20,820 | 165 | 1% | 31,655 | 780 | 2% |
| | UGA | 4,365 | 1,060 | 24% | 7,460 | 1,690 | 23% |
| | **Total** | **25,185** | **1,225** | **5%** | **39,115** | **2,470** | **6%** |
| Rainier | City | 610 | 0 | 0% | 1,045 | 0 | 0% |
| | UGA | 45 | 0 | 0% | 155 | 0 | 0% |
| | **Total** | **655** | **0** | **0%** | **1,200** | **0** | **0%** |
| Tenino | City | 700 | 0 | 0% | 1,320 | 15 | 1% |
| | UGA | 5 | 0 | 0% | 195 | 175 | 90% |
| | **Total** | **705** | **0** | **0%** | **1,515** | **190** | **13%** |
| Tumwater | City | 7,370 | 0 | 0% | 12,975 | 0 | 0% |
| | UGA | 2,555 | 40 | 2% | 5,785 | 490 | 8% |
| | **Total** | **9,925** | **40** | **0%** | **18,760** | **490** | **3%** |
| Yelm | City | 2,000 | 0 | 0% | 9,410 | 0 | 0% |
| | UGA | 515 | 0 | 0% | 1,255 | 0 | 0% |
| | **Total** | **2,515** | **0** | **0%** | **10,665** | **0** | **0%** |
| Grand Mound UGA | **Total** | **325** | **150** | **46%** | **1,125** | **405** | **36%** |
| Chehalis Reservation[1] | **Total** | **15** | **15** | **100%** | **70** | **60** | **86%** |
| Nisqually Reservation[1] | **Total** | **225** | **0** | **0%** | **360** | **0** | **0%** |
| **Total Cities** | | **46,750** | **170** | **0%** | **80,215** | **795** | **1%** |
| **Total UGAs [2]** | | **20,350** | **1,350** | **7%** | **38,020** | **2,920** | **8%** |
| **Total Reservations[1]** | | **240** | **15** | **6%** | **430** | **60** | **14%** |
| **Rural Unincorporated County[3]** | | **29,795** | **10,995** | **37%** | **44,260** | **15,980** | **36%** |
| **Thurston County Total** | | **97,100** | **12,500** | **13%** | **162,900** | **19,800** | **12%** |

**Source**: Thurston Regional Planning Council Populaton Forecast, 2007.

**Explanations**: Numbers may not add due to rounding.

[1]Data is for Thurston County portion of reservation only; includes Great Wolf Lodge in Chehalis Reservation.

[2]UGA - Urban Growth Area. Unincorporated area designated to be annexed into city limits over 20 years time to accommodate urban growth.

[3]Rural unincorporated county is the portion of the unincorporated county that lies outside UGA and Reservation boundaries.

## Table 4.5.10: Fire Hazard Area, Residential Dwellings - Special Districts, 2006 and 2030

| | | 2006 Dwelling Estimate | | | 2030 Dwelling Forecast | | |
|---|---|---|---|---|---|---|---|
| | | Total | In Hazard Area | % in Hazard Area | Total | In Hazard Area | % in Hazard Area |
| **Fire Districts** | | | | | | | |
| | Bucoda | 255 | 0 | 0% | 420 | 0 | 0% |
| | Olympia | 20,840 | 165 | 1% | 31,725 | 780 | 2% |
| | Tumwater[1] | 7,755 | 0 | 0% | 13,940 | 0 | 0% |
| 1,11 | Rochester/Littlerock[2] | 7,525 | 1,610 | 21% | 13,295 | 3,350 | 25% |
| 2,4 | Yelm/Rainer[2] | 7,810 | 575 | 7% | 19,010 | 715 | 4% |
| 3 | Lacey | 31,885 | 0 | 0% | 51,430 | 15 | 0% |
| 4 | Rainier | 1,825 | 60 | 3% | 3,400 | 95 | 3% |
| 6 | East Olympia | 4,550 | 0 | 0% | 7,015 | 0 | 0% |
| 7 | North Olympia | 1,690 | 1,565 | 93% | 2,150 | 1,990 | 93% |
| 8 | South Bay | 2,855 | 1,685 | 59% | 4,610 | 2,245 | 49% |
| 9,5 | McLane/Black Lake[2] | 6,000 | 4,525 | 75% | 8,830 | 6,645 | 75% |
| 12 | Tenino | 2,170 | 120 | 6% | 4,345 | 605 | 14% |
| 13 | Griffin | 2,315 | 2,260 | 98% | 3,315 | 3,255 | 98% |
| 16 | Gibson Valley | 175 | 5 | 3% | 580 | 120 | 21% |
| 17 | Bald Hills | 1,320 | 0 | 0% | 2,250 | 20 | 1% |
| **School Districts** | | | | | | | |
| Centralia | | 145 | 0 | 0% | 480 | 40 | 8% |
| Griffin | | 2,680 | 2,315 | 86% | 3,805 | 3,330 | 88% |
| North Thurston | | 35,325 | 1,665 | 5% | 56,380 | 2,235 | 4% |
| Olympia | | 25,740 | 4,835 | 19% | 39,095 | 7,180 | 18% |
| Rainier | | 1,780 | 0 | 0% | 7,180 | 0 | 0% |
| Rochester | | 4,570 | 930 | 20% | 7,515 | 2,445 | 33% |
| Tenino | | 3,600 | 120 | 3% | 7,335 | 605 | 8% |
| Tumwater | | 14,775 | 2,065 | 14% | 25,220 | 3,170 | 13% |
| Yelm | | 8,550 | 575 | 7% | 15,935 | 735 | 5% |
| Intercity Transit | | 62,475 | 1,310 | 2% | 105,855 | 2,460 | 2% |
| LOTT* | | 43,335 | 670 | 2% | 103,310 | 3,120 | 3% |

(*Sewered Area for 2006; Lacey, Olympia Tumwater UGA for 2030).

Note: The service areas for the following participating jurisdictions are multi-county or county-wide: The Evergreen State College, South Puget Sound Community College, Thurston County PUD, Port of Olympia, Timberland Regional Library

[1]Munn Lake Fire District 15 contracts services with the City of Tumwater Fire Department; its data is combined with Tumwater's
[2]Fire Districts 1 and 11, 2 and 4, 5 and 9 have joint operations agreements; therefore the data for the paired districts is combined.

## Table 4.5.11: Fire Hazard Area, Valuation of Building and Contents, 2006 and 2008

| Jurisdiction | | Residential | | | Commercial/Industrial | | | Government/Institutional | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Total (mil. $) | In Hazard Area | % in Hazard Area | Total (mil. $) | In Hazard Area | % in Hazard Area | Total (mil. $) | In Hazard Area | % in Hazard Area |
| Bucoda | **Total** | **$19** | **$0** | **0%** | **$1** | **$0** | **0%** | **$2** | **$0** | **0%** |
| Lacey | City | $1,944 | $0 | 0% | $1,265 | $0 | 0% | $433 | $0 | 0% |
| | UGA | $2,036 | $6 | 0% | $112 | $0 | 0% | $133 | $0 | 0% |
| | **Total** | **$3,980** | **$6** | **0%** | **$1,377** | **$0** | **0%** | **$567** | **$0** | **0%** |
| Olympia | City | $3,062 | $30 | 1% | $1,952 | $20 | 1% | $1,727 | $3 | 0% |
| | UGA | $930 | $215 | 23% | $43 | $10 | 23% | $17 | $1 | 4% |
| | **Total** | **$3,993** | **$245** | **6%** | **$1,994** | **$30** | **1%** | **$1,745** | **$4** | **0%** |
| Rainier | City | $70 | $0 | 0% | $6 | $0 | 0% | $28 | $0 | 0% |
| | UGA | $7 | $0 | 0% | $0 | $0 | 0% | $0 | $0 | 0% |
| | **Total** | **$77** | **$0** | **0%** | **$6** | **$0** | **0%** | **$28** | **$0** | **0%** |
| Tenino | City | $75 | $0 | 1% | $17 | $0 | 0% | $42 | $0 | 1% |
| | UGA | $1 | $0 | 22% | $0 | $0 | 0% | $0 | $0 | 0% |
| | **Total** | **$76** | **$1** | **1%** | **$17** | **$0** | **0%** | **$42** | **$0** | **1%** |
| Tumwater | City | $1,039 | $0 | 0% | $703 | $0 | 0% | $423 | $0 | 0% |
| | UGA | $395 | $8 | 2% | $119 | $0 | 0% | $18 | $0 | 0% |
| | **Total** | **$1,434** | **$8** | **1%** | **$822** | **$0** | **0%** | **$441** | **$0** | **0%** |
| Yelm | City | $266 | $0 | 0% | $127 | $0 | 0% | $140 | $0 | 0% |
| | UGA | $76 | $0 | 0% | $6 | $0 | 0% | $11 | $0 | 0% |
| | **Total** | **$342** | **$0** | **0%** | **$134** | **$0** | **0%** | **$151** | **$0** | **0%** |
| Grand Mound UGA | **Total** | **$15** | **$6** | **43%** | **$16** | **$2** | **14%** | **$15** | **$15** | **100%** |
| Chehalis Reservation[1] | **Total** | **$1** | **$1** | **100%** | **$9** | **$9** | **100%** | **$0** | **$0** | **0%** |
| Nisqually Reservation[1] | **Total** | **$11** | **$0** | **0%** | **$0** | **$0** | **0%** | **$50** | **$0** | **0%** |
| **Total Cities** | | **$6,476** | **$31** | **0%** | **$4,071** | **$20** | **0%** | **$2,797** | **$4** | **0%** |
| **Total UGAs [2]** | | **$3,460** | **$235** | **7%** | **$296** | **$12** | **4%** | **$194** | **$16** | **8%** |
| **Total Reservations[1]** | | **$12** | **$1** | **9%** | **$9** | **$9** | **100%** | **$50** | **$0** | **0%** |
| **Rural Unincorporated County[3]** | | **$5,672** | **$2,493** | **44%** | **$193** | **$44** | **23%** | **$755** | **$586** | **78%** |
| **Thurston County Total** | | **$15,620** | **$2,760** | **18%** | **$4,569** | **$85** | **2%** | **$3,796** | **$605** | **16%** |

**Source**: Thurston Regional Planning Council Populaton Forecast, 2007; Thurston County Assessor's Office; Local Jurisdictions.
**Explanations**: Numbers may not add due to rounding.
[1]Data is for Thurston County portion of reservation only.
[2]UGA - Urban Growth Area. Unincorporated area designated to be annexed into city limits over 20 years time to accommodate urban growth.
[3]Rural unincorporated county is the portion of the unincorporated county that lies outside UGA and Reservation boundaries.

## Table 4.5.12: Fire Hazard Area, Valuation of Building and Contents - Special Districts, 2006 and 2008

| | | Residential | | | Commercial/Industrial | | | Government/Institutional | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Total (mil. $) | In Hazard Area | % in Hazard Area | Total (mil. $) | In Hazard Area | % in Hazard Area | Total (mil. $) | In Hazard Area | % in Hazard Area |
| **Fire Districts** | | | | | | | | | | |
| | Bucoda | $19 | $0 | 0% | $1 | $0 | 0% | $2 | $0 | 0% |
| | Olympia | $3,064 | $30 | 1% | $1,952 | $20 | 1% | $1,727 | $3 | 0% |
| | Tumwater[1] | $1,091 | $0 | 0% | $755 | $0 | 0% | $424 | $0 | 0% |
| 1,11 | Rochester/Littlerock[2] | $1,383 | $255 | 18% | $135 | $25 | 19% | $166 | $21 | 13% |
| 2,4 | Yelm/Rainer[2] | $830 | $97 | 12% | $156 | $1 | 0% | $162 | $1 | 1% |
| 3 | Lacey | $4,783 | $0 | 0% | $1,415 | $0 | 0% | $640 | $0 | 0% |
| 4 | Rainier | $270 | $10 | 4% | $9 | $0 | 0% | $30 | $0 | 0% |
| 6 | East Olympia | $991 | $0 | 0% | $48 | $0 | 0% | $26 | $0 | 0% |
| 7 | North Olympia | $347 | $316 | 91% | $6 | $6 | 100% | $20 | $20 | 100% |
| 8 | South Bay | $719 | $445 | 62% | $20 | $9 | 47% | $13 | $10 | 77% |
| 9,5 | McLane/Black Lake[2] | $1,313 | $1,066 | 81% | $39 | $21 | 53% | $550 | $532 | 97% |
| 12 | Tenino | $313 | $23 | 7% | $29 | $0 | 0% | $45 | $0 | 1% |
| 13 | Griffin | $534 | $527 | 99% | $5 | $4 | 79% | $16 | $16 | 100% |
| 16 | Gibson Valley | $22 | $0 | 2% | $0 | $0 | 0% | $0 | $0 | 0% |
| 17 | Bald Hills | $211 | $0 | 0% | $8 | $0 | 0% | $4 | $0 | 0% |
| **School Districts** | | | | | | | | | | |
| Centralia | | $20 | $0 | 1% | $0 | $0 | 0% | $1 | $0 | 0% |
| Griffin | | $606 | $537 | 89% | $5 | $4 | 79% | $16 | $16 | 100% |
| North Thurston | | $5,475 | $441 | 8% | $1,931 | $9 | 0% | $642 | $10 | 2% |
| Olympia | | $4,540 | $1,152 | 25% | $1,500 | $43 | 3% | $2,151 | $553 | 26% |
| Rainier | | $258 | $0 | 0% | $9 | $0 | 0% | $30 | $0 | 0% |
| Rochester | | $572 | $103 | 18% | $75 | $23 | 30% | $107 | $21 | 20% |
| Tenino | | $536 | $23 | 4% | $42 | $0 | 0% | $49 | $0 | 1% |
| Tumwater | | $2,342 | $401 | 17% | $832 | $5 | 1% | $582 | $4 | 1% |
| Yelm | | $1,275 | $107 | 8% | $175 | $1 | 0% | $219 | $1 | 1% |
| **Other Participating Jurisdictions (Service Area)** | | | | | | | | | | |
| Intercity Transit | | $9,356 | $258 | 3% | $4,208 | $28 | 1% | $3,453 | $525 | 15% |
| LOTT* | | $6,438 | $179 | 3% | $3,604 | $19 | 1% | $2,443 | $2 | 0% |

*Sewered Area.

Note: The service areas for the following participating jurisdictions are multi-county or county-wide: The Evergreen State College, South Puget Sound Community College, Thurston County PUD, Port of Olympia, Timberland Regional Library

[1]Munn Lake Fire District 15 contracts services with the City of Tumwater Fire Department; its data is combined with Tumwater's
[2]Fire Districts 1 and 11, 2 and 4, 5 and 9 have joint operations agreements; therefore the data for the paired districts is combined.

### Table 4.5.13: Fire Hazard Area, Valuation of Building and Contents - Colleges, 2006 and 2008

| | Government/Institutional | | |
|---|---|---|---|
| | Total (mil. $) | In Hazard Area | % in Hazard Area |
| **College** | | | |
| The Evergreen State College | 505 | 505 | 100% |
| South Puget Sound Community College | 63 | 0 | 0% |

### Table 4.5.14: Fire Hazard Area, Valuation of Building and Contents - Multi-Country Districts, 2006 and 2008

| | Government/Institutional | | |
|---|---|---|---|
| | Total (1,000 $) | In Hazard Area | % in Hazard Area |
| **Thurston PUD** | | | |
| Thurston County | 1,780 | 114 | 6% |
| Lewis County | 1,046 | 166 | 16% |
| Grays Harbor County | 69 | 0 | 0% |
| Mason County | 63 | 0 | 0% |
| Pierce County | 1,204 | 15 | 1% |
| **Total** | 4,162 | 296 | 7% |
| **Timberland Regional Library** | | | |
| Thurston County | 6,700 | 0 | 0% |
| Lewis County | 4,533 | 2,291 | 51% |
| Grays Harbor County | 4,277 | 0 | 0% |
| Mason County | 5,273 | 0 | 0% |
| Pacific County | 2,698 | 0 | 0% |
| **Total** | 23,481 | 2,291 | 10% |

**Note**: The service areas for these jurisdictions are multi-county-wide

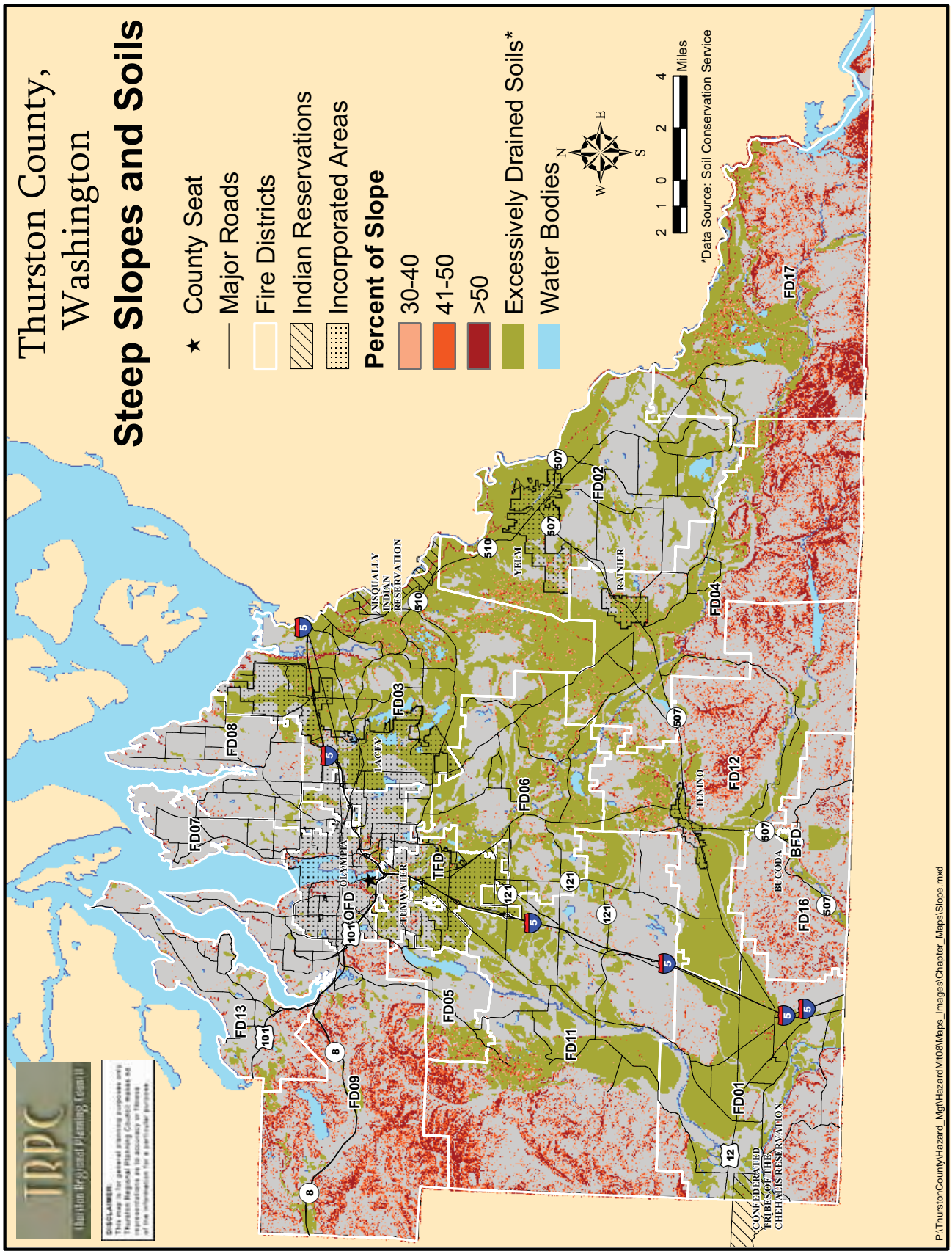
**Table 4.5.15: Fire Hazard Area, Valuation of Building and Contents - Colleges, 2006 and 2008**

| | Government/Institutional | | |
|---|---|---|---|
| | Total (mil. $) | In Hazard Area | % in Hazard Area |
| **Hospital** | | | |
| Providence St. Peter Hospital | 401 | 401 | 100% |

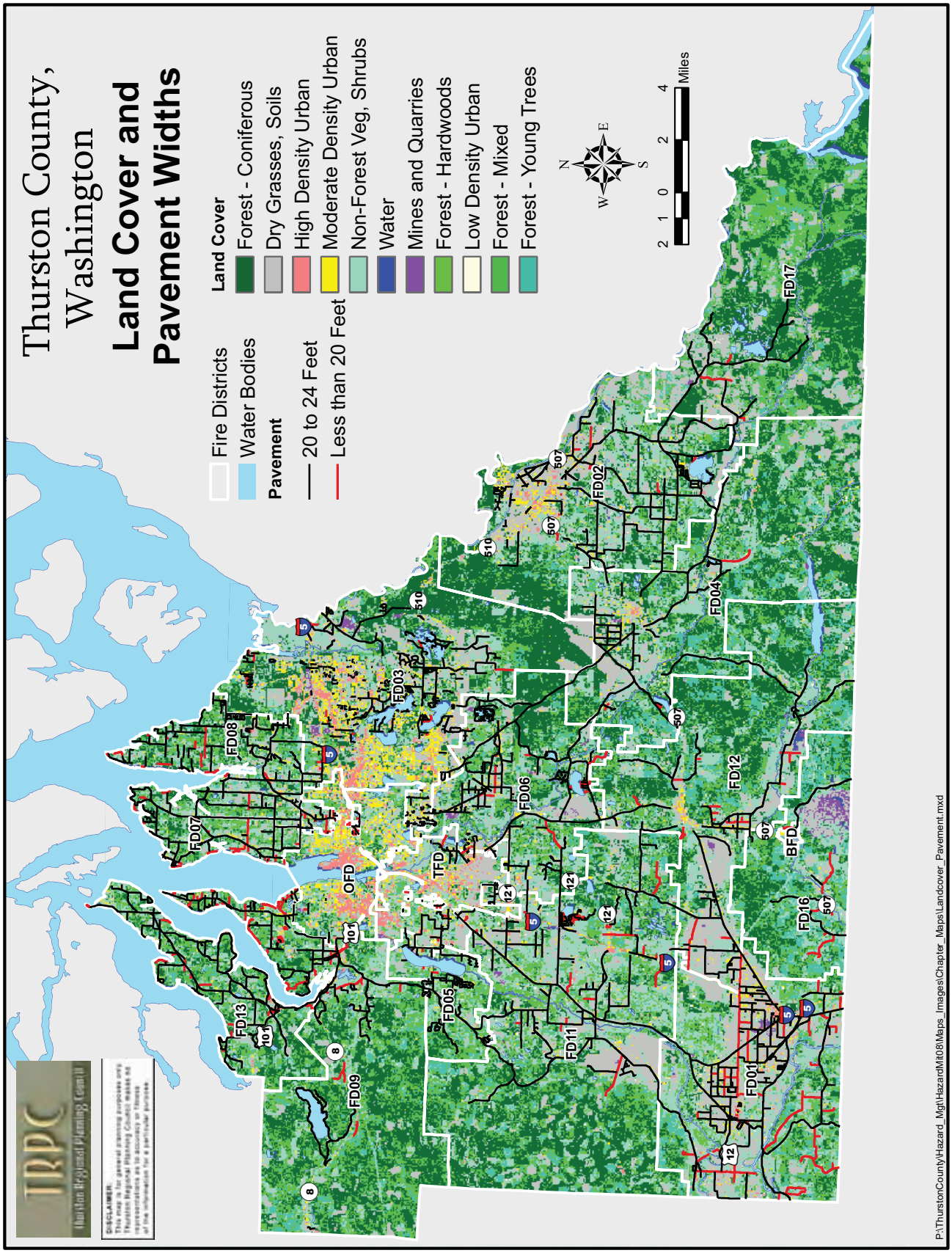
## Table 4.5.16: Critical Infrastructure in the Wildland Fire Hazard Area

| Critical Facility Sector and Subsector | Total | In Hazard Area | % In Hazard Area |
|---|---|---|---|
| **1. AGRICULTURE/FOOD SUPPLY** | **22** | **1** | 4.5% |
| 1.1 PRODUCTION | 2 | 1 | 50.0% |
| 1.2 FOOD DISTRIBUTION/STORAGE | 20 | 0 | 0.0% |
| **2. GOVERNMENT** | **135** | **17** | 12.6% |
| 2.1 FIRE SERVICES | 43 | 13 | 30.2% |
| 2.2 LAW ENFORCEMENT | 9 | 0 | 0.0% |
| 2.3 EMERGENCY OPERATIONS CENTERS | 11 | 0 | 0.0% |
| 2.4 CORONER/MORGUE | 1 | 0 | 0.0% |
| 2.5 SHELTER | 69 | 4 | 5.8% |
| 2.7 AMBULANCE | 3 | 0 | 0.0% |
| **4. MEDICAL CARE** | **84** | **2** | 2.4% |
| 4.1.A HOSPITALS | 4 | 0 | 0.0% |
| 4.1.B LARGE CLINICS | 36 | 0 | 0.0% |
| 4.1.B LARGE CLINICS - RURAL | 5 | 2 | 40.0% |
| 4.1.C URGENT CARE | 6 | 0 | 0.0% |
| 4.1.D SURGICAL SUITES | 6 | 0 | 0.0% |
| 4.2 CHEMICAL DEPENDENCY TREATMENT CENTER | 1 | 0 | 0.0% |
| 4.3A METHADONE | 1 | 0 | 0.0% |
| 4.3B DIALYSIS | 1 | 0 | 0.0% |
| 4.3C MENTAL HEALTH | 2 | 0 | 0.0% |
| 4.3D BIRTHING CENTERS | 2 | 0 | 0.0% |
| 4.4 NURSING HOMES | 7 | 0 | 0.0% |
| 4.5 ASSISTED LIVING FACILITIES | 13 | 0 | 0.0% |
| **5. UTILITIES** | **8** | **0** | 0.0% |
| 5.5 RADIO/TELEVISION | 2 | 0 | 0.0% |
| 5.6 DATA TRANSMISSION LINES | 1 | 0 | 0.0% |
| 5.8 SOLID WASTE MANAGEMENT | 5 | 0 | 0.0% |
| **6. TRANSPORTATION** | **16** | **1** | 6.3% |
| 6.3 ROADS - CENTERLINE MILES | 1951 | 630 | 32.3% |
| 6.4 VEHICLE FUEL | 4 | 0 | 0.0% |
| 6.5 STUDENT TRANSPORTATION | 8 | 1 | 12.5% |
| 6.6 MASS TRANSIT | 2 | 0 | 0.0% |
| 6.7 PORT | 1 | 0 | 0.0% |
| **Grand Total** | **265** | **21** | 0.0% |

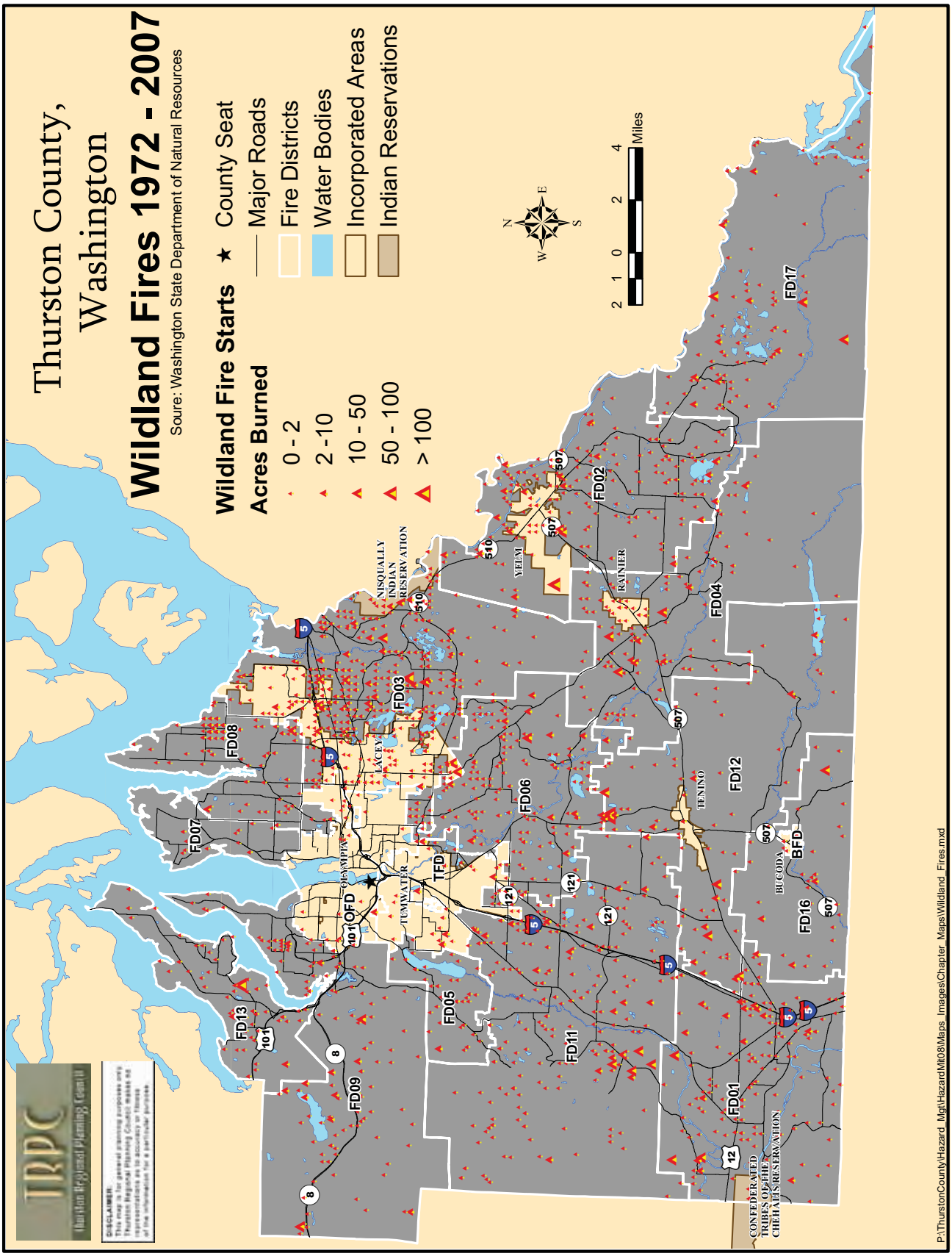
**Map 4.5.1**


Thurston County, Washington
Steep Slopes and Soils
County Seat
Major Roads
Fire Districts
Indian Reservations
Incorporated Areas
Percent of Slope
30-40
41-50
>50
Excessively Drained Soils*
Water Bodies
N
W
E
S
2 1 0 2 4
Miles
*Data Source: Soil Conservation Service
TRPC
Thurston Regional Planning Council
DISCLAIMER:
This map is for general planning purposes only. Thurston Regional Planning Council makes no representations as to accuracy or fitness of the information for a particular purpose.
FD07
FD08
FD13
FD09
FD05
FD11
FD06
FD03
FD02
FD04
FD12
FD16
FD17
FD01
OFD
TFD
BFD
OLYMPIA
LACEY
TUMWATER
NISQUALLY INDIAN RESERVATION
YELM
RAINER
TENINO
BUCODA
CONFEDERATED TRIBES OF THE CHEHALIS RESERVATION
P:\ThurstonCounty\Hazard_Mgt\HazardMit08\Maps_Images\Chapter_Maps\Slope.mxd

**Map 4.5.2**


Thurston County, Washington
Land Cover and Pavement Widths
Fire Districts
Water Bodies
Pavement
20 to 24 Feet
Less than 20 Feet
Land Cover
Forest - Coniferous
Dry Grasses, Soils
High Density Urban
Moderate Density Urban
Non-Forest Veg, Shrubs
Water
Mines and Quarries
Forest - Hardwoods
Low Density Urban
Forest - Mixed
Forest - Young Trees
N
W
E
S
2 1 0 2 4
Miles
FD01
FD02
FD03
FD04
FD05
FD06
FD07
FD08
FD09
FD11
FD12
FD13
FD16
FD17
OFD
TFD
BFD
P:\ThurstonCounty\Hazard_Mgt\HazardMit08\Maps_Images\Chapter_Maps\Landcover_Pavement.mxd

**Map 4.5.3**


Thurston County, Washington
Wildland Fires 1972 - 2007
Soure: Washington State Department of Natural Resources
Wildland Fire Starts
County Seat
Major Roads
Fire Districts
Water Bodies
Incorporated Areas
Indian Reservations
Acres Burned
0 - 2
2 -10
10 - 50
50 - 100
> 100
Miles
2 1 0 2 4
N
W
E
S
TRPC
Thurston Regional Planning Council
DISCLAIMER:
This map is for general planning purposes only. Thurston Regional Planning Council makes no representations as to accuracy or fitness of the information for a particular purpose.
FD07
FD08
FD13
FD09
FD05
FD11
FD06
FD03
FD02
FD04
FD12
FD01
FD16
FD17
OFD
TFD
BFD
OLYMPIA
TUMWATER
LACEY
NISQUALLY INDIAN RESERVATION
YELM
RAINER
TENINO
BUCODA
CONFEDERATED TRIBES OF THE CHEHALIS RESERVATION
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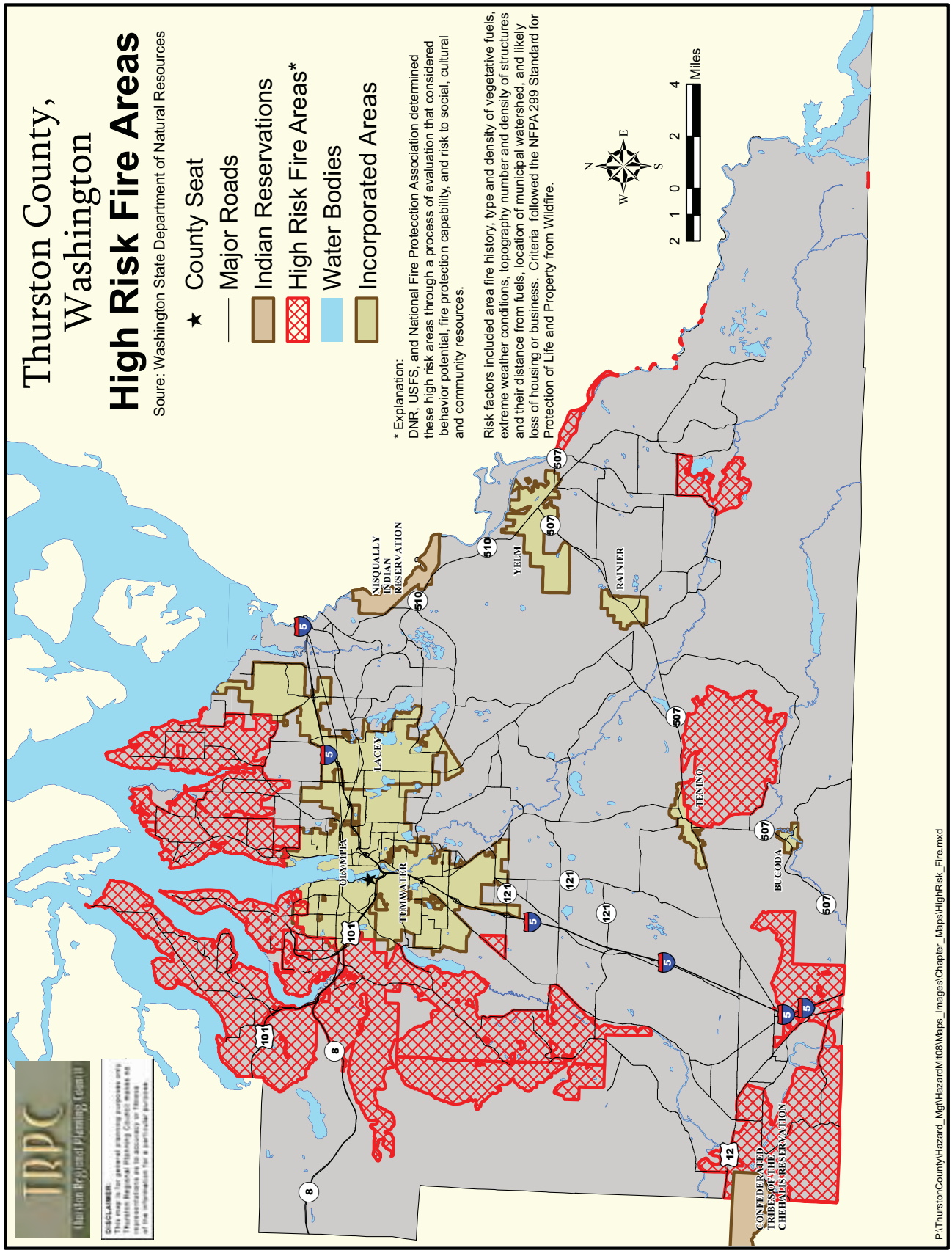
**Map 4.5.4**


Thurston County, Washington
High Risk Fire Areas
Soure: Washington State Department of Natural Resources
County Seat
Major Roads
Indian Reservations
High Risk Fire Areas*
Water Bodies
Incorporated Areas
* Explanation:
DNR, USFS, and National Fire Protection Association determined these high risk areas through a process of evaluation that considered behavior potential, fire protection capability, and risk to social, cultural and community resources.
Risk factors included area fire history, type and density of vegetative fuels, extreme weather conditions, topography number and density of structures and their distance from fuels, location of municipal watershed, and likely loss of housing or business. Criteria followed the NFPA 299 Standard for Protection of Life and Property from Wildfire.
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Miles
NISQUALLY INDIAN RESERVATION
YELM
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TENINO
BUCODA
CONFEDERATED TRIBES OF THE CHEHALIS RESERVATION
P:\ThurstonCounty\Hazard_Mgt\HazardMit08\Maps_Images\Chapter_Maps\HighRisk_Fire.mxd

## Wildfire Endnotes

[1]Washington State Emergency Management Division. 2007. Washington State Hazard Mitigation Plan.
[2]Ibid
[3]Washington State Department of Natural Resources. 2008. Wildland Fire Starts GIS Database. WA Department of Natural Resources, Resource Protection Division.
[4]Ibid
[5]Diane Huber. 2006. Volatile Brush Erupts – Eight Acres Burn in Lacey; Conditions Ripe for more Fires. The Olympian. September 1, 2006.
[6]Scott Gutierrez. 2003. Fireworks Spark 3-Acre Blaze. The Olympian, July 4, 2003.
[7]Jim Carlile. 2002. Lacey Brush Fire Chars 15 Acres. The Olympian. April, 5, 2002.
[8]Liona Tannesen. 2001. Brush Fire Draws Swift Response. The Olympian, August 21, 2001.
[9]Jerry Weatherhogg and Joel Coffidis. 1998. Brush Blazes Spread Havoc. The Olympian. August 6, 1998.
[10]Washington State Emergency Management Division. 2007.
[11]Skagit County. 2003. Skagit County Natural Hazards Mitigation Plan.

# Chapter 4.6: Volcanic Hazard Profile

## Introduction

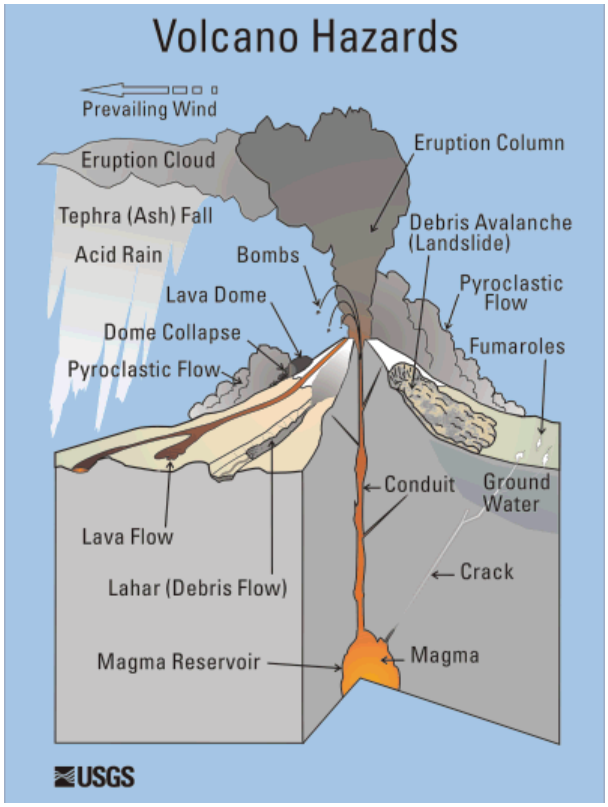
There are five major Cascade volcanoes in Washington State: Mount Baker, Glacier Peak, Mount Rainier, Mount St. Helens, and Mount Adams. In the last 4,000 years, 11 Cascade volcanoes have erupted an estimated 100 times; a rate of two events per century.[1] The May 18, 1980 eruption of Mount St. Helens reminds Washington residents that dormant Cascade volcanoes can reawaken with destructive forces and severely impact surrounding communities causing loss of life. The 1980 eruption killed 57 people and caused damage that exceeded one billion dollars.

Two of the most active and hazardous volcanoes in the United States, Mount Rainier, and Mount St. Helens, are located only 22 and 39 miles, respectively, from the southeast corner of Thurston County near Alder Lake. The proximity of these mountains to Thurston County communities increases the region's risk for disasters initiated from a volcanic event. The region has a low risk for ash fall, but a moderate risk for a large volcanic mudflow know as a lahar.

## Hazard Identification

The Cascade Range is approximately 700 miles long and it extends north-south from British Columbia, Canada to northern California. It contains over a dozen active volcanoes.[2] These mountains have been erupting and reshaping over the last 500,000 years. Cascade volcanoes are typically conical shaped mountains surrounding a vent that is connected to a reservoir of molten rock below the surface of the earth. Gas, ash, ballistic projectiles, rock fragments, and magma are forced to the surface through these vents from rising pressures within the earth's interior. The volcanoes were formed through the buildup of their own eruptive materials combined with catastrophic loss events such as landslides, lahars, and gradual erosion from glaciers.

**Figure 4.6.1: Volcanic Hazards**




Graphic courtesy of USGS

Many volcanic events such as pyroclastic flows, lava flows, landslides, and explosive blasts can devastate an area of ten miles or greater from the source of the eruption (Figure 4.6.1). Although these events can destroy flora, fauna, human life, and almost every structure in their path, their geographical range of destruction is limited (Map 4.6.1). Should Mount Rainier erupt, the direct devastation from these types of events would be likely limited to the area within the boundary of Mount Rainier National Park.[3]

An explosive eruption could create an ash plume that could conceivably deposit ash all across Thurston County. A volcanic event could trigger large debris and mudflows, known as a lahar. A lahar could originate on the flanks of the mountain and flow downhill and create a path of destruction and inundation all the way to the Puget Sound via the Nisqually River Valley. These two volcanic hazards are the most likely to affect the Thurston Region and are included in this hazard profile.

## 1. Tephra Hazard

### Definition

Tephra is the term for volcanic dust and rock fragments blasted into the air from an explosive volcanic eruption. It can produce a hazardous plume or column of debris that subsequently falls to the ground in the direction of prevailing winds (Figure 4.6.1). Tephra plumes can travel for hundreds of miles and deposit ash along its path. Airborne particle suspension diminishes as tephra columns increase in elevation and distance from the volcano. Both the thickness of the deposition and the size of the particles also decrease with increasing distance from the site of eruption. The following terms are used to describe the various sizes of tephra:

a. Ash: dust particles less than 2mm diameter
b. Lapilli: small rock fragments from 2mm to 64mm
c. Blocks or Bombs: tephra greater than 64 mm

### Severity

Mount Rainier is only 22 miles from the border of south east Thurston County. With the right winds, the entire County could conceivably be blanketed with ash. The severity of the hazard would depend on the thickness of the ash deposition. The 1980 eruption of Mount St. Helens blew an ash column 15 miles into the atmosphere above the crater. Over the course of the day of the eruption, nearly 540 million tons of ash was blown by winds to the east.[4] Fallout from the ash created complete darkness in Spokane, nearly 250 miles away; dropping one half inch of ash only a few hours after the start of the eruption.

### Impacts

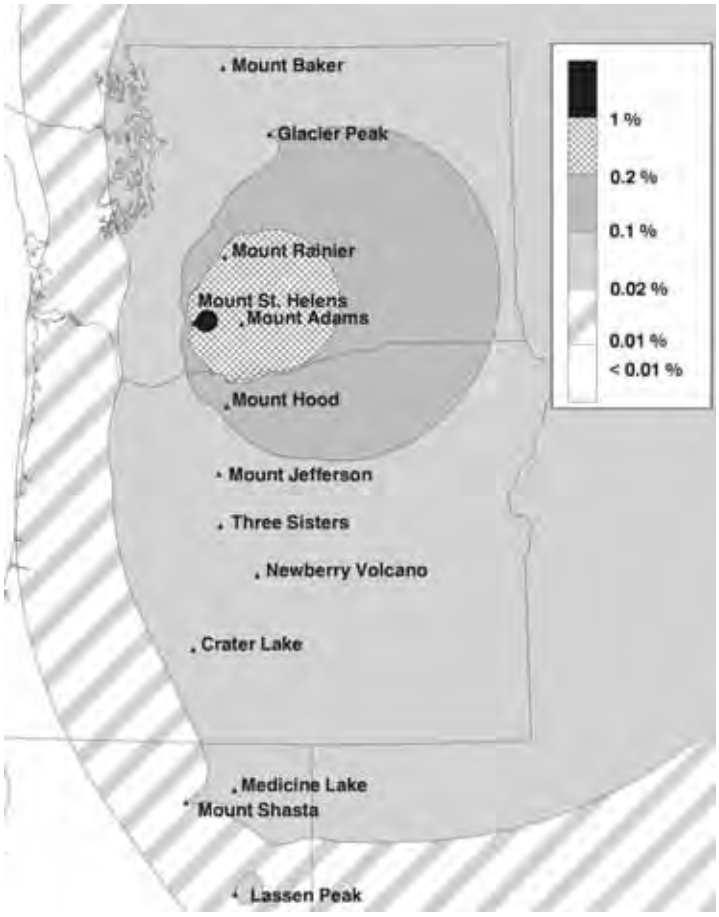
Ash fall of a quarter inch or more will reduce motorists' visibility and disrupt nearly every mode of transportation. Wet ash could create hazardous driving conditions and result in traffic injuries or fatalities. Aircraft is especially vulnerable as ash may disable engines and completely obscure pilots' visibility. Air transportation would be grounded in the affected area as long as conditions pose a hazard. Inhalation of ash particles could cause respiratory irritation and pose more serious problems for people with asthma or other respiratory diseases, but this could be mitigated by simply avoiding exposure. Ash can destroy agricultural crops, contaminate surface water sources, clog drainage and sewer systems, and inhibit or destroy mechanical systems such as outdoor heating, ventilation, and air conditioning systems. Ash fall of just a few inches in depth could exceed the load capacity of some building rooftops and lead to structural failure. Failure could occur with lower depths if ash absorbed subsequent precipitation. Wet ash has been known to cause power lines to short out.

Clean up and recovery would likely be the greatest cost to both the public and private sector. The 1980 eruption of Mount St. Helens posed a major nuisance for communities in Eastern Washington. In Yakima, ash removal took ten weeks and cost $2.2 million.[5]

### Probability of Occurrence

The United States Geological Survey reports that Mount Rainier has only produced moderate quantities of ash in past eruptions. The eruption of Mount St. Helens in 1980 did deposit a scant layer of ash in Thurston County, but the fallout did not pose a significant hazard to the region. Thurston County winds prevail from the south and west, therefore ash is more likely to fall on the east side of the Cascades than the west side. If Mount Rainier or Mount St. Helens were to erupt, a resultant ash plume would require an easterly wind to deposit ash in Thurston County. The USGS calculated that the annual probability for a significant ash deposit of one centimeter or greater in Thurston County is 0.02 percent for the south eastern third of the county and 0.01 percent for the northwestern two-thirds of the county (Figure 4.6.2).[6] This hazard has a low probability of occurrence.

**Figure 4.6.2: Total Cascades Tephra Hazard**




Annual probability of the deposition of 1 centimeter or more of tephra (ash) from any of the major Cascade Volcanoes. Graphic Courtesy of U.S.G.S.

## 2. Lahar Hazard

### Definition

United States Geological Service (USGS) defines a lahar as follows:

> *A lahar is a flowing mixture of water-saturated debris that moves downslope under the force of gravity. Debris flows consist of material varying in size from clay to blocks several tens of meters in maximum dimension. When moving, they resemble masses of wet concrete and tend to flow downslope along channels or stream valleys. Debris flows are formed when loose masses of unconsolidated wet debris become unstable. Water may be supplied by rainfall or by melting of snow or ice. Debris flows may be formed directly if lava or pyroclastic flows are erupted onto snow and ice. Debris flows may be either hot or cold, depending on their manner of origin and temperature of their constituent debris.*[7]

The scientific literature for Cascade lahars identifies several size and origin classifications. Lahars can be both large and small. The USGS has summarized two types of Mount Rainier lahar origination events that could pose a hazard to the Nisqually River valley:

a. **Meltwater Generated Lahar** – A volcanic eruption can produce an explosive event which releases a mixture of hot gases and rock debris, known as a pyroclastic flow. A pyroclastic flow behaves almost like a fluid and flows down the topography of the mountain. This hot churning debris flow swiftly melts snow and ice and subsequently mixes with the meltwater to form a lahar. Such lahars are often preceded by volcanic events or seismic activity which can provide some warning of an impending eruption. Geological evidence indicates that several of Mount Rainier's past lahars were formed by this phenomenon.

b. **Landslide Generated Lahars** - Landslides can occur on the flanks of Mount Rainier that can displace significant volumes of earth and water to form a substantial lahar. Magma can rise and force pressure against the internal structures of a mountain causing deformation and destabilization of the mountain's edifice. A modern example of this type of effect occurred with the bulge that formed on the north flank of Mount St. Helens in the months preceding the May 18, 1980 eruption. This bulge eventually collapsed creating one of the largest known landslides in modern times. Earthquakes can also initiate a landslide of unstable structures. Landslides can also occur from an eventual failure of a rock mass's cohesive strength. Rocks can be weakened by the chemical action of acidic fluids that are created from volcanic gases, heat and ground water. Overtime this acidic fluid infiltrates the rock and eventually converts the hard volcanic rock into weak, clay-rich rock. This process is called hydrothermal alteration or metamorphism. These altered rocks and water-saturated clay-rich deposits could eventually slough away from the mountain from the force of a volcanic eruption. These landslides can rapidly transform into a lahar. Many large scale lahars on Mount Rainier have formed in this fashion. Hydrothermally altered rock landslides have also produced lahars without the trigger of a volcanic eruption. One such lahar, known as the 500-year-old Electron Mudflow, is believed to have originated without a volcanic eruption. No eruptive volcanic deposits have been discovered that coincide with the age of this lahar. This lahar deposited debris as high as 20 feet thick, and contains remnants of an old-growth forest in the vicinity of the City of Orting in Pierce County.

## Severity

At 14,410 feet, Mount Rainier is the highest peak in the Cascade Range. The mountain is estimated to contain nearly one cubic mile of glacial ice, more than all of the other Cascade volcanoes combined.[8] The total mass of rock and glacial ice in combination with its precipitous slopes, incised steep valleys, and its history of volcanic activity, supply the mountain's potential to unleash destructive lahars in the future. The sheer volume, mass, rate of speed, and churning contents of a massive debris flow could destroy virtually all human made structures in its path. Past Cascade lahars surged nearly 45 to 50 miles per hour at steep slopes and were 100 feet or more thick. Scientists have identified more than 60 lahars that have originated from Mount Rainier in the past 10,000 years. Deposits of past lahars are found in all of the valleys that originate on Mount Rainier's flanks.[9] The Washington State Hazard Mitigation Plan states that more than 150,000 people live on historic lahar deposits in the Puget Sound lowlands. The USGS rates the risk of a large lahar from

Mount Rainier, to the surrounding Western Washington population, as the Puget Sound Region's greatest volcanic hazard.

Scientific research and mapping of hydrothermally altered rocks[10] on Mount Rainier's high altitude slopes suggests that the west flank of the mountain, including the head of the Puyallup River, has the greatest potential for generating large landslides that are likely to initiate far reaching lahars. The Puyallup River valley, and to a lesser extent, the Nisqually River valley, whose basin also includes weakened rock, are at most risk from large landslide-generated lahar events. Lahars generated by eruptions could descend any of the mountain's valleys.[11]

Scientists with the USGS have studied artifacts from past lahars to predict what future vulnerabilities may be. Deposits are analyzed to determine the types, frequencies, and magnitude of past events. Through these studies, scientists predicted a potential inundation hazard in the lower Nisqually River valley caused by a lahar entering and possibly flowing beyond Alder Reservoir. Because Alder Dam exists for power generation, Alder Lake is never empty. Scientists are concerned that a lahar entering the reservoir could either cause dam failure or catastrophically displace a significant volume of the water in storage.

The Alder Dam and the Alder Lake Reservoir, owned and operated by Tacoma Power for power generation, creates uncertainty about the potential lahar flow dynamics downstream from the dam. This dam is vulnerable to a Case 1 Lahar. The travel time of a Case 1 flow from the edifice of Mount Rainier to the reservoir could be less than two hours. High reservoir water levels do not offer sufficient capacity to contain the volume of the lahar flow. Scientists report that the reservoir is most vulnerable to failure caused by a wave of translation, because the relatively confined valley upstream is capable of conveying a large lahar without great volume loss.[12] A wave of translation would likely cause water to overtop the dam and send waves of water downstream from the reservoir. Smaller lahars entering the reservoir may not pose immediate risks for downstream flooding, but could increase the rate of sedimentation for the dam and thereby shorten its term of operation.

The 1999 Tacoma Power "Emergency Action Plan for the Nisqually Hydroelectric Project FERC Project No. 1862 [LaGrande and Alder Dams]" includes the following excerpt:

> *Another possible [hazard] event is that of a lahar or mudflow originating from Mt. Rainier. Travel time of a lahar or mudflow to Alder lake is estimated between 0.5 and 4.2 hours. Most lahars having sufficient volume to cause a significant rise in the lake level will travel in less than 2 hours. Because of the rapid nature of the inflow, it is not possible to affect any meaningful advance spill to increase reservoir capacity. An advance spill of 20,000 cfs for one hour will only yield approximately ½-foot of reservoir capacity at full lake. Therefore, should lake levels rise rapidly (>3 feet/hour) no spill is recommended and evacuation to an observation post should be made. The combined outflow of both a large spill and overtopping may be more adverse than would result from overtopping only. In the unusual case of a lahar causing more gradual rise in inflow, spill could be implemented, but is not recommended unless reduction in spill can be made remotely. Rapid evacuation should be planned prior to local operation of the spillway.*

There are no lahar sensors on the southwest flank of Mount Rainier that would provide a notification of a pending lahar in the Nisqually River valley, but sensors and gauges at the Alder Dam would provide indication of changes in the level of water at the reservoir. Tacoma Power would notify multiple emergency response agencies if failure of the Alder or LaGrande Dams seemed imminent. Those agencies receiving a notification include Washington State Military Department and Emergency Management Division, Washington State Patrol, Washington State Department of Transportation, the National Weather Service, Thurston County Emergency Management Division, the City of Yelm Police Department, and the Nisqually Indian Tribe Police. Residents within the Nisqually River valley could evacuate to higher ground if given sufficient warning of a catastrophic dam failure. The Alder and LaGrande Sequential Dam Failure Flood Inundation zones approximate the USGS's extent of the inundation zone for a Case 1 lahar in the Nisqually River valley (Map 4.6.1).

Should a Case 1 lahar adversely affect the Alder dam, flood inundation could occur at the Nisqually River bridge at SR507 (McKenna, Pierce Co.) in two hours and 30 minutes. The inundation would peak at this same location in four hours and 36 minutes.[13]

## Impacts

Case 1 lahars could be high in consequence and pose a major hazard to human life and property in the Nisqually River valley should the Alder and LaGrande dams fail. The major hazard to human life is from debris flows with the potential to bury or smash those in its path. Up river from the reservoir, people and animals could be severely burned by such flows carrying hot debris. Buildings and other structures in the path of a debris flow can be buried or carried away. Because of their relatively high density and viscosity, these flows can move and even carry away vehicles and other objects as large as bridges. The following major bridges/routes are located within the Case 1 inundation zone and could be adversely impacted or destroyed: State Route 507 Bridge between Yelm and McKenna, Old Pacific Highway, and Interstate 5. There are also three railroad bridge crossings: the Tacoma Rail Mountain Division railroad, the Yelm Prairie Line (non-operational), and the Burlington Northern Santa Fe mainline near I-5.

Because debris flows are confined to areas down-slope and down-valley from their points of origin, people can avoid them by seeking high ground. The debris-flow hazard decreases gradually down-valley from possible source volcanoes, but more abruptly with increasing altitude above valley floors. People seeking to escape flows should climb valley sides rather than try to outrun the flows in valley bottoms. During eruptive activity or precursors to eruptions, local government officials may ask for prompt evacuation of areas likely to be affected.

## Probability of Occurrence

The historical occurrences of Lahars have been classified by size. The largest lahar, historically represented by the Osceola mudflow, is designated a Case M Lahar for a maximum lahar event. Scientists offer this scenario as "low probability and high consequence," with the implication that the risk may be unacceptable at even very small probabilities.[14] This lahar is estimated to occur about every 10,000 years. When compared with other historic lahars from postglacial times, scientists

consider this maximum lahar a statistical outlier. There is no geologic record of a Case M Lahar affecting Thurston County.

A Case 1 lahar originating from Mount Rainier is considered by scientists to be the most appropriate planning case scenario for hazard mitigation planning.[15] This type of lahar event is best historically represented by the Electron Mudflow. The risk of this lahar type exceeds that of all smaller but more frequent flows. In addition, the risk is increased by a potential to occur without a major volcanic eruption, which may not afford downstream populations an early warning. A non-eruptive event could be initiated by non-magmatic seismic activity, by steam eruptions, or just by gravity in places where a failure plane has been lubricated by clay and hydrothermal fluids. This lahar is estimated to have a recurrence interval of approximately every 500 to 1,000 years. The probability of a Case 1 Lahar is low.

## Historical Occurrences and Impacts of Lahar Hazards in Thurston County

Historically, lahars originating from Mount Rainier have been a fairly common occurrence; they vary in size and magnitude and are fairly unpredictable. No significant lahars have impacted Thurston County in modern times. Past Nisqually River valley lahars are known to have flowed down the slopes of Mount Rainier all the way to the Puget Sound. The USGS provides the following short history of major lahar events originating from Mount Rainier:

> *The largest lahar originating at Mount Rainier in the last 10,000 years is known as the Osceola Mudflow. This cohesive lahar, which occurred about 5600 years ago, was at least 10 times larger than any other known lahar from Mount Rainier. It was the product of a large debris avalanche composed mostly of hydrothermally-altered material, and may have been triggered as magma forced its way into the volcano. Osceola deposits cover an area of about 550 square kilometers (212 square miles) in the Puget Sound lowland, extending at least as far as the Seattle suburb of Kent, and to Commencement Bay, now the site of the Port of Tacoma. The communities of Orting, Buckley, Sumner, Puyallup, Enumclaw, and Auburn are also wholly or partly located on top of deposits of the Osceola Mudflow and, in some cases, of more recent debris flows as well.*
>
> *At least six smaller debris avalanches have spawned lahars in the past 5,600 years. One of these, the Electron Mudflow, which was derived from a slope failure on the west flank of Mount Rainier about 600 years ago, has not been correlated with an eruption. The Electron Mudflow was more than 30 meters (yards) deep where it entered the Puget Sound lowland at the community of Electron. Its deposits at Orting are as much as 6 meters (yards) thick and contain remnants of an old-growth forest.*
>
> *Large non-cohesive lahars at Mount Rainier are associated with volcanism. About 1,200 years ago, a lahar of this type filled valleys of both forks of the White River to depths of 20 to 30 meters (60 to 90 feet) and flowed 100 km (60 miles) to Auburn. Hot rock fragments flowing over glacier ice and snow generated huge quantities of melt water, which mixed with the rock debris to form lahars. Less than 2200 years ago, another lahar of similar origin, named the*

*National Lahar, inundated the Nisqually River valley to depths of 10 to 40 meters (30-120 feet) and flowed all the way to Puget Sound. More than a dozen lahars of this type have occurred at Mount Rainier during periods of volcanism in the past 6,000 years.*[16]

### Delineation of Hazard Area

The U.S. Geological Survey has mapped the potential inundation zone for Case I lahar. Map 2 shows the lahar hazard area for Thurston County.[17] On the lower Nisqually River below Alder Dam, the inundation area shown downstream from Alder Dam is a sub-case of the Case I lahar. Inundation could result from dam failure caused by lahar impact, displacement by the lahar of some of the water impounded by the Alder Lake and LaGrande reservoirs, or possible continuation of the lahar past the dam site. Some part of a Case I lahar may be impounded by the reservoir. Thus, without dam failure, lahar-related inundation downstream from Alder Dam would most probably affect less area than shown in Map 4.6.2. Table 4.6.1 shows the size of the Case 1 Lahar hazard area by jurisdiction.

### Communities Most Vulnerable to a Lahar

Based on the Case 1 lahar scenario, properties along the Nisqually River Valley are the most susceptible to lahar inundation. Following the Nisqually River southeast to northwest, the following general vicinities and communities along the Nisqually River may be most affected under this scenario:

- Properties north of Clear Lake along Peissner Rd SE and Hobson Rd SE
- Properties north east of Bald Hills Rd in the vicinity of Cook Rd SE and Dan Cook St SE
- McKenna Elementary School (Pierce County), Yelm Community School District
- Properties between the Nisqually River and the Yelm Urban Growth Area Boundary in the vicinity of Bridge St SE and Flume Rd SE
- Properties northeast of Yelm in the north east section of the Nisqually Pines residential community in the vicinity of Port Orford Blvd SE , Heather Ln SE, and Briar St SE
- The City of Centralia Power Plant off Mud Run Road (eight employees and family members live on site)[18]
- Properties along the entire eastern half of the Nisqually Indian Reservation east of the Nisqually River
- Virtually all properties in the Nisqually Valley from Durgin Rd SE north to the Puget Sound.

## Population and Employment in the Hazard Area

Tephra falls would likely affect the entire County. As a result, tephra hazard area tables were not developed. The “Total” columns in the Population and Assets tables provided for the lahar hazard provides information in assessing the population and assets at risk from this countywide hazard.

Approximately 2,900 residents (1 percent) and 500 employees live and work in the area designated as at risk for a Case 1 Lahar. Estimates of the region’s population and employment in the lahar hazard area is summarized in tables 4.6.3 through 4.6.6. The population and employment in the tephra fall hazard zone is represented by the “total” columns. These table assesses an aspect of

current and future vulnerability by providing data on the number of people living and working within the hazard area as compared to total population, by jurisdiction, in the years 2006 and 2030.

## Inventory of Assets and Dollar Value in the Hazard Area

Estimates of the region's structures and their contents in the lahar hazard area is summarized in tables 4.6.7 through 4.6.13. These tables provide an estimate of the number of existing and future structures which are potentially impacted by the hazard, as well as an estimate of structure and building contents value in order to provide information on potential dollar losses. Tables are provided by jurisdiction, for the years 2006 and 2030.

## Critical Facilities and Infrastructure in Hazard Area

A lahar could destroy or damage facilities that may be critical for responding to the disaster and for maintaining a safe environment and public order, particularly roads, rail lines and bridges. Wired communication infrastructure, power lines; water storage, purification, and pumping facilities. Nearly 23 centerline miles of State and County owned roads in Thurston County could be inundated or destroyed by a Case 1 Lahar. Table 4.6.14 lists the type and number of critical facilities located in the Case 1 Lahar hazard area.

## Summary Assessment

Under certain wind conditions a tephra fall could adversely affect the entire county. The effects would not pose immediate life threatening conditions to the population, but the clean up and recovery costs could be significant. Therefore the region is moderately vulnerable to a tephra fall. The probability of ash deposition is very low, so overall the risk of ash fall to the Thurston Region is low.

A lahar could pose immediate danger to the nearly 2,900 residents and 500 employees that live and work in the lahar hazard zone. Although no lahar warning system exists for the upper Nisqually River valley, the Tacoma Power Alder and La Grande Dam warning system could notify appropriate authorities to initiate evacuation efforts for downstream residents. Thurston County Emergency Management could notify area residents and businesses with its flood warning system and local emergency personnel could be deployed to assist people to evacuate to higher ground. Nearly 1,100 properties could be damaged or destroyed. Surface transportation routes across the Nisqually River could be closed or destroyed and affect the mobility needs of the entire Puget Sound Region. The combination of these impacts suggests that the region is highly vulnerable. Therefore the overall risk of a Case 1 lahar is moderate, as an event of this magnitude has a low probability of occurrence.

**Summary Risk Assessment for Tephra Fall and Case 1 Lahar Hazards in the Thurston Region**

| Volcanic Hazard | Probability of Occurrence | Vulnerability | Risk |
|---|---|---|---|
| Tephra (Ash) Fall | Low | Moderate | Low |
| Lahar | Low | High | Moderate |

**Table 4.6.1: Lahar Hazard Area, by Jurisdiction**

| Jurisdiction | | Total Acres | Lahar Hazard Area: In Hazard Area | Lahar Hazard Area: % In Hazard Area |
|---|---|---|---|---|
| Bucoda | **Total** | **379.6** | 0.0 | **0.0%** |
| Lacey | City | 10549.7 | 0.0 | 0.0% |
| | UGA | 10645.1 | 0.0 | 0.0% |
| | **Total** | **21194.9** | **0.0** | **0.0%** |
| Olympia | City | 11858.8 | 0.0 | 0.0% |
| | UGA | 4119.2 | 0.0 | 0.0% |
| | **Total** | **15978.0** | **0.0** | **0.0%** |
| Rainier | City | 1104.8 | 0.0 | 0.0% |
| | UGA | 319.5 | 0.0 | 0.0% |
| | **Total** | **1424.2** | **0.0** | **0.0%** |
| Tenino | City | 924.0 | 0.0 | 0.0% |
| | UGA | 65.2 | 0.0 | 0.0% |
| | **Total** | **989.3** | **0.0** | **0.0%** |
| Tumwater | City | 9274.2 | 0.0 | 0.0% |
| | UGA | 5811.5 | 0.0 | 0.0% |
| | **Total** | **15085.7** | **0.0** | **0.0%** |
| Yelm | City | 3633.7 | 0.0 | 0.0% |
| | UGA | 2395.9 | 41.9 | 1.7% |
| | **Total** | **6029.6** | **41.9** | **0.7%** |
| Ground Mound UGA | **Total** | **982.9** | **0.0** | **0.0%** |
| Chehalis Tribe | **Total** | **832.6** | **0.0** | **0.0%** |
| Nisqually Tribe | **Total** | **1699.5** | **705.5** | **41.5%** |
| **Total Cities** | | **37724.9** | **0.0** | **0.0%** |
| **Total UGAs** | | **24339.4** | **41.9** | **0.2%** |
| **Total Reservations** | | **2532.1** | **705.5** | **27.9%** |
| **Rural Unincorporated County** | | **8330.1** | **8330.1** | **7.5%** |
| **Thurston County Total** | | **470838.8** | **9077.4** | **1.9%** |

## Table 4.6.2: Lahar Hazard Area, by Special Districts

| | | | Lahar Hazard | |
|---|---|---|---|---|
| | | Total Acres | In Hazard Area | % in Hazard Area |
| **Fire Districts** | | | | |
| | Bucoda | 379 | 0 | 0% |
| | Olympia | 11,882 | 0 | 0% |
| | Tumwater[1] | 10,057 | 0 | 0% |
| 1,11 | Rochester/Littlerock[2] | 101,349 | 0 | 0% |
| 2,4 | Yelm/Rainer[2] | 83,420 | 26,420 | 32% |
| 3 | Lacey | 45,769 | 2,643 | 6% |
| 6 | East Olympia | 25,108 | 0 | 0% |
| 7 | North Olympia | 7,060 | 0 | 0% |
| 8 | South Bay | 13,113 | 0 | 0% |
| 9,5 | McLane/Black Lake[2] | 50,984 | 0 | 0% |
| 12 | Tenino | 44,254 | 0 | 0% |
| 13 | Griffin | 13,953 | 0 | 0% |
| 16 | Gibson Valley | 19,081 | 0 | 0% |
| 17 | Bald Hills | 44,962 | 2,458 | 5% |
| **School Districts** | | | | |
| Centralia | | 12,852 | 0 | 0% |
| Griffin | | 21,768 | 0 | 0% |
| North Thurston | | 48,504 | 3,862 | 8% |
| Olympia | | 51,918 | 0 | 0% |
| Rainier | | 35,550 | 0 | 0% |
| Rochester | | 68,314 | 0 | 0% |
| Tenino | | 70,501 | 0 | 0% |
| Tumwater | | 73,848 | 0 | 0% |
| Yelm | | 126,543 | 9,004 | 7% |
| **Other Participating Jurisdictions (Service Area)** | | | | |
| Intercity Transit | | 62,333 | 2,650 | 4% |
| LOTT* | | 21,160 | 0 | 0% |
| (*Sewered Area). | | | | |
| **Colleges** | | | | |
| SPSCC-Main Campus | | 92 | 0 | 0% |
| TESC - Main Campus | | 939 | 0 | 0% |
| **Non-Profit** | | | | |
| Providence St. Peter Hospital | | 157 | 0 | 0% |

Note: The service areas for the following participating jurisdictions are multi-county: Thurston County PUD, Timberland Regional Library (see local annex for details)

[1]Munn Lake Fire District 15 contracts services with the City of Tumwater Fire Department; its data is combined with Tumwater's
[2]Fire Districts 1 and 11, 2 and 4, 5 and 9 have joint operations agreements; therefore the data for the paired districts is combined.

## Table 4.6.3: Lahar Hazard Area, Population by Jurisdiction, 2006 and 2030

| Jurisdiction | | 2006 Population Estimate | | | 2030 Population Forecast | | |
|---|---|---|---|---|---|---|---|
| | | Total | In Hazard Area | % in Hazard Area | Total | In Hazard Area | % in Hazard Area |
| Bucoda | **Total** | **650** | **0** | **0%** | **1,050** | **0** | **0%** |
| Lacey | City | 34,115 | 0 | 0% | 52,015 | 0 | 0% |
| | UGA | 32,820 | 0 | 0% | 54,740 | 185 | 0% |
| | **Total** | **66,935** | **0** | **0%** | **106,755** | **185** | **0%** |
| Olympia | City | 44,350 | 0 | 0% | 64,385 | 0 | 0% |
| | UGA | 10,820 | 0 | 0% | 17,710 | 0 | 0% |
| | **Total** | **55,170** | **0** | **0%** | **82,095** | **0** | **0%** |
| Rainier | City | 1,675 | 0 | 0% | 2,540 | 0 | 0% |
| | UGA | 115 | 0 | 0% | 355 | 0 | 0% |
| | **Total** | **1,790** | **0** | **0%** | **2,895** | **0** | **0%** |
| Tenino | City | 1,525 | 0 | 0% | 3,110 | 0 | 0% |
| | UGA | 20 | 0 | 0% | 475 | 0 | 0% |
| | **Total** | **1,545** | **0** | **0%** | **3,585** | **0** | **0%** |
| Tumwater | City | 15,475 | 0 | 0% | 27,610 | 0 | 0% |
| | UGA | 6,180 | 0 | 0% | 13,805 | 0 | 0% |
| | **Total** | **21,655** | **0** | **0%** | **41,415** | **0** | **0%** |
| Yelm | City | 4,570 | 0 | 0% | 21,025 | 0 | 0% |
| | UGA | 1,335 | 60 | 4% | 3,035 | 60 | 2% |
| | **Total** | **5,905** | **60** | **1%** | **24,060** | **60** | **0%** |
| Grand Mound UGA | **Total** | **845** | **0** | **0%** | **2,685** | **0** | **0%** |
| Chehalis Reservation[1] | **Total** | **35** | **0** | **0%** | **175** | **0** | **0%** |
| Nisqually Reservation[1] | **Total** | **635** | **240** | **38%** | **940** | **270** | **29%** |
| **Total Cities** | | **102,360** | **0** | **0%** | **171,735** | **0** | **0%** |
| **Total UGAs [2]** | | **52,140** | **60** | **0%** | **92,810** | **250** | **0%** |
| **Total Reservations[1]** | | **670** | **240** | **36%** | **1,115** | **270** | **24%** |
| **Rural Unincorporated County[3]** | | **75,880** | **2,570** | **3%** | **107,285** | **3,362** | **3%** |
| **Thurston County Total** | | **231,100** | **2,900** | **1%** | **372,900** | **3,900** | **1%** |

**Source**: Thurston Regional Planning Council Populaton Forecast, 2007.

**Explanations**: Numbers may not add due to rounding.

[1]Data is for Thurston County portion of reservation only.

[2]UGA - Urban Growth Area. Unincorporated area designated to be annexed into city limits over 20 years time to accommodate urban growth.

[3]Rural unincorporated county is the portion of the unincorporated county that lies outside UGA and Reservation boundaries.

## Table 4.6.4: Lahar Hazard Area, Population - Special Districts, 2006 and 2030

| | | 2006 Population Estimate | | | 2030 Population Forecast | | |
|---|---|---|---|---|---|---|---|
| | | Total | In Hazard Area | % in Hazard Area | Total | In Hazard Area | % in Hazard Area |
| **Fire Districts** | | | | | | | |
| | Bucoda | 650 | 0 | 0% | 1,050 | 0 | 0% |
| | Olympia | 44,380 | 0 | 0% | 64,505 | 0 | 0% |
| | Tumwater[1] | 16,365 | 0 | 0% | 29,855 | 0 | 0% |
| 1,11 | Rochester/Littlerock[2] | 20,200 | 0 | 0% | 33,665 | 0 | 0% |
| 2,4 | Yelm/Rainier[2] | 19,390 | 1,185 | 6% | 43,935 | 1,470 | 3% |
| 3 | Lacey | 78,040 | 1,555 | 2% | 121,245 | 1,805 | 1% |
| 4 | Rainier | 4,705 | 0 | 0% | 8,095 | 0 | 0% |
| 6 | East Olympia | 11,815 | 0 | 0% | 17,430 | 0 | 0% |
| 7 | North Olympia | 3,920 | 0 | 0% | 4,730 | 0 | 0% |
| 8 | South Bay | 7,165 | 0 | 0% | 11,050 | 0 | 0% |
| 9,5 | McLane/Black Lake[2] | 14,990 | 0 | 0% | 21,420 | 0 | 0% |
| 12 | Tenino | 5,425 | 0 | 0% | 10,580 | 0 | 0% |
| 13 | Griffin | 5,075 | 0 | 0% | 6,870 | 0 | 0% |
| 16 | Gibson Valley | 465 | 0 | 0% | 1,430 | 0 | 0% |
| 17 | Bald Hills | 3,170 | 120 | 4% | 5,170 | 580 | 11% |
| **School Districts** | | | | | | | |
| Centralia | | 380 | 0 | 0% | 1,190 | 0 | 0% |
| Griffin | | 5,885 | 0 | 0% | 7,885 | 0 | 0% |
| North Thurston | | 85,305 | 1,540 | 2% | 131,365 | 1,790 | 1% |
| Olympia | | 58,000 | 0 | 0% | 83,735 | 0 | 0% |
| Rainier | | 4,580 | 0 | 0% | 16,110 | 0 | 0% |
| Rochester | | 12,555 | 0 | 0% | 19,380 | 0 | 0% |
| Tenino | | 9,175 | 0 | 0% | 17,985 | 0 | 0% |
| Tumwater | | 34,185 | 0 | 0% | 57,795 | 0 | 0% |
| Yelm | | 21,040 | 1,315 | 6% | 37,565 | 2,065 | 5% |
| **Other Participating Jurisdictions (Service Area)** | | | | | | | |
| Intercity Transit | | 143,815 | 90 | 0% | 236,195 | 365 | 0% |
| LOTT* | | 95,525 | 0 | 0% | 230,265 | 185 | 0% |

(*Sewered Area for 2006; Lacey, Olympia Tumwater UGA for 2030).

Note: The service areas for the following participating jurisdictions are multi-county or county-wide: The Evergreen State College, South Puget Sound Community College, Thurston County PUD, Port of Olympia, Timberland Regional Library

[1]Munn Lake Fire District 15 contracts services with the City of Tumwater Fire Department; its data is combined with Tumwater's
[2]Fire Districts 1 and 11, 2 and 4, 5 and 9 have joint operations agreements; therefore the data for the paired districts is combined.

## Table 4.6.5: Lahar Hazard Area, Employment, 2006 and 2030

| Jurisdiction | | 2006 Employment Estimate | | | 2030 Employment Forecast | | |
|---|---|---|---|---|---|---|---|
| | | Total | In Hazard Area | % in Hazard Area | Total | In Hazard Area | % in Hazard Area |
| Bucoda | **Total** | **35** | **0** | **0%** | **175** | **0** | **0%** |
| Lacey | City | 21,955 | 0 | 0% | 34,120 | 0 | 0% |
| | UGA | 5,195 | 0 | 0% | 7,995 | 50 | 1% |
| | **Total** | **27,150** | **0** | **0%** | **42,115** | **50** | **0%** |
| Olympia | City | 53,400 | 0 | 0% | 70,870 | 0 | 0% |
| | UGA | 1,470 | 0 | 0% | 2,550 | 0 | 0% |
| | **Total** | **54,870** | **0** | **0%** | **73,420** | **0** | **0%** |
| Rainier | City | 375 | 0 | 0% | 1,065 | 0 | 0% |
| | UGA | 10 | 0 | 0% | 20 | 0 | 0% |
| | **Total** | **385** | **0** | **0%** | **1,085** | **0** | **0%** |
| Tenino | City | 810 | 0 | 0% | 2,100 | 0 | 0% |
| | UGA | 35 | 0 | 0% | 45 | 0 | 0% |
| | **Total** | **845** | **0** | **0%** | **2,145** | **0** | **0%** |
| Tumwater | City | 17,775 | 0 | 0% | 28,260 | 0 | 0% |
| | UGA | 2,270 | 0 | 0% | 4,850 | 0 | 0% |
| | **Total** | **20,045** | **0** | **0%** | **33,110** | **0** | **0%** |
| Yelm | City | 3,290 | 0 | 0% | 8,080 | 0 | 0% |
| | UGA | 325 | 0 | 0% | 545 | 5 | 1% |
| | **Total** | **3,615** | **0** | **0%** | **8,625** | **5** | **0%** |
| Grand Mound UGA | **Total** | **445** | **0** | **0%** | **1,110** | **0** | **0%** |
| Chehalis Reservation[1] | **Total** | **860** | **0** | **0%** | **2,450** | **0** | **0%** |
| Nisqually Reservation[1] | **Total** | **720** | **15** | **2%** | **1,650** | **15** | **1%** |
| **Total Cities** | | **97,640** | **0** | **0%** | **144,670** | **0** | **0%** |
| **Total UGAs [2]** | | **9,750** | **0** | **0%** | **17,120** | **60** | **0%** |
| **Total Reservations[1]** | | **1,580** | **15** | **1%** | **4,100** | **15** | **0%** |
| **Rural Unincorporated County[3]** | | **12,370** | **475** | **4%** | **18,795** | **665** | **4%** |
| **Thurston County Total** | | **121,300** | **500** | **0%** | **184,700** | **700** | **0%** |

**Source**: Thurston Regional Planning Council Populaton Forecast, 2007.

**Explanations**: Numbers may not add due to rounding.

[1]Data is for Thurston County portion of reservation only; includes Great Wolf Lodge in Chehalis Reservation.

[2]UGA - Urban Growth Area. Unincorporated area designated to be annexed into city limits over 20 years time to accommodate urban growth.

[3]Rural unincorporated county is the portion of the unincorporated county that lies outside UGA and Reservation boundaries.

## Table 4.6.6: Lahar Hazard Area, Employment - Special Districts, 2006 and 2030

| | | 2006 Employment Estimate | | | 2030 Employment Forecast | | |
|---|---|---|---|---|---|---|---|
| | | Total | In Hazard Area | % in Hazard Area | Total | In Hazard Area | % in Hazard Area |
| **Fire Districts** | | | | | | | |
| | Bucoda | 35 | 0 | 0% | 175 | 0 | 0% |
| | Olympia | 53,445 | 0 | 0% | 71,015 | 0 | 0% |
| | Tumwater[1] | 18,545 | 0 | 0% | 29,290 | 0 | 0% |
| 1,11 | Rochester/Littlerock[2] | 5,460 | 0 | 0% | 11,570 | 0 | 0% |
| 2,4 | Yelm/Rainier[2] | 5,510 | 100 | 2% | 12,030 | 170 | 1% |
| 3 | Lacey | 29,625 | 360 | 1% | 45,875 | 470 | 1% |
| 4 | Rainier | 835 | 0 | 0% | 1,825 | 0 | 0% |
| 6 | East Olympia | 2,095 | 0 | 0% | 3,400 | 0 | 0% |
| 7 | North Olympia | 450 | 0 | 0% | 615 | 0 | 0% |
| 8 | South Bay | 1,110 | 0 | 0% | 1,645 | 0 | 0% |
| 9,5 | McLane/Black Lake[2] | 2,755 | 0 | 0% | 4,095 | 0 | 0% |
| 12 | Tenino | 1,240 | 0 | 0% | 3,075 | 0 | 0% |
| 13 | Griffin | 765 | 0 | 0% | 1,120 | 0 | 0% |
| 16 | Gibson Valley | 60 | 0 | 0% | 165 | 0 | 0% |
| 17 | Bald Hills | 240 | 20 | 8% | 610 | 80 | 13% |
| **School Districts** | | | | | | | |
| Centralia | | 40 | 0 | 0% | 115 | 0 | 0% |
| Griffin | | 850 | 0 | 0% | 1,230 | 0 | 0% |
| North Thurston | | 37,675 | 360 | 1% | 57,820 | 470 | 1% |
| Olympia | | 48,130 | 0 | 0% | 62,085 | 0 | 0% |
| Rainier | | 855 | 0 | 0% | 2,005 | 0 | 0% |
| Rochester | | 3,790 | 0 | 0% | 7,600 | 0 | 0% |
| Tenino | | 1,755 | 0 | 0% | 4,115 | 0 | 0% |
| Tumwater | | 22,170 | 0 | 0% | 36,835 | 0 | 0% |
| Yelm | | 6,090 | 130 | 2% | 12,880 | 260 | 2% |
| **Other Participating Jurisdictions (Service Area)** | | | | | | | |
| Intercity Transit | | 104,795 | 25 | 0% | 154,615 | 95 | 0% |
| LOTT* | | 90,055 | 0 | 0% | 148,645 | 50 | 0% |

(*Sewered Area for 2006; Lacey, Olympia Tumwater UGA for 2030).

Note: The service areas for the following participating jurisdictions are multi-county or county-wide: The Evergreen State College, South Puget Sound Community College, Thurston County PUD, Port of Olympia, Timberland Regional Library

[1]Munn Lake Fire District 15 contracts services with the City of Tumwater Fire Department; its data is combined with Tumwater's
[2]Fire Districts 1 and 11, 2 and 4, 5 and 9 have joint operations agreements; therefore the data for the paired districts is combined.

## Table 4.6.7: Lahar Hazard Area, Residential Dwellings, 2006 and 2030

| Jurisdiction | | 2006 Dwelling Estimate | | | 2030 Dwelling Forecast | | |
|---|---|---|---|---|---|---|---|
| | | Total | In Hazard Area | % in Hazard Area | Total | In Hazard Area | % in Hazard Area |
| Bucoda | **Total** | **255** | **0** | **0%** | **420** | **0** | **0%** |
| Lacey | City | 14,995 | 0 | 0% | 23,390 | 0 | 0% |
| | UGA | 12,540 | 0 | 0% | 22,045 | 65 | 0% |
| | **Total** | **27,535** | **0** | **0%** | **45,435** | **65** | **0%** |
| Olympia | City | 20,820 | 0 | 0% | 31,655 | 0 | 0% |
| | UGA | 4,365 | 0 | 0% | 7,460 | 0 | 0% |
| | **Total** | **25,185** | **0** | **0%** | **39,115** | **0** | **0%** |
| Rainier | City | 610 | 0 | 0% | 1,045 | 0 | 0% |
| | UGA | 45 | 0 | 0% | 155 | 0 | 0% |
| | **Total** | **655** | **0** | **0%** | **1,200** | **0** | **0%** |
| Tenino | City | 700 | 0 | 0% | 1,320 | 0 | 0% |
| | UGA | 5 | 0 | 0% | 195 | 0 | 0% |
| | **Total** | **705** | **0** | **0%** | **1,515** | **0** | **0%** |
| Tumwater | City | 7,370 | 0 | 0% | 12,975 | 0 | 0% |
| | UGA | 2,555 | 0 | 0% | 5,785 | 0 | 0% |
| | **Total** | **9,925** | **0** | **0%** | **18,760** | **0** | **0%** |
| Yelm | City | 2,000 | 0 | 0% | 9,410 | 0 | 0% |
| | UGA | 515 | 25 | 5% | 1,255 | 25 | 2% |
| | **Total** | **2,515** | **25** | **1%** | **10,665** | **25** | **0%** |
| Grand Mound UGA | **Total** | **325** | **0** | **0%** | **1,125** | **0** | **0%** |
| Chehalis Reservation[1] | **Total** | **15** | **0** | **0%** | **70** | **0** | **0%** |
| Nisqually Reservation[1] | **Total** | **225** | **85** | **38%** | **360** | **105** | **29%** |
| **Total Cities** | | **46,750** | **0** | **0%** | **80,215** | **0** | **0%** |
| **Total UGAs [2]** | | **20,350** | **30** | **0%** | **38,020** | **90** | **0%** |
| **Total Reservations[1]** | | **240** | **85** | **35%** | **430** | **105** | **24%** |
| **Rural Unincorporated County[3]** | | **29,795** | **1,025** | **3%** | **44,260** | **1,415** | **3%** |
| **Thurston County Total** | | **97,100** | **1,100** | **1%** | **162,900** | **1,600** | **1%** |

**Source**: Thurston Regional Planning Council Populaton Forecast, 2007.

**Explanations**: Numbers may not add due to rounding.

[1]Data is for Thurston County portion of reservation only.

[2]UGA - Urban Growth Area. Unincorporated area designated to be annexed into city limits over 20 years time to accommodate urban growth.

[3]Rural unincorporated county is the portion of the unincorporated county that lies outside UGA and Reservation boundaries.

## Table 4.6.8: Lahar Hazard Area, Residential Dwellings - Special Districts, 2006 and 2030

| | | 2006 Dwelling Estimate | | | 2030 Dwelling Forecast | | |
|---|---|---|---|---|---|---|---|
| | | Total | In Hazard Area | % in Hazard Area | Total | In Hazard Area | % in Hazard Area |
| **Fire Districts** | | | | | | | |
| | Bucoda | 255 | 0 | 0% | 420 | 0 | 0% |
| | Olympia | 20,840 | 0 | 0% | 31,725 | 0 | 0% |
| | Tumwater[1] | 7,755 | 0 | 0% | 13,940 | 0 | 0% |
| 1,11 | Rochester/Littlerock[2] | 7,525 | 0 | 0% | 13,295 | 0 | 0% |
| 2,4 | Yelm/Rainier[2] | 7,810 | 455 | 6% | 19,010 | 600 | 3% |
| 3 | Lacey | 31,885 | 625 | 2% | 51,430 | 750 | 1% |
| 4 | Rainier | 1,825 | 0 | 0% | 3,400 | 0 | 0% |
| 6 | East Olympia | 4,550 | 0 | 0% | 7,015 | 0 | 0% |
| 7 | North Olympia | 1,690 | 0 | 0% | 2,150 | 0 | 0% |
| 8 | South Bay | 2,855 | 0 | 0% | 4,610 | 0 | 0% |
| 9,5 | McLane/Black Lake[2] | 6,000 | 0 | 0% | 8,830 | 0 | 0% |
| 12 | Tenino | 2,170 | 0 | 0% | 4,345 | 0 | 0% |
| 13 | Griffin | 2,315 | 0 | 0% | 3,315 | 0 | 0% |
| 16 | Gibson Valley | 175 | 0 | 0% | 580 | 0 | 0% |
| 17 | Bald Hills | 1,320 | 50 | 4% | 2,250 | 250 | 11% |
| **School Districts** | | | | | | | |
| Centralia | | 145 | 0 | 0% | 480 | 0 | 0% |
| Griffin | | 2,680 | 0 | 0% | 3,805 | 0 | 0% |
| North Thurston | | 35,325 | 620 | 2% | 56,380 | 745 | 1% |
| Olympia | | 25,740 | 0 | 0% | 39,095 | 0 | 0% |
| Rainier | | 1,780 | 0 | 0% | 7,180 | 0 | 0% |
| Rochester | | 4,570 | 0 | 0% | 7,515 | 0 | 0% |
| Tenino | | 3,600 | 0 | 0% | 7,335 | 0 | 0% |
| Tumwater | | 14,775 | 0 | 0% | 25,220 | 0 | 0% |
| Yelm | | 8,550 | 505 | 6% | 15,935 | 855 | 5% |
| **Other Participating Jurisdictions (Service Area)** | | | | | | | |
| Intercity Transit | | 62,475 | 35 | 0% | 105,855 | 140 | 0% |
| LOTT* | | 43,335 | 0 | 0% | 103,310 | 65 | 0% |

(*Sewered Area for 2006; Lacey, Olympia Tumwater UGA for 2030).

Note: The service areas for the following participating jurisdictions are multi-county or county-wide: The Evergreen State College, South Puget Sound Community College, Thurston County PUD, Port of Olympia, Timberland Regional Library

[1]Munn Lake Fire District 15 contracts services with the City of Tumwater Fire Department; its data is combined with Tumwater's
[2]Fire Districts 1 and 11, 2 and 4, 5 and 9 have joint operations agreements; therefore the data for the paired districts is combined.

## Table 4.6.9: Lahar Hazard Area, Valuation of Building and Contents, 2006/2008

| Jurisdiction | | Residential Total (mil. $) | Residential In Hazard Area | Residential % in Hazard Area | Commercial/Industrial Total (mil. $) | Commercial/Industrial In Hazard Area | Commercial/Industrial % in Hazard Area | Government/Institutional Total (mil. $) | Government/Institutional In Hazard Area | Government/Institutional % in Hazard Area |
|---|---|---|---|---|---|---|---|---|---|---|
| Bucoda | **Total** | **19** | **0** | **0%** | **1** | **0** | **0%** | **2** | **0** | **0%** |
| Lacey | City | 1,944 | 0 | 0% | 1,265 | 0 | 0% | 433 | 0 | 0% |
| | UGA | 2,036 | 0 | 0% | 112 | 0 | 0% | 133 | 0 | 0% |
| | **Total** | **3,980** | **0** | **0%** | **1,377** | **0** | **0%** | **567** | **0** | **0%** |
| Olympia | City | 3,062 | 0 | 0% | 1,952 | 0 | 0% | 1,727 | 0 | 0% |
| | UGA | 930 | 0 | 0% | 43 | 0 | 0% | 17 | 0 | 0% |
| | **Total** | **3,993** | **0** | **0%** | **1,994** | **0** | **0%** | **1,745** | **0** | **0%** |
| Rainier | City | 70 | 0 | 0% | 6 | 0 | 0% | 28 | 0 | 0% |
| | UGA | 7 | 0 | 0% | 0 | 0 | 0% | 0 | 0 | 0% |
| | **Total** | **77** | **0** | **0%** | **6** | **0** | **0%** | **28** | **0** | **0%** |
| Tenino | City | 75 | 0 | 0% | 17 | 0 | 0% | 42 | 0 | 0% |
| | UGA | 1 | 0 | 0% | 0 | 0 | 0% | 0 | 0 | 0% |
| | **Total** | **76** | **0** | **0%** | **17** | **0** | **0%** | **42** | **0** | **0%** |
| Tumwater | City | 1,039 | 0 | 0% | 703 | 0 | 0% | 423 | 0 | 0% |
| | UGA | 395 | 0 | 0% | 119 | 0 | 0% | 18 | 0 | 0% |
| | **Total** | **1,434** | **0** | **0%** | **822** | **0** | **0%** | **441** | **0** | **0%** |
| Yelm | City | 266 | 0 | 0% | 127 | 0 | 0% | 140 | 0 | 0% |
| | UGA | 76 | 3 | 4% | 6 | 0 | 0% | 11 | 0 | 0% |
| | **Total** | **342** | **3** | **1%** | **134** | **0** | **0%** | **151** | **0** | **0%** |
| Grand Mound UGA | **Total** | **15** | **0** | **0%** | **16** | **0** | **0%** | **15** | **0** | **0%** |
| Chehalis Reservation[1] | **Total** | **1** | **0** | **0%** | **9** | **0** | **0%** | **0** | **0** | **0%** |
| Nisqually Reservation[1] | **Total** | **11** | **0** | **1%** | **0** | **0** | **0%** | **50** | **0** | **0%** |
| **Total Cities** | | **6,476** | **0** | **0%** | **4,071** | **0** | **0%** | **2,797** | **0** | **0%** |
| **Total UGAs [2]** | | **3,460** | **3** | **0%** | **296** | **0** | **0%** | **194** | **0** | **0%** |
| **Total Reservations[1]** | | **12** | **0** | **1%** | **9** | **0** | **0%** | **50** | **0** | **0%** |
| **Rural Unincorporated County[3]** | | **5,672** | **99** | **2%** | **193** | **16** | **8%** | **755** | **3** | **0%** |
| **Thurston County Total** | | **15,620** | **102** | **1%** | **4,569** | **16** | **0%** | **3,796** | **3** | **0%** |

**Source**: Thurston Regional Planning Council Populaton Forecast, 2007; Thurston County Assessor's Office; Local Jurisdictions.

**Explanations**: Numbers may not add due to rounding.

[1]Data is for Thurston County portion of reservation only.

[2]UGA - Urban Growth Area. Unincorporated area designated to be annexed into city limits over 20 years time to accommodate urban growth.

[3]Rural unincorporated county is the portion of the unincorporated county that lies outside UGA and Reservation boundaries.

## Table 4.6.10: Lahar Hazard Area, Valuation of Building and Contents, 2006/2008

| | | Residential | | | Commercial/Industrial | | | Government/Institutional | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Total (mil. $) | In Hazard Area | % in Hazard Area | Total (mil. $) | In Hazard Area | % in Hazard Area | Total (mil. $) | In Hazard Area | % in Hazard Area |
| **Fire Districts** | | | | | | | | | | |
| | Bucoda | 19 | 0 | 0% | 1 | 0 | 0% | 2 | 0 | 0% |
| | Olympia | 3,064 | 0 | 0% | 1,952 | 0 | 0% | 1,727 | 0 | 0% |
| | Tumwater[1] | 1,091 | 0 | 0% | 755 | 0 | 0% | 424 | 0 | 0% |
| 1,11 | Rochester/Littlerock[2] | 1,114 | 0 | 0% | 126 | 0 | 0% | 135 | 0 | 0% |
| 2,4 | Yelm/Rainier[2] | 1,099 | 49 | 4% | 165 | 3 | 2% | 192 | 0 | 0% |
| 3 | Lacey | 4,783 | 43 | 1% | 1,415 | 7 | 0% | 640 | 3 | 0% |
| 4 | Rainier | 270 | 0 | 0% | 9 | 0 | 0% | 30 | 0 | 0% |
| 6 | East Olympia | 991 | 0 | 0% | 48 | 0 | 0% | 26 | 0 | 0% |
| 7 | North Olympia | 347 | 0 | 0% | 6 | 0 | 0% | 20 | 0 | 0% |
| 8 | South Bay | 719 | 0 | 0% | 20 | 0 | 0% | 13 | 0 | 0% |
| 9,5 | McLane/Black Lake[2] | 1,313 | 0 | 0% | 39 | 0 | 0% | 550 | 0 | 0% |
| 12 | Tenino | 313 | 0 | 0% | 29 | 0 | 0% | 45 | 0 | 0% |
| 13 | Griffin | 534 | 0 | 0% | 5 | 0 | 0% | 16 | 0 | 0% |
| 16 | Gibson Valley | 22 | 0 | 0% | 0 | 0 | 0% | 0 | 0 | 0% |
| 17 | Bald Hills | 211 | 10 | 5% | 8 | 7 | 84% | 4 | 0 | 0% |
| **School Districts** | | | | | | | | | | |
| Centralia | | 20 | 0 | 0% | 0 | 0 | 0% | 1 | 0 | 0% |
| Griffin | | 606 | 0 | 0% | 5 | 0 | 0% | 16 | 0 | 0% |
| North Thurston | | 5,475 | 43 | 1% | 1,931 | 7 | 0% | 642 | 3 | 0% |
| Olympia | | 4,540 | 0 | 0% | 1,500 | 0 | 0% | 2,151 | 0 | 0% |
| Rainier | | 258 | 0 | 0% | 9 | 0 | 0% | 30 | 0 | 0% |
| Rochester | | 572 | 0 | 0% | 75 | 0 | 0% | 107 | 0 | 0% |
| Tenino | | 536 | 0 | 0% | 42 | 0 | 0% | 49 | 0 | 0% |
| Tumwater | | 2,342 | 0 | 0% | 832 | 0 | 0% | 582 | 0 | 0% |
| Yelm | | 1,275 | 60 | 5% | 175 | 9 | 5% | 219 | 1 | 0% |
| **Other Participating Jurisdictions (Service Area)** | | | | | | | | | | |
| Intercity Transit | | 9,356 | 8 | 0% | 4,208 | 1 | 0% | 3,453 | 1 | 0% |
| LOTT* | | 6,438 | 0 | 0% | 3,604 | 0 | 0% | 2,443 | 0 | 0% |

*Sewered Area.

Note: The service areas for the following participating jurisdictions are multi-county or county-wide: The Evergreen State College, South Puget Sound Community College, Thurston County PUD, Port of Olympia, Timberland Regional Library

[1]Munn Lake Fire District 15 contracts services with the City of Tumwater Fire Department; its data is combined with Tumwater's
[2]Fire Districts 1 and 11, 2 and 4, 5 and 9 have joint operations agreements; therefore the data for the paired districts is combined.

### Table 4.6.11: Lahar Hazard Area, Valuation of Building and Contents - Colleges, 2006 and 2008

| | Government/Institutional | | |
|---|---|---|---|
| | Total (mil. $) | In Hazard Area | % in Hazard Area |
| **College** | | | |
| The Evergreen State College | 505 | 0 | 0% |
| South Puget Sound Community College | 63 | 0 | 0% |

### Table 4.6.12: Lahar Hazard Area, Valuation of Building and Contents - Multi-County Districts, 2006 and 2008

| | Government/Institutional | | |
|---|---|---|---|
| | Total (1,000 $) | In Hazard Area | % in Hazard Area |
| **Thurston PUD** | | | |
| Thurston County | 1,780 | 67 | 4% |
| Lewis County | 1,046 | 75 | 7% |
| Grays Harbor County | 69 | 0 | 0% |
| Mason County | 63 | 0 | 0% |
| Pierce County | 1,204 | 131 | 11% |
| **Total** | 4,162 | 272 | 7% |
| **Timberland Regional Library** | | | |
| Thurston County | 6,700 | 0 | 0% |
| Lewis County | 4,533 | 725 | 16% |
| Grays Harbor County | 4,277 | 0 | 0% |
| Mason County | 5,273 | 0 | 0% |
| Pacific County | 2,698 | 0 | 0% |
| **Total** | 23,481 | 725 | 3% |

**Note**: The service areas for these jurisdictions are multi-county-wide

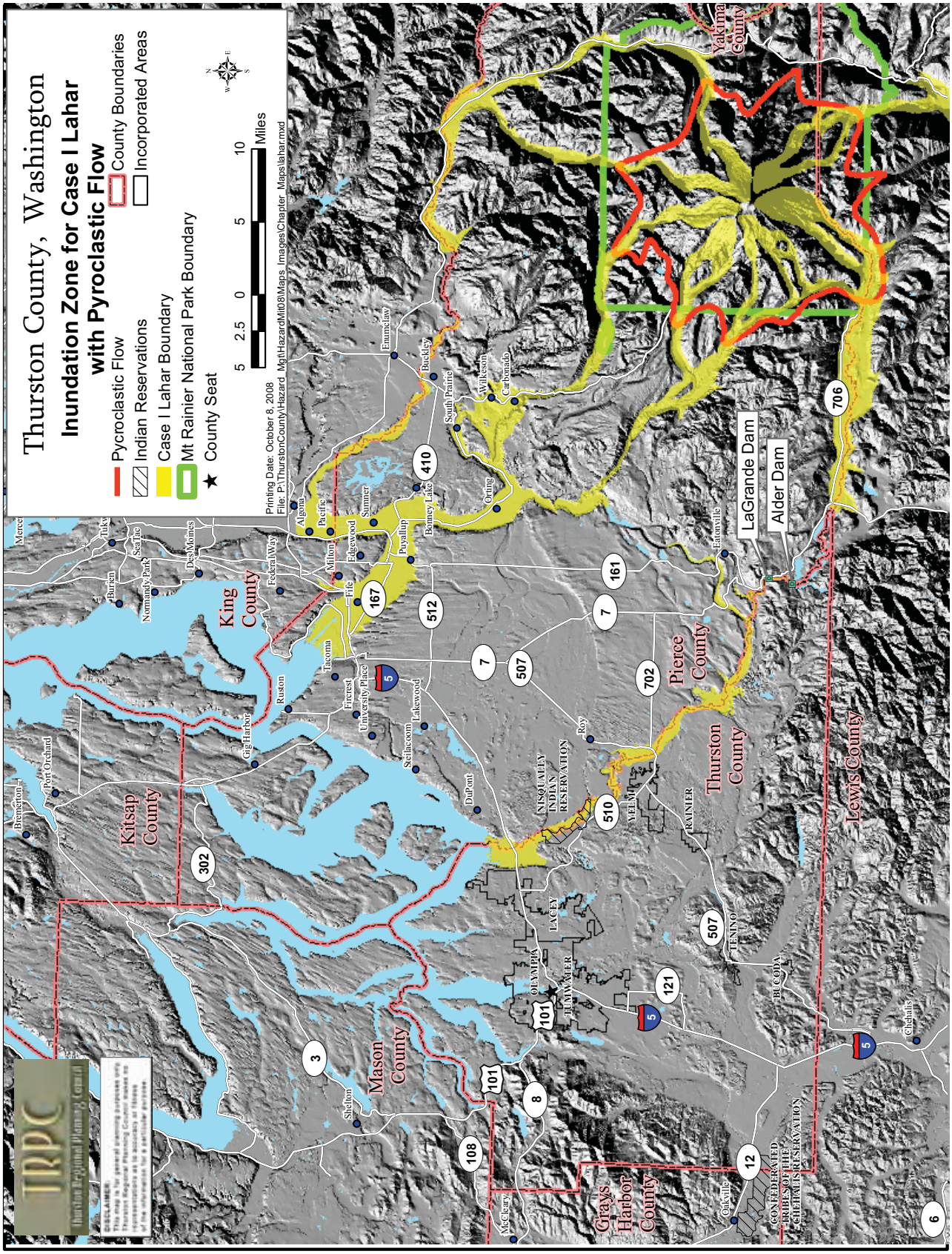
**Table 4.6.13: Lahar Hazard Area, Valuation of Building and Contents - Non-Profit 2006 and 2008**

| | Government/Institutional | | |
|---|---|---|---|
| | Total (mil. $) | In Hazard Area | % in Hazard Area |
| **Hospital** | | | |
| Providence St. Peter Hospital | 401 | 0 | 0% |

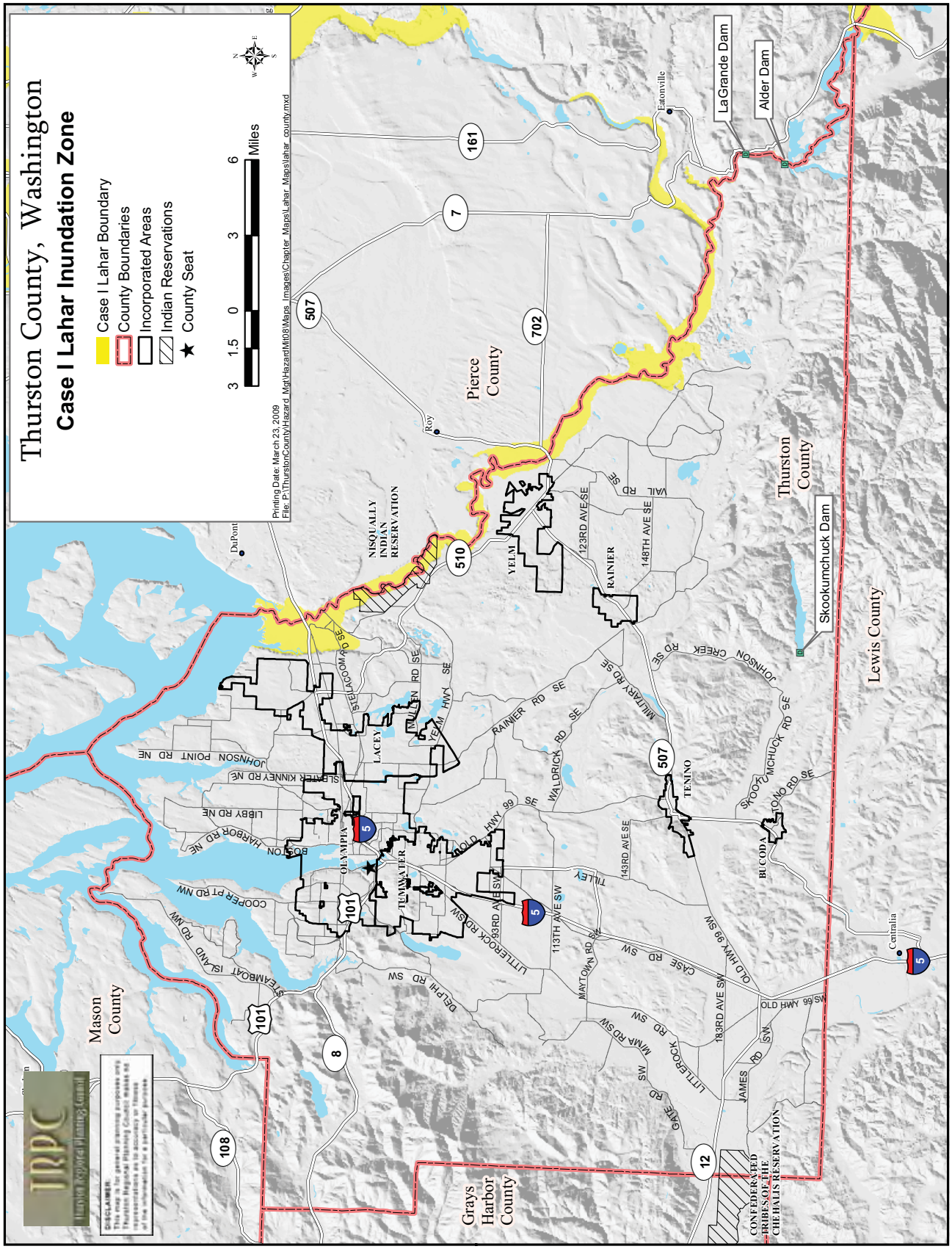
## Table 4.6.14: Critical Facilities in Volcanic Hazard Zone

| Critical Facility Sector and Subsector | Total | In Hazard Area | % In Hazard Area |
|---|---|---|---|
| **1. AGRICULTURE/FOOD SUPPLY** | **22** | **0** | 0.0% |
| 1.1 PRODUCTION | 2 | 0 | 0.0% |
| 1.2 FOOD DISTRIBUTION/STORAGE | 20 | 0 | 0.0% |
| **2. GOVERNMENT** | **135** | **0** | 0.0% |
| 2.1 FIRE SERVICES | 43 | 0 | 0.0% |
| 2.2 LAW ENFORCEMENT | 9 | 0 | 0.0% |
| 2.3 EMERGENCY OPERATIONS CENTERS | 11 | 0 | 0.0% |
| 2.4 CORONER/MORGUE | 1 | 0 | 0.0% |
| 2.5 SHELTER | 69 | 1 | 1.4% |
| 2.7 AMBULANCE | 3 | 0 | 0.0% |
| **4. MEDICAL CARE** | **84** | **0** | 0.0% |
| 4.1.a HOSPITALS | 4 | 0 | 0.0% |
| 4.1.B LARGE CLINICS | 36 | 0 | 0.0% |
| 4.1.B LARGE CLINICS - RURAL | 5 | 0 | 0.0% |
| 4.1.C URGENT CARE | 6 | 0 | 0.0% |
| 4.1.D SURGICAL SUITES | 6 | 0 | 0.0% |
| 4.2 CHEMICAL DEPENDENCY TREATMENT CENTER | 1 | 0 | 0.0% |
| 4.3A METHADONE | 1 | 0 | 0.0% |
| 4.3B DIALYSIS | 1 | 0 | 0.0% |
| 4.3C MENTAL HEALTH | 2 | 0 | 0.0% |
| 4.3D BIRTHING CENTERS | 2 | 0 | 0.0% |
| 4.4 NURSING HOMES | 7 | 0 | 0.0% |
| 4.5 ASSISTED LIVING FACILITIES | 13 | 0 | 0.0% |
| **5. UTILITIES** | **8** | **0** | 0.0% |
| 5.5 RADIO/TELEVISION | 2 | 0 | 0.0% |
| 5.6 DATA TRANSMISSION LINES | 1 | 0 | 0.0% |
| 5.8 SOLID WASTE MANAGEMENT | 5 | 0 | 0.0% |
| **6. TRANSPORTATION** | **16** | **0** | 0.0% |
| 6.3 ROADS - CENTERLINE MILES | 1951 | 23 | 1.2% |
| 6.4 VEHICLE FUEL | 4 | 0 | 0.0% |
| 6.5 STUDENT TRANSPORTATION | 8 | 0 | 0.0% |
| 6.6 MASS TRANSIT | 2 | 0 | 0.0% |
| 6.7 PORT | 1 | 0 | 0.0% |
| **Grand Total** | **266** | **1** | 0.4% |

**Map 4.6.1**


Thurston County, Washington
Inundation Zone for Case I Lahar with Pyroclastic Flow
Pycroclastic Flow
Indian Reservations
Case I Lahar Boundary
Mt Rainier National Park Boundary
County Seat
County Boundaries
Incorporated Areas
5 2.5 0 5 10 Miles
Printing Date: October 8, 2008
File: P:\ThurstonCounty\Hazard_Mgt\HazardMit08\Maps_Images\Chapter_Maps\lahar.mxd
LaGrande Dam
Alder Dam
Kitsap County
King County
Mason County
Pierce County
Thurston County
Lewis County
Grays Harbor County
Yakima County
Bremerton
Port Orchard
Burien
Tukwila
SeaTac
Normandy Park
Des Moines
Federal Way
Gig Harbor
Ruston
Tacoma
Fircrest
University Place
Steilacoom
Lakewood
DuPont
Shelton
McCleary
Oakville
Chehalis
Rochester
Tenino
Bucoda
Yelm
Rainier
Roy
Eatonville
Orting
Carbonado
Wilkeson
South Prairie
Buckley
Enumclaw
Bonney Lake
Puyallup
Sumner
Edgewood
Milton
Fife
Pacific
Algona
Olympia
Lacey
Tumwater
Nisqually Indian Reservation
Confederated Tribes of the Chehalis Reservation
3
101
8
108
302
5
167
512
410
7
507
161
702
510
121
12
706
6

## Map 4.6.2


Thurston County, Washington
Case I Lahar Inundation Zone
Case I Lahar Boundary
County Boundaries
Incorporated Areas
Indian Reservations
County Seat
3 1.5 0 3 6 Miles
Printing Date: March 23, 2009
File: P:\ThurstonCounty\Hazard_Mat\HazardMit08\Maps_Images\Chapter_Maps\Lahar_Maps\lahar_county.mxd
Pierce County
Thurston County
Lewis County
Mason County
Grays Harbor County
LaGrande Dam
Alder Dam
Skookumchuck Dam
Eatonville
Roy
DuPont
Centralia
OLYMPIA
LACEY
TUMWATER
YELM
RAINIER
TENINO
BUCODA
NISQUALLY INDIAN RESERVATION
CONFEDERATED TRIBES OF THE CHEHALIS RESERVATION
IRPC
Thurston Regional Planning Council

## Volcanic Endnotes

[1]Myers, Bobbie and Driedger, Carolyn, 2008. Eruptions in the Cascade Range during the past 4,000 years: U.S. Geological Survey General Information Product 63, 1 sheet [http://pubs.usgs.gov/gip/63/].

[2]Dzurisin, Dan, et.al. 2008. Living with Volcanic Risk in the Cascades. U.S.Geological Survey Fact Sheet 165-97. [http://pubs.usgs.gov/fs/1997/fs165-97/].

[3]Hoblitt,R.P., et.al. 1998. Volcano Hazards from Mount Rainier, Washington, Revised 1998: U.S. Geological Survey Open-File Report 98-428

[4]Tilling,Robert, I. et.al. 1990. Eruptions of Mount St. Helens: Past, Present, and Future, U.S. Geological Survey Special Interest Publication,

[5]Ibid

[6]Hoblitt,R.P., et.al. 1998. Volcano Hazards from Mount Rainier, Washington, Revised 1998: U.S. Geological Survey Open-File Report 98-428 Map Plate 2

[7]Miller. 1989. Potential Hazards from Future Volcanic Eruptions in California: USGS Bulletin 1847

[8]Driedger, Carolyn, L. and Scott, William, E. 2008. Mount Rainier - Living Safely With a Volcano in Your Backyard. USGS Fact Sheet 2008-3062.

[9]Ibid

[10]Reid, Mark, E. et.al. 2001. Volcano Collapse Promoted by hydrothermal Alteration and Edifice Shape, Mount Rainier, Washington. Geology. V29; No.9.

[11]Scott, K.M., et.al. 1995. Sedimentology, Behavior, and Hazards of Debris Flows at Mount Rainier Washington. U.S. Geological Survey Professional Paper 1547.

[12]Tacoma Power. 1999. Emergency Action Plan for the Nisqually Hydroelectric Project FERC Project No. 1862.

[13]Scott, K.M., et.al. 1995. Sedimentology, Behavior, and Hazards of Debris Flows at Mount Rainier Washington. U.S. Geological Survey Professional Paper 1547.

[14]Oral Communication from William E. Scott, Geologist, Cascades Volcano Observatory, U.S. Geological Survey, October 7, 2008.

[15]Hoblitt,R.P., et.al. 1998. Volcano Hazards from Mount Rainier, Washington, Revised 1998: U.S. Geological Survey Open-File Report 98-428

[16]Scott, K.M. and Vallance, J.W., 1995, Debris flow, debris avalanche, and flood hazards at and downstream from Mount Rainier, Washington: U.S. Geological Survey, Hydrologic Investigations Atlas

[17]Oral Communication from Orin Albro, General Manager, City of Centralia, Yelm Power Plant, February 11, 2009.

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# Chapter 4.7: Climate Change Projections

## Climate Change: Natural Hazard or Aggravating Hazard Variable?

Hazard mitigation planning is foremost focused on hazards resulting from natural disaster events such as severe storms and earthquakes that are limited in geographical extent and time. Communities and their governments have gained experience planning and developing preparedness and mitigation strategies to respond to these types of events because they occur frequently, the resulting hazards are relatively well understood, and the impacts are acute. Wind-, rain-, ice-and snowstorms are not unusual hazardous weather events and have obviously impacted the safety and daily routine of Thurston County communities. The probability that extreme weather events will reoccur is high, so it is appropriate that local agencies develop mitigation strategies to respond to these known hazards.

Climate change does not conform to the conventional description of a natural hazard, and its complexity does not readily allow local governments to treat it as such. There is much uncertainty and imprecise information as to how, when, and to what extent the communities of the Pacific Northwest will be impacted by the effects of a changing climate. Nevertheless, a warmer future climate is considered inevitable and it will force communities to adapt to stressors such as changing weather patterns, changing shorelines, and changes in the availability and/or composition of natural resources. Some climate change effects may be manifested in natural hazards such as more frequent severe storms, longer drier summers exacerbating the risk for wildland fires, or sea level rise contributing to more episodic flooding in marine waterfront communities. It is appropriate that the hazard mitigation planning process make inferences about climate change impacts on public safety and community infrastructure.

**Climate change mitigation** refers to actions taken to reduce greenhouse gas emissions arising from human activities.

**Hazard mitigation** refers to actions taken to reduce or eliminate the long-term risk to human life and property from hazards (often referred to as *adaptation* in the context of climate change).

## How Does this Plan Address Climate Change?

This plan's update incorporates basic scientific findings and the most current projections for global climate change and its potential impacts to the Pacific Northwest Region. This literature review provides local policy makers, stakeholders, and community members, a context for evaluating the potential effects of climate change phenomena within the realm of natural hazard mitigation planning for the Thurston Region.

It is beyond the scope of this plan to synthesize a comprehensive overview of climate change science, scenarios, or the predicted impacts to the region. A few property-specific climate change impacts, principally for sea level rise, were gleaned from the literature review and are included later in this section. The solutions included in this plan are unique to the needs of each individual community and are directed at reducing threats to people, community resources, and infrastructure rather than mitigating climate change itself. This approach is consistent with the principle of natural hazard mitigation planning. Future updates to this hazard mitigation plan will incorporate new information about Pacific Northwest climate change and its implications for the Thurston Region.

## What is Climate Change?

Whereas weather is the ever-changing condition and activity of the atmosphere, climate is the average state of the weather. It is understood through historic and continuous methodical observations of variables such as temperature, precipitation, humidity, cloud cover, and wind. The climate of a location is affected by numerous factors such as latitude, altitude, terrain, vegetative cover, snow pack, proximity to large bodies of water, and ocean and wind currents. Overtime, the climate changes in response to the earth's dynamic and ever-changing environment. It is a natural phenomenon that is influenced to some degree by natural forces such as extreme volcanic events and solar activity.

Scientific research provides evidence that the earth is undergoing a warming trend. Research also strongly suggests that human activity is indeed influencing the rate of this trend through the burning of fossil fuels released from activities such as industry, transportation, electrical generation, and other effects resulting from agriculture and deforestation.[1] These activities constitute a higher than naturally occurring input of greenhouse gas emissions into the earth's atmosphere. The level of atmospheric carbon dioxide in the year 2005 (379 parts per million) was higher than any other period over the previous 650,000 years (pre industrial levels were 180 to 300 parts per million)[2].

A change in the chemical makeup of the earth's atmosphere can change the dynamics of climate. Greenhouse gases have the capacity to absorb and reflect infrared energy and therefore play a major role in influencing the dynamics of atmospheric conditions. Growing concentrations of greenhouse gases, such as carbon dioxide, methane, and nitrous oxide magnify the atmosphere's greenhouse effect. These gases trap the sun's radiation within the atmosphere and prevent thermal energy from escaping into space. The trapped energy increases the earth's surface and air temperatures. Direct observations of the 20th century's climate, as reported by the Intergovernmental Panel on Climate Change, provide evidence that the trend of global warming is in progress:[3]

- The mean global surface temperature of the earth has increased by approximately 1.3 degrees F (0.76 degrees C) between 1906 and 2005. The linear trend of rising temperatures over the last 50 years (0.23 degrees F or 0.13 degrees C per decade) is nearly twice the rate than the last 100 years. The years 1995 to 2006 rank among the warmest years of measured global surface temperature.
- The global average sea level has grown at an average rate of 1.8 millimeters per year between 1961 and 2003, and increased by 3.1 millimeters per year between 1993 and 2003.
- The oceans have been absorbing more than 80 percent of the heat added to the earth's climate system. Average global ocean temperatures have increased in depth to 3000 meters. This deeper sea level warming results in greater volumes of seawater expansion, thereby contributing to sea level rise.
- There is worldwide decreases in the extent of mountain glaciers and snow cover in both the northern and southern hemispheres. The ice sheets of Greenland and Antarctica are decreasing in size and the rate of flow of melt water has increased. The transition of this ice to water also contributes to rising sea levels.

- Analysis of satellite data indicates that the annual average arctic sea ice extent has decreased by 2.7 percent per decade. Summer decreases averaged 7.4 percent per decade.

## Washington State Takes Steps to Mitigate Climate Change

Climate change is a global phenomenon that will require intervention from all levels of government and all sectors of society. Washington State has acknowledged that climate change is our society's most significant economic and environmental issue [4]. The State has committed to reductions in greenhouse gas emissions to mitigate the effects of global climate change. In 2008, the State Legislature and Governor Christine Gregoire adopted into law E2SHB 2815 which set forth a framework for Washington State's economy to reduce green house gas emissions as follows:

- Return to 1990 emissions levels by 2020.
- Reduce emissions 25 percent below 1990 levels by 2035.
- Reduce emissions 50 percent below 1990 levels by 2050.

In December 2008, Washington State published "Growing Washington's Economy in a Carbon-Constrained World: A Comprehensive Plan to Address the Challenges and Opportunities of Climate Change."[5] This plan outlines an emission reduction strategy through the long-term development of a green economy, participation in the Western Climate Initiative's market based cap-and-trade greenhouse gas emissions reduction program, and through incentives that promote energy efficient technologies and practices across all sectors of Washington's economy.

## Local Governments Lead in Mitigating Climate Change

Local governments in Thurston County have initiated steps on their own to reduce greenhouse gas emissions and create more sustainable communities through the following types of activities:

- Purchasing and operating more fuel efficient and alternative energy vehicles
- Purchasing green energy to power government buildings and operations (most notably the City of Lacey, LOTT, and The Evergreen State College purchase 100 percent green power from Puget Sound Energy)
- Developing energy efficiency programs
- Implementing waste reduction and recycling programs
- Making significant investments in the capability and capacity to reclaim municipal wastewater at the LOTT wastewater treatment facilities
- Promoting residential and business water conservation programs
- Implementing employee commute trip reduction programs aimed at curbing drive-alone motor vehicle trips
- Community tree planting and reforestation programs

Local governments have adopted land use zoning that also plays a role in reducing emissions. By regulating and encouraging higher density and mixed-use development, communities will eventually

transform to enable more frequent and accessible shorter distance trips that can be made by walking, bicycling, or using transit.

Some communities have also begun the process of educating their residents and businesses about the effects of climate change. The City of Olympia hosted a major community climate change forum at the Washington Center for Performing Arts on October 2, 2007. A guest panel of climate change specialists provided information about climate change science and its potential effects. Around 1,000 people attended to learn what actions and steps individuals and households can take to reduce greenhouse gas emissions. Faculty and students from the Evergreen State College and South Puget Sound Community college assisted in organizing a local teach-in forum on January 30, 2008. Nearly 500 students and community members attended to learn about the effects of global climate change .

## Projected Pacific Northwest Climate Changes

Though significant attention has focused on mitigating climate change by reducing green house gas emissions, the fact is that the current concentration of greenhouse gases in the atmosphere will continue to gradually warm the earth through the remainder of this century. Factoring for the uncertainty of the future climate in planning processes now can enable communities to become more resilient, sustainable, and better able to adapt to 21st century environmental conditions.[6] Scientists and climate change specialists can assist communities by providing objective data and information about climate change based on past observations and modeled projections. With this data, communities can consider a range of projected extreme environmental and climatic conditions in planning processes.

The Climate Impacts Group (CIG), based at the University of Washington, is an interdisciplinary group of scientists and researchers who study natural climate variability and global climate change in the U.S. Pacific Northwest. Their research, publications, and interactions with state and local governments and other regional stakeholders serve to "…increase the resilience of the Pacific Northwest to fluctuations in climate." The CIG's research focuses on four key sectors of the Pacific Northwest environment: water resources, aquatic ecosystems, forests, and coasts. The CIG offers the best available science and projections for Pacific Northwest communities struggling with the uncertainties of climate change.

Scientists use computer based global climate change models to project future greenhouse gas concentrations and estimate future climatic conditions. Models are built on multiple assumptions such as population growth, energy consumption, and multiple atmospheric variables. A model's effectiveness for predicting the future is based on how well it can replicate past observed conditions. In general, scientists have more confidence in the near term climate change projections because there is more certainty with greenhouse gas emissions trends for the first half than the second half of the 21st Century.[7]

The Intergovernmental Panel on Climate Change has developed a standard set of simulations that allow scientists to evaluate and compare the results of multiple global climate change models over time. These large scale models render simulations of both atmospheric and oceanic conditions. In order to better understand localized impacts, modelers evaluate the results from a combination of models including subsets of larger global models and regional models that output climate change

projections for more specific geographic regions like the Pacific Northwest.[8] The CIG's latest Pacific Northwest climate change scenarios utilized regional models that represent the area of Washington, Oregon, Idaho, western Montana, and a small section of British Columbia (between 124 degrees and 111 degrees west longitude, 41.5 degrees to 49.5 degrees north latitude). A summary of 21st century temperature and precipitation projections is presented in Table 4.7.1 (used with permission from the CIG)[9].

**Table 4.7.1: Projected Twenty-First Century Changes in Pacific Northwest Annual Mean Temperature and Precipitation**

| Changes in Annual Mean | | |
|---|---|---|
| | Temperature | Precipitation |
| ***2020s*** | | |
| **Low** | + 1.1ºF *(0.6ºC)* | -9% |
| **Average** | + 2.2ºF *(1.2ºC)* | +1% |
| **High** | + 3.4ºF *(1.9ºC)* | +12% |
| ***2040s*** | | |
| **Low** | + 1.6ºF *(0.9ºC)* | -11% |
| **Average** | + 3.5ºF *(2.0ºC)* | +2% |
| **High** | + 5.2ºF *(2.9ºC)* | +12% |
| ***2080s*** | | |
| **Low** | + 2.8ºF *(1.6ºC)* | -10% |
| **Average** | + 5.9ºF *(3.3ºC)* | +.4% |
| **High** | + 9.7ºF *(5.4ºC)* | +20% |

## Temperature Projections

The following passage from the CIG's website (used with permission) provides a comparative summary of 20th and 21st century temperatures for the Pacific Northwest (PNW) based on historic data and 2008 model projections:[10]

- **The rate of change will be greater.** Climate models project an average rate of warming of approximately 0.5 degrees F per decade through the 2050s (range: 0.2-1.0 degrees F per decade). For comparison, the observed rate of 20th century PNW warming was approximately 0.2 degrees F per decade. The observed rate of warming for the second half of the 20th century was approximately 0.4 degrees F per decade.
- **The total amount of change will be greater.** Average annual temperature is projected to increase 2.2 degrees F by the decade of the 2020s, 3.5 degrees F by the decade of the 2040s, and 5.9 degrees F by the decade of the 2080s, relative to 1970-1999 average temperature. The projected change in average annual temperature is substantially greater than the 1.5 degrees F increase in average annual temperature observed in the PNW during the 20th century.
- **All seasons will be warmer.** Temperatures are projected to increase across all seasons with most models projecting the largest temperature increases in summer (June-August).
- **Average annual temperature will likely exceed the range of 20th century variability.** Average annual temperature in the 21st century could increase beyond the range of year-to-year variability observed in the PNW during the 20th century as early as the 2020s. This means that species or systems that respond primarily to changes in temperature are likely to continually face new conditions as a result of climate change.

### Precipitation Projections

The CIG projects modest changes in Pacific Northwest precipitation through the middle of this century. Researchers admit that there are limits with modeling regional precipitation due to the complexity of dynamic natural systems such as ocean currents, tropical circulation, and interactions between vegetation and the atmosphere. Some models project increases in precipitation levels whereas other scenarios project decreases. The CIG also emphasize that natural annual versus decadal fluctuations in precipitation are likely to be more apparent than the long term trend associated with climate change. The following passage from the CIG's website (used with permission) provides a comparative summary of 21st century precipitation projections with 20th century levels:[11]

- **The projected change in average annual precipitation for all models combined is near zero.** Little change in 21st century average annual precipitation is expected based on this generation of models. While individual models produce changes as much as -10 percent or +20 percent by the 2080s, our best estimate of change is that average annual precipitation will increase only 1 to 2 percent.
- **Existing seasonal patterns of precipitation could be emphasized.** Just over half (59 percent) of the models and scenarios analyzed show an increase in winter (December-February) precipitation in the 2020s and 2040s. By the 2080s, increases in winter precipitation are more likely. More than 70 percent of models and scenarios analyzed agree that summer precipitation will decrease. Regardless of how much winter precipitation changes, a larger percentage of overall winter precipitation is expected to fall as rain rather than snow due to warmer winter temperatures.
- **Average annual precipitation will likely stay within the range of 20th century variability.** Average annual precipitation is likely to stay within the range of 20th century variability. This does not, however, tell us how the intensity of precipitation may change.

## Sea Level Rise Projections

Sea level rise is a critical consideration for public and private sector decision making processes for existing and future shoreline development and protection. Many of Washington State's major cities, numerous smaller cities and towns, ports, tribal lands, residential developments, marine preserves, aquacultural land uses, and a variety of rural lands are situated on or around the coasts. Thurston County and the cities of Lacey and Olympia have marine shorelines that will likely be affected by rising sea levels. Rising sea levels will inundate low lying segments of coastlines, exacerbate tidal flooding conditions for some communities, and subject some shorelines to an increased risk of erosion from storm surge and wind generated waves.[12]

Several factors are used to calculate local sea level rise projections including the thermal expansion of the ocean, the increasing amount of melt water from land-based ice, atmospheric circulation dynamics, and local changes in the elevation of the earth's surface as influenced by movement of the land (tectonic forces and compaction). The most current low, medium, and high Puget Sound sea level rise projections for 2050 and 2100 are listed in Table 4.7.2.

**Table 4.7.2: Puget Sound Sea Level Rise Projections for 2050 and 2100[13]**

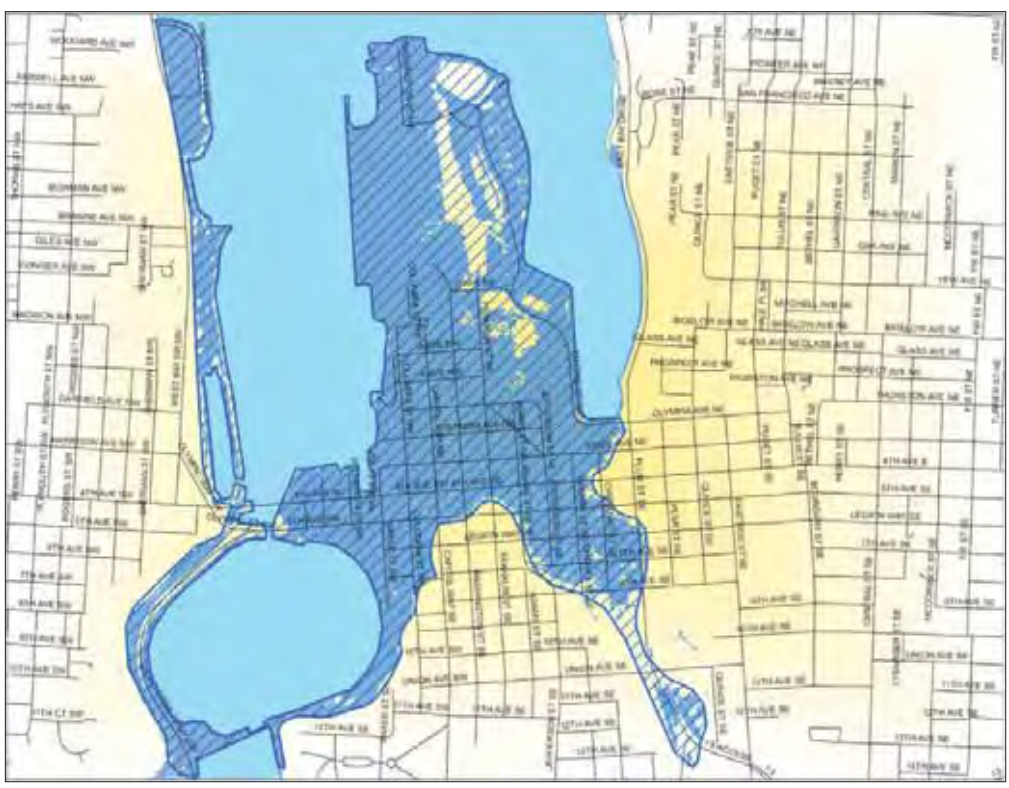
| Sea Level Rise Estimate | By Year 2050 | By Year 2100 |
|---|---|---|
| Low | 8 cm (3”) | 16 cm (6”) |
| Medium | 15 cm (6”) | 34 cm (13”) |
| High | 55 cm (22”) | 128 cm (50”) |

The high projection is based on a scenario with higher estimates of ice loss from Greenland and Antarctica, seasonal changes in the atmospheric circulation in the Pacific, and greater vertical land deformation. For Puget Sound this is a sea level rise of 22 inches by 2050 and 50 inches by the end of the century. The CIG recommends that communities that are evaluating marine shoreline development with long timelines and low risk tolerance should consider using this high-impact low-probability estimate.[14]

## Projected Sea Level Rise Impacts to City of Olympia

Among Thurston County communities, the City of Olympia’s downtown faces the greatest threat from sea level rise as a significant portion of its urbanized waterfront lies only one to three feet above the current highest high tides. In 2007, the City of Olympia conducted a preliminary sea level rise risk analysis[15] for a portion of its downtown core at the southern end of Budd Inlet. The city utilized a three-foot sea level rise scenario forecast to occur by the year 2100. The analysis included factors for global sea level rise, land subsidence, and storm surge. The results revealed inundation of approximately three feet above the current FEMA 100-year flood elevation for downtown Olympia. The hatched and shaded areas in Figure 1 depict the area of downtown Olympia that is at risk from a projected sea level rise of three feet.

**Figure 4.7.1: Downtown Olympia Area at Risk from a Three-Foot Sea Level Rise Scenario.**



Source: City of Olympia, Water Resources.[16]

If no protective measures are taken to mitigate the effects of sea level rise, the following impacts for downtown Olympia can be expected:

- A one-foot sea level rise could result in localized flooding on some city streets and low lying structures during extreme high tides (occur once or twice a year).
- A two-foot sea level rise combined with a high tide would overwhelm some stormwater utility pipes' ability to handle run-off from storm events causing more widespread flooding. Higher sea levels could cause a reverse flow in stormwater drainage systems resulting in sea water flowing out of some street drains onto city streets.
- A three foot-rise would cause seawater to crest over some shoreline segments during extreme high tides and flood a large portion of the downtown. Higher sea levels could further lead to seawater infiltrating wastewater pipes through infiltration and flows into combined storm drains and stress the treatment capacity of the region's LOTT wastewater treatment facility.

The interim findings for sea level rise included in "HB 1303 Interim Report: A Comprehensive Assessment of the Impacts of Climate Change on the State of Washington," identifies potential impacts to the downtown Olympia waterfront. The Olympia port peninsula is built on fill at low elevations and is vulnerable to substantial flooding under a two-foot sea level rise scenario. The LOTT wastewater treatment facility and the Cascade Pole hazardous waste clean-up site are both above the coastal flood zone even at a four-foot sea level rise scenario, but the report states that these properties may be at risk from "storm surge and wind driven waves."[18]

The City of Olympia's primary source of drinking water, McAllister Springs is at risk of salt water intrusion from a rise in sea levels. Eighty-four percent of the city's water comes from this spring located outside of city limits in northeast Thurston County, south of the Nisqually River Delta. The city is already taking steps to mitigate contamination by relocating its primary water source to a more protected location at the McAllister Wellfield site, upland from the current spring.[19]

## Projected Sea Level Rise Impacts to Low-Lying Infrastructure around Capitol Lake

Washington State Department of General Administration (GA) is responsible for the management of Capitol Lake. A study was conducted to evaluate the effects of sea level rise on low-lying infrastructure in the vicinity of Capitol Lake for both the current Lake (management) Alternative and for an Estuary Alternative, whereby the lake is converted back to an estuary. The study evaluated utilities, transportation, parks, and individual buildings and proposed mitigation measures for affected structures. The study identified the following infrastructure as vulnerable to sea level rise:[20]

1. **Deschutes Parkway, BNSF Crossing/Marathon Park Vicinity**

   Though this road is a State owned facility, managed by GA, it is one of the few public routes within the City of Olympia that provides connectivity between west Olympian, the County Courthouse complex, and downtown. Under the Lake Alternative, this low lying section of parkway would flood during a 100-year flood event with a one-foot sea level rise. The same segment would be adversely affected by a six inch sea level rise without a flood event under the estuary scenario. Initial estimates to raise this section of the parkway with associated utility improvements would cost $4 million for either alternative.

2. **The Percival Cove Bridge, Deschutes Parkway**

   This bridge is part of Deschutes Parkway and is also managed by GA. Under the Estuary Alternative, the underside of the bridge would lie within the 2-year flood plain zone, and within the splash zone for high spring tides. The authors assume that the bridge superstructure would be protected with protective coatings, but no cost estimate was included in the report for this measure.

3. **Burlington Northern Santa Fe (BNSF) Railroad Company Railroad Trestle**

   This railroad bridge is critical for connecting freight customers in the Mottman Industrial area, in the City of Tumwater, with rail service to the mainline or the Port of Olympia. BNSF owns this structure, but Tacoma Rail provides rail service along this route. Under the Lake Alternative, the twenty-five year flood elevation reaches within one foot of the top of the railroad tracks with a one- to two-foot elevation in sea-level rise (2 feet above the 100-year floodplain elevation is preferred). Under the Estuary Alternative, this flood elevation is reached with a sea level rise between six inches and one-foot. The initial cost estimates to replace the trestle, and provide transition tracks on both ends of the bridge to meet existing tracks, is $8 million to $9 million for either alternative. The study's authors assume the bridge would be rebuilt when sea level reaches a point where it threatens the bridge's operations. The authors also assume that the railroad tracks that cross Deschutes Parkway would be reconstructed the same time that Deschutes Parkway is elevated.

4. **Capitol Lake Vicinity Parks**

   Marathon and Capitol Lake Interpretive State Parks, managed by GA, and Tumwater Historical Park, owned by the City of Tumwater, are all currently vulnerable to episodic flooding whether or not sea level rise increases under either management alternative. Occasional flooding of the trails in these parks may be acceptable. The parking and the restroom at Marathon Park could be afforded protection from sea level rise flood risks by a perimeter dike when conditions necessitate mitigation. Initial cost estimates for this measure is around $100,000.

   The Old Brewhouse on the east bank of the south basin of Capitol Lake lies within the 100-year flood plain. This structure will be vulnerable to increased flood risk from a one- to two-foot sea level rise. Should this building ever be restored for public and or private use, the study's authors recommend protecting the structure with a perimeter dike. Initial cost estimates for this measure is $500,000.

## Pacific Northwest Climate Change Impacts

The ramifications for a 21st century climate will be based largely on fluctuations in the hydrological cycle. Changes in the timing and amount of rain, snow, the melting of snow, stream flow, and soil moisture will present challenges for managing natural resources that are dependent on surface water. In addition, changes in temperature and precipitation levels may also increase the duration or frequency of future severe winter storm events or prolonged droughts. But how, when, and to what extent these effects might take place remains uncertain.

A 2005 report titled, "Climate Impacts on Washington's Hydropower, Water Supply, Forests, Fish, and Agriculture," concludes that Washington State's economy and natural resources are sensitive to changes in climate. The following passage, presented verbatim, summarizes the report's major findings:[21]

## Hydroelectric Power Production

Increasing temperatures, decreases in snowpack, and shifts in the amount and timing of streamflow will likely reduce winter electricity demands and increase winter electricity generation. Conversely, summer demands are likely to increase overall while summer generation is likely to decrease. Any changes in annual hydropower generation are highly dependent on future changes in winter precipitation, and will probably be determined by the characteristics of future wet or dry cycles, the timing and intensity of which remain uncertain.

## Flood and Stormwater Management

Increasing temperatures and small increases in winter precipitation could lead to increases in the frequency of flooding in some river basins. It is unclear how urban stormwater flooding may change in the future, as modeling the behavior of individual storms, and their potential response to global warming, is currently beyond the capabilities of global climate models.

## Forests

In response to increasing temperatures, some tree species will shift their geographic range, migrating to higher elevations and latitudes. Other species may be unable to adapt and their numbers will decline. Increasing temperatures will likely create favorable conditions for fire and pest outbreaks, which could become more frequent and severe.

## Fisheries

Increasing stream and lake temperatures along with changes in the volume and timing of streamflow could create environmental conditions that are inhospitable to many Pacific Northwest cold water fish populations. Salmon, which represent some of the region's most important fish species, are at particular risk.

## Agriculture

Increasing temperatures and atmospheric carbon dioxide concentrations will likely increase crop yields in places where sufficient soil moisture or irrigation water is available. However, in areas where soil moisture is projected to decrease, crops could suffer more days of heat and moisture stress. The shifts in the timing of peak streamflow could reduce the availability of irrigation water during the summer when it is needed the most. The increasing temperatures may also enhance threats posed by crop pests and pathogens.

## Climate Change Impacts on Human Health

Human health will be impacted by climate change effects. Federal, state, county, and local agency governments will all have a role with the evaluation, management, and development of responses to address climate change impacts on public health. The spread of health impacts will be mitigated through health education and preparedness. Public health planning, disease surveillance, emergency response, and zoning and building codes will also play a critical role in protecting human health from the effects of climate change. HB 1303 Interim Report provides the following preliminary projected effects on human health:[22]

- Heat waves may become more frequent, more intense, and longer lasting. Pacific Northwest cities currently lack air conditioning and older residents and other health-compromised populations could be vulnerable to heat injuries.
- Air quality problems may be exacerbated. Ambient concentrations of ozone and fine particulate matter may increase. A longer growing season will result in a longer pollen season. This increase in respiratory irritants and allergens will adversely impact people with asthma and other respiratory diseases.
- Increased temperatures and flooding could create conditions favorable for the spread of infectious diseases known in Washington, such as Hantavirus pulmonary syndrome (spread by rodents), Vibriosis (from eating raw shellfish), and mosquito-borne diseases such as malaria and West Nile virus.

## The Challenge of Confronting Climate Change

Many local governments and communities feel incapable of confronting the challenges of climate change because it is perceived as a global phenomenon that should be addressed by higher levels of government. Furthermore, mainstream society is just beginning to accept that human activity plays a role in altering the balance of the earth's atmosphere. It may be difficult for some communities to overcome public or political opposition to planning or making investments to mitigate an effect or a hazard that has not been experienced or appears intangible or abstract.

It is important that local government decision-makers take an active role in preparing their communities for climate change, because climate change impacts will be unique to each local community, understood best by the local community, and felt by the local community. Developing flexible plans to factor for the unknown is a good practice in risk management. Relying solely on historic trends will no longer serve as an effective technique for planning for future operations, maintenance, and infrastructure needs – this is also applicable to natural hazard mitigation planning. By increasing the public's awareness of future climate change challenges, local governments are more likely to gain public support to respond to and maintain flexibility for future environmental conditions.

## Climate Change Endnotes

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[2]Ibid.

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[4]Washington State Department of Ecology and Washington State Department of Community Trade and Economic Development. 2008. Growing Washington's Economy in a Carbon-Constrained World: A Comprehensive Plan to Address the Challenges and Opportunities of Climate Change. Publication No. 08-01-025.

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[8]Mote, Philip, E. Salathe, V. Duliere, and E. Jump. 2008. Scenarios of Future Climate for the Pacific Northwest. Climate Impacts Group, University of Washington.

[9]Climate Impacts Group. 2008. Table 1: Average changes in PNW climate from 20 climate models and two greenhouse gas emissions scenarios (B1 and A1B) for the 2020s, 2040s, and 2080s. All changes are benchmarked to average temperature and precipitation for 1970-1999. Model values are weighted to produce the "average." http://cses.washington.edu/cig/fpt/ccscenarios.shtml

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[13]Mote, P.M., A. Petersen, S. Reeder, H. Shipman, and L.W. Binder. 2008. Sea Level Rise in the Coastal Waters of Washington State. A Report by the University of Washington Climate Impacts Group and the Washington Department of Ecology. Table adapted from Table III on p. 10.

[14]Ibid

[15]Haub Andy, D. Harrington, V. McGowan, and H. Reed. 2007. City of Olympia's Response to the Challenge of Climate Change: A Background Report and Preliminary Recommendations. City of Olympia Public Works Department, Water Resources. Pages 22-23 and Appendix A.

[16]Haub et al. 2007.

[17]Personal Communication with Andy Haub, Planning and Engineering Manager, City of Olympia Public Works, Water Resources on September 29, 2008. And City of Olympia City Council Staff Report, May 20, 2008, Agenda Item 6A.

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[22]Miles et al. 2007.

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# Chapter 4.8: Risk Assessment Methodology

## Methodology for Forecast, Inventory, Dollar Value of Assets, and Critical Infrastructure

### Population, Dwelling Unit, and Employment Estimates and Forecasts

Thurston Regional Planning Council (TRPC) develops a population and employment forecast for the region every 3-5 years. The most recent forecast was the 2004-05 Population and Employment Forecast for Thurston County, amended in 2007 to take into account changes in zoning.

The base year (2006) and forecast information on population, dwelling units and employment is available at the tax-parcel level for aggregation to service areas or jurisdictions within Thurston County.

The extent of each hazard was mapped using a geographic information system (GIS). The boundaries were overlain on tax-parcels to provide for an indication as to whether an asset lay within or outside of a specific hazard area. Two different approaches were used to determine if assets fell within a hazard:

- Flood – if the majority of the parcel fell within the 100 or 500 year floodplain or areas susceptible to high ground water flooding then any population, dwelling units and employment associated with that parcel will be counted as susceptible to flooding. This is to take into account that tax-parcel boundaries often extend to the river's edge, however structures are more likely to be located on upland portions if room were available. The assumption is that flood plain mapping is quite detailed for the region, and can be related to specific tax parcels. Thurston County's permitting regulations also prevent most new structures being built in the floodplains, and require structures to be elevated in areas of high groundwater flooding.
- Fire, Landslide, Lahar and Earthquake Hazards – if any portion of the tax parcel overlapped with the identifiable (mapped) hazard any population, dwelling units and employment associated with that parcel will be counted as susceptible to the hazard. The assumption is that the data layers identifying the geographic extent of these hazards is not parcel specific, therefore a broader approximation of the extent of the hazard is acceptable.

Full documentation on the 2004-05 Forecast and 2007 amendments can be found in the Appendices of the Buildable Lands Report for Thurston County, 2007. This report is available online at: http://www.trpc.org/library/planning/growth+management/index.htm or from TRPC.

### Inventory of Assets

The inventory of assets was developed from a variety of sources:

## Assets owned by Participating Jurisdictions

Participating jurisdictions provided their most current replacement valuations of building, contents, and equipment assets for assets owned and maintained by their jurisdiction. Each asset record included the underlying parcel number. Valuation was provided for structures other than buildings, including playground equipment, pump stations, and other local government owned facilities. The data displayed in the assets valuation tables reflect the sum of the building's replacement value and contents replacement value.

## Estimated Building Value

For all assets other than those owned and maintained by participating jurisdictions, replacement building value was assumed to be equivalent to assessed building value. These valuations were received at the tax-parcel level from the Thurston County's Assessor's office (2008 assessment). Assessed values are available for all taxable properties within Thurston County. Note: the assessment of buildings owned by the state or federal government is not necessarily conducted by Thurston County Assessor's Office as these structures are often non-taxable.

## Estimated Building Contents Value

For all assets other than those owned and maintained by participating jurisdictions, building contents value was estimated based on general criteria provided by HAZUS. Each building in Thurston County is categorized based on its occupancy class. Building contents value is estimated to be a percentage of the building replacement value based on that class.

**Table 4.8.1: Occupancy class and estimated contents value of buildings**

| Occupancy Class | Contents Value % (as a percentage of building replacement value) |
|---|---|
| Residential (including temporary lodging, dormitory, and nursing homes) | 50 |
| Commercial (including retail, wholesale, professional, services, financial, entertainment & recreation) | 100 |
| Commercial (including hospital and medical office/clinic) | 150 |
| Commercial Parking | 50 |
| Industrial (including heavy, light, technology) | 150 |
| Agriculture | 100 |
| Religion/Non-Profit | 100 |
| Government Emergency Response | 150 |
| Government General Services | 100 |
| Education Schools/Libraries | 100 |
| Education Colleges/Universities | 150 |

## Critical Infrastructure

Critical Infrastructure consists of assets that are essential to a community's basic life needs. A completely new critical infrastructure database was developed after the adoption of the 2003 Hazard Mitigation Plan. In June and July 2006, local government stakeholders convened to form a Thurston County Critical Infrastructure Database Workgroup. The following jurisdictions participated in the workgroup: Bucoda, Lacey, Olympia, Tenino, Tumwater, Rainier, Yelm, and Thurston County.

The workgroup met to compile critical infrastructure that met certain reporting requirements set by the Washington State Emergency Management Division for Homeland Security purposes. During this data assembly process, the local agencies also developed a database that could be used by members of the Emergency Management Council (EMC) for local emergency planning and response.

TRPC facilitated the workgroup meetings and compiled the information collected during the data exchanges into a database. The workgroup identified 350 government and private sector critical facilities that are located both within and outside of the communities of Thurston County.

**Table 4.8.2: Thurston Region Local Governance Critical Infrastructure Sectors and Subsectors**

| SECTOR | SUBSECTOR | LOCAL CRITERIA |
|---|---|---|
| 1. AGRICULTURE/ FOOD SUPPLY | | |
| | 1.1 Production | Large farms that supply foodstuffs to Thurston County residents |
| | 1.2 Food Distribution/Storage | Those facilities that store and distribute significant amounts of food. |
| | 1.3 Animal Food Distribution/ Storage | Those facilities that store or distribute significant amounts of animal food. |
| 2. GOVERNMENT | 2.1 Fire Services | Those facilities that support the fire services. |
| | 2.2 Emergency Operations Centers | Those facilities that serve as Emergency Operations Centers and alternate sites. |
| | 2.3 Law Enforcement | Those facilities that support law enforcement. |
| | 2.4 Coroner/Morgue | Those facilities that provide primary and secondary coroner/morgue/crematory services. |
| | 2.5 Shelter | Those facilities designated as shelter sites. |
| | 2.6 Laboratories | Those facilities that provide essential laboratory services. |
| | 2.7 Ambulance | Those private facilities that provide ambulance service. |
| 3. FINANCIAL INSTITUTIONS | 3.1 Banking | Those facilities with over 1 billion dollars in State deposits. |
| 4. MEDICAL CARE | 4.1a Hospitals<br>4.1b Large Clinics<br>4.1c Urgent Care Centers<br>4.1d Surgical Suites | Those facilities that provide urgent and critical care. |
| | 4.2 Chemical Dependency Treatment Center | Those facilities that provide chemical dependency care. |

| | | |
|---|---|---|
| | 4.3 Special Population Treatment Center<br>4.3a Methadone<br>4.3b Dialysis<br>4.3c Mental Health<br>4.3d Birthing Centers | Those facilities that provide services to special populations. |
| | 4.4 Nursing Homes | Those facilities that provide nursing care. |
| | 4.5 Assisted Living Centers | Those facilities that provide assisted living. |
| | 4.6 Medical Care Providers | Those facilities that provide medical services. |
| 5. UTILITIES | 5.1 Wastewater treatment facilities | Those facilities that treat wastewater. |
| | 5.2 Electricity and Gas | Those facilities that transmit electricity and natural gas with special concern for primary switching stations or hubs. |
| | 5.3 Communication towers | Those towers that provide critical communications links |
| | 5.4 Land line Phone | Those facilities that provide land line phone service. |
| | 5.5 Radio/Television | Those providers designated as emergency broadcast stations |
| | 5.6 Data Transmission Lines | Those lines that carry essential data that supports essential business and governmental functions. |
| | 5.7 Water systems and reservoirs | Those systems that are considered public. |
| | 5.8 Solid waste management | Those facilities that provide solid waste management. |
| 6. TRANSPORTATION | 6.1 Air | Those facilities that provide commercial /regional air service. |
| | 6.2 Rail | Those facilities that provide mainline and port access. |
| | 6.3 Roads | Those facilities designated as priority by jurisdictions. |
| | 6.4 Vehicle Fuel | Those facilities that provide fuel for vehicles involved in providing essential services. Also, those facilities that are hubs, major storage facilities, or switching stations for fuel. |
| | 6.5 Student Transportation | Those facilities that provide transportation services that could be enlisted for mass evacuation or emergency transport. |
| | 6.6 Mass transit | Those facilities that provide transit services to the general public that could also be used for mass evacuation or emergency transport. |
| | 6.7 Port | Those facilities that have the capacity to ship or receive essential goods. |

As part of the five-year Hazard Mitigation Plan update, TRPC updated this database with additional records to capture new infrastructure such as newly constructed police and fire stations, schools, and water treatment facilities. Through a geographic information system, each record that contained a street address was assigned a unique X and Y coordinate; a process known as geo-coding. As a result, each geo-coded record could be mapped and analyzed to determine if it was located in the earthquake, flood, landslide, lahar, or wildland fire hazard zones. The storm hazard was not considered because there is no geographical delineation for weather (100 percent of all critical infrastructure has some level of storm exposure).

Approximately 76 percent of the records (266) were associated with a known location and were subsequently analyzed for hazard zone detection. Records that were not geo-coded could not be processed because they lacked a valid address or fell outside of Thurston County and therefore were not considered in the critical infrastructure hazard assessment. For each hazard profile, a regional summary of the total critical infrastructure within the hazard zone is tabulated by sector. Specific locations of critical infrastructure assets are maintained by Thurston County Emergency Management and the respective jurisdictions.

## Hazard Delineation Zone Data Sources

The following spatial data sets were used in the development of the Hazard Mitigation Plan

| Spatial Data | Source |
|---|---|
| Flood Hazard Data<br>Thurston County<br>100 Year SFHA<br>500 Year Floodplan<br>High Groundwater | Thurston GeoData Center staff (http://www.geodata.org/home.htm) digitized the 100 and 500 year flood hazards off of the original 1982 FEMA FIRM panels. General accuracy is reported to be within 150 feet.<br>The High Groundwater dataset was digitized by Thurston GeoData Center staff following the 1997 and 1999 flood events. This dataset includes a 300 foot buffer around high groundwater affected areas. Data were digitized off of WSDOT aerial photos flown immediately after the flood.<br>The 100 and 500 year flooddata for the Nisqually Indian Reservation is from Pierce County's preliminary DFIRM (in review by FEMA). |
| Other Counties<br>100 Year SFHA<br>500 Year SFHA | Flood Hazard data for the counties neighboring Thurston County were acquired from the FEMA Q3 flood hazard mapping program.<br>(http://www.fema.gov/hazard/map/q3.shtm) |
| Earthquake Liquefaction Data | Washington State Department of Natural Resources Open File Report 2004-20: Liquefaction Susceptibility and Site Class Maps of Washington State, by County, by Stephen P. Palmer, Sammantha L. Magsino, Eric L. Bilderback, James L. Poelstra, Derek S. Folger, and Rebecca A. Niggemann. 2004. Data is available via the DNR website (http://www.dnr.wa.gov/) |
| Case 1 Volcanic Lahar Data | United States Geological Survey, Cascade Volcano Observatory. Digital Data for Volcano Hazards from Mount Rainier, Washington: Revised 1998: Case1. By S.P. Schilling, S. Doelger, R.P. Hoblitt, J.S. Walder, C.L. Driedger, K.M. Scott, P.T. Pringle, J.W. Vallance. 1:100,000 scale. Data is available via the USGS website (http://www.usgs.gov/). |
| Coastal Landslide Hazard (landforms.shp) | Washington State Department of Natural Resources, Division of Geology and Earth Resources, Unpublished Data, Michael Polenz et al. (ftp://198.187.3.44/geology/thurston%20landslides/) |
| Landslide Hazard (slopes > 40%) | Slopes within Thurston County were calculated with the ArcGIS Slope tool based on a 30 foot cell size which was resampled from the original 6 foot cell size as developed by the Puget Sound Lidar Consortium (http://pugetsoundlidar.ess.washington.edu/)<br>Slopes outside of Thurston County were calculated using a 100 foot cell size with the source being the USGS 10-meter DEM. |
| Wildland Urban Interface Fire At Risk Communities | Data were acquired from the Washington State Department of Natural Resources and are based upon the current National Fire Protection Association (NFPA 299) risk assessment. (http://fortress.wa.gov/dnr/app1/dataweb/dmmatrix.html#Wildfire%20and%20Prevention) |
| Parcel Data | Parcel data were acquired from the Thurston GeoData Center and are developed and maintained by the Thurston County Assessors Office. A slightly modified version of the 2006 parcel data was prepared by TRPC to match TRPC's Buildable Lands Database. |

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# Chapter 5: Mitigation Goals and Initiatives

## Introduction

This chapter describes the framework that comprises the region's mitigation strategy. The mitigation strategy serves as the long-term blueprint for reducing potential losses that are described in the risk assessment. The mitigation strategy consists of goals, objectives, and prioritized mitigation initiatives.

The goals and objectives identify what the Thurston Region's hazard mitigation planning partners intend to achieve in order to reduce the impacts of natural hazards on people and property and reduce potential losses. The goals and objectives also guide the development of mitigation actions or initiatives. Mitigation initiatives are the action items in the *Natural Hazards Mitigation Plan for the Thurston Region*. The term "mitigation initiative" refers to an action designed to reduce or eliminate losses resulting from natural hazards. Local governments formulate their mitigation strategies by: proposing actions and identifying who will be responsible for implementing them; estimating costs and potential funding sources; projecting timeline for implementation; and selecting a process for monitoring and evaluating the outcomes. It is through the implementation of these initiatives that the communities within Thurston County can truly become more disaster resistant.

Although this chapter describes how mitigation initiatives were identified and prepared, it only includes a list of county wide mitigation initiatives that are common and beneficial to all of the region's planning partners. Initiatives that are specific to each jurisdiction are located in their respective annex.

## Goals and Objectives

Federal hazard mitigation planning requirements specify that a plan must identify goals that reduce communities' vulnerabilities to the hazards that are identified in the plan's risk assessment.

| | |
|---|---|
| ***Requirement §201.6(c)(3)(i):*** | [The hazard mitigation strategy **shall** include a] description of mitigation goals to reduce or avoid long-term vulnerabilities to the identified hazards. |

In 2003, the region's hazard mitigation planning partners identified goals and objectives to guide hazard mitigation planning to the year 2025. Since the plan's adoption, the region has made noteworthy progress towards accomplishing several objectives. Considerable more work is required, by individual jurisdictions and collectively as regional partners, to create more disaster resilient communities.

The original plan's goals remain valid and are unchanged except for very minor modifications (the changes are documented at the end of the next section). Each goal statement has objectives that provide a more specific framework for actions to be taken by the planning partners. The goals and objectives in this plan also serve to build consistency in hazard mitigation planning efforts between the communities of Thurston County and the State of Washington.

## Thurston Region Hazards Mitigation Goals and Objectives

The goals and objectives are adopted by all of the region's hazards mitigation planning partners. The objectives define actions or results that can be placed into measurable terms, and translated into specific assignments for implementation. Each objective fulfills an important role and is integral to the creation of more disaster resilient communities. The goals and objectives listed below are not prioritized in terms of their significance or the order in which they will be fulfilled. Their numbers serve as reference link between the mitigation initiatives and the goals and objectives they support.

The following are the goals and objectives for mitigating natural disasters in the Thurston Region:

1. **All sectors of the community work together to create a disaster resistant community.**
   - A. State, tribal and local governmental entities and community organizations choose to participate in the planning process.
   - B. Promote hazards mitigation planning between local government, the business community, and volunteer organizations.
   - C. Update the natural hazards mitigation plan on a regular basis, and as needed after a disaster event.
   - D. Develop a process to share "lessons learned" after each significant disaster event in the Thurston region.
   - E. Alert the community to the next update cycle of the natural hazards mitigation plan, and how they might become involved in that planning process.
2. **Local and state government entities have the capabilities to develop, implement, and maintain effective natural hazards mitigation programs in the Thurston region.**
   - F. Maintain existing data as well as gather new data and information needed to define hazards, risk areas, and vulnerabilities in the Thurston Region.
   - G. Undertake an evaluation by 2015 (during the third plan development cycle) to determine the effectiveness of mitigation initiatives implemented in the Thurston region.
   - H. Ensure that employees in the Thurston region have the necessary technical skills for mitigation planning and programming.
3. **Collectively the communities in the Thurston region have the capacity to initiate and sustain emergency operations during and after a disaster.**
   - A. Ensure that local emergency services have the capability to detect emergency situations and promptly initiate emergency response operations.
   - B. Ensure that local emergency services facilities can withstand the impacts of disasters. Retrofit or relocate these facilities, as needed.
   - C. Ensure that utility and communications systems supporting emergency services operations can withstand the impacts of disasters. Retrofit or relocate these facilities, as needed.
   - D. Designate and modify evacuation routes before, during and after a disaster event.
   - E. Designate suitable evacuation shelters before, during and after a disaster event.

F. Ensure that structures for vehicles and equipment needed for emergency services operation can withstand disaster impacts. Retrofit or relocate these facilities, as needed.

I. Prioritize the reopening of vehicle access routes to evacuation shelters and key health care facilities after a disaster.

**4. Local government operations are not significantly disrupted by disasters from natural hazards.**

A. Prepare community specific redevelopment plans to guide recovery after a disaster.

B. Protect important local government records from the impacts of disasters.

C. Retrofit or relocate buildings and facilities used for routine operations of government so they can withstand the impacts of disasters.

D. Have available (e.g. purchase and stockpile) redundant equipment, facilities, and supplies to reestablish local government operations after a disaster.

E. Adopt a plan and identify resources for how local government operations will be reestablished after a disaster.

**5. Reduce the vulnerability to natural hazards in order to protect the life, health, safety and welfare of the community's residents and visitors.**

A. Provide the highest degree of natural hazards protection at the least cost by working with natural systems and using prevention as a first priority.

B. Ensure there are adequate systems in place to provide emergency instructions during a disaster.

C. Remove or relocate residential structures from 100 year floodplains and identified landslide hazard areas, as state or federal monies are available.

D. Elevate residential structures above the 100 year floodplain as state or federal monies are available, when removal or relocation is not feasible.

E. Rely upon a combination of state, or federal grants and locally generated funds (for the required match) to implement most mitigation initiatives.

**6. Local governments will support natural hazards mitigation planning, and implement the mitigation initiatives for their jurisdiction.**

A. Integrate the mitigation initiatives from the natural hazards mitigation plan into local government's comprehensive plans, development regulations, and capital facilities plans (CFPs).

B. Adopt Critical Area Ordinance (CAO) regulations which prohibit the location of inappropriate land uses within areas of high risk, and require mitigation measures when structures or facilities are allowed in areas of less risk.

C. Adopt and enforce the most recent version of the International Building Code (IBC) along with its chapters as a way to address landslide and earthquake hazards.

D. Adopt land use designations, comprehensive plan policies, and development regulations which minimize new development within high hazard areas.

E. Enroll in the Community Rating System (CRS) as a part of the National Flood Insurance Program.

F. Locate new facilities outside of areas vulnerable to the impacts of natural hazards. Where this is not feasible, design these facilities so they can withstand the impacts of a disaster.

G. Minimize the vulnerability of libraries, museums, and other institutions important to the daily lives of the community.

7. **The local infrastructure of communities in the Thurston region is not significantly affected by a disaster from a natural hazard.**

   A. Design and retrofit essential transportation facilities and systems to minimize the potential for disruption during a disaster.

   B. Design and retrofit essential water and sewer services to minimize the potential for disruption during a disaster.

   C. Encourage private sector hazards mitigation planning for the design and retrofit of energy and telecommunication infrastructure to minimize the potential for disruption during a disaster.

   D. Support key employers in the community to implement mitigation measures for their facilities and systems.

8. **Residents understand the natural hazards of the Thurston region and are aware of ways to reduce their personal vulnerability to those hazards.**

   A. Develop and implement education programs which explain the vulnerabilities and risks of natural hazards in the Thurston region, and ways to reduce their personal vulnerability to those hazards.

   B. Develop and implement education programs which explain the mitigation initiatives to be undertaken by various communities in the Thurston region.

   C. Develop and implement education programs for appropriate local government employees that explain the mitigation initiatives to be undertaken in the Thurston region.

## Revisions to Goals and Objectives

The goals and objectives were reviewed by both the Hazards Mitigation Plan Workgroup and the Emergency Management Council. Despite the issuance of six Federal Disaster Declarations since the first plan's adoption, the region's planning partners consented that the region's goals and objectives remain valid. Only three changes were made:

1. Objective 2B was changed from "Undertake an evaluation by 2008 (during the second planned update cycle)…" to "Undertake an evaluation by 2015 (during the third plan development cycle) …"
2. For goal number 5, the word "life" was added to emphasize the scope of protection.
3. Objective 6C was changed from "Uniform Building Code" to "International Building Code."

## Progress towards Goals and Objectives

The region's planning partners have made steady progress towards fulfilling this plan's goals and objectives. Although the original plan set a goal fulfillment date of the year 2025, most of the plan objectives will require continuous effort and must be maintained in perpetuity to protect life and property throughout the county. The progress made on goals 1 and 2 in the last five years can be successfully measured in the contents of this plan update. However, hazards mitigation planning is a process that requires multiple stakeholders to continuously monitor, evaluate, and revise the plan as appropriate. Planning partnerships must be maintained and communities must continue to invest in their capabilities to perform successful hazards mitigation planning.

The successful outcome of many of the plans objectives will be measured by progress made in the locally adopted mitigation initiatives. Some will take considerable time and resources to complete, but evidence of progress is apparent for several jurisdictions in fulfilling the region's objectives. The following accomplishments have made communities in Thurston County more disaster resilient:

- The City of Yelm has completed its highest priority mitigation initiative, the replacement of its aging police station with a modern seismically safe law and justice facility. This mitigation action supported objectives 3B and 3C.
- The cities of Olympia and Tumwater have adopted development regulations for high groundwater areas which will reduce the likelihood of future structures being affected by flooding. These efforts support objective 6B.
- Thurston County continues to improve its capabilities to develop, implement, and maintain effective natural hazards mitigation programs in the Thurston region. It has played a lead role in the update to the *Natural Hazards Mitigation Plan for the Thurston Region* and it continues to be actively involved in Chehalis River Basin Flood Authority. These efforts fully support all of the objectives of Goals 1 and 2.
- In 2008 Thurston County obtained a State Community Development Block Grant to elevate up to 35 residences in the Chehalis River basin in unincorporated areas of Thurston County. This effort supports objective 5D.
- Intercity Transit upgraded its backup electric generator in 2006. The new generator has enough capacity to completely power Intercity Transit's main base of operations. The system has provided critical backup power services on several occasions since its installation. The backup power service has enabled the region's transit service provider to continue providing much needed public transportation services. This effort supported objectives 3C and 4D.
- The Evergreen State College completed a seismic retrofit of the Daniel J. Evans Library Building, supporting objective 4C.

## Relationships with the Washington State Natural Hazards Mitigation Plan

The Washington State Hazard Mitigation Plan provides guidance for hazard mitigation planning in the State of Washington. The mission of the State's plan is to "Reduce the adverse impacts and losses caused by natural hazard events."[1] The Thurston Region's goals and objectives are specific to the needs of the region's communities, but it is important to establish consistency between state and

local plans in order to effectively coordinate mitigation activities. The Thurston Region's goals and objectives are consistent with the state plan as shown in Table 5.1.

**Table 5.1: State Mitigation Goals and Objectives and their Relationship to the Thurston Region's Mitigation Objectives**

| State Goals | State Objectives | Relates to Thurston Region Objectives |
|---|---|---|
| **1. Protect Life** | 1.1 Improve systems that provide warning and emergency communications. | 3A, 3C, 5B |
| | 1.2 Develop or amend laws so they effectively address hazard mitigation. | 6B, 6D |
| | 1.3 Reduce the impacts of hazards on vulnerable populations. | 5C, 5D, 5E |
| | 1.4 Strengthen state and local building code enforcement. | 6C |
| | 1.5 Train emergency responders. | 2C, 3A, 4A |
| **2. Protect Property** | 2.1 Protect critical assets. | 3F, 4B, 4C, 7B, 7C |
| | 2.2 Protect and preserve facility contents. | 3F, 4B |
| | 2.3 Reduce repetitive and severe repetitive losses, including those caused by flooding. | 5C, 5D, 5E |
| **3. Promote a Sustainable Economy** | 3.1 Provide incentives for mitigation initiatives. | 5E, 6E |
| | 3.2 Continue critical business operations. | 3F, 3G, 4D, 4E |
| | 3.3 Form partnerships to leverage and share resources. | 1A, 1B, 1E, 2A, 7D |
| **4. Protect the Environment** | 4.1 Develop hazard mitigation policies that protect the environment. | 5A, 5C, 6A, 6B, 6D |
| **5. Increase Public Preparedness for Disasters** | 5.1 Understand natural hazards and the risk they pose. | 1D, 2A |
| | 5.2 Improve hazard information, including databases and maps. | 1D, 2A |
| | 5.3 Improve public knowledge of hazards and protective measures so individuals appropriately respond during hazard events. | 8A, 8B, 8C |
| | 5.4 Develop new policies to enhance hazard mitigation initiatives. | 1C, 2B |

## Identification and Preparation of Mitigation Initiatives

Federal hazard mitigation planning requirements specify that local governments evaluate the benefits and costs of mitigation initiative alternatives and prioritize initiatives according to their benefits or the needs of the jurisdiction.

| | |
|---|---|
| *Requirement §201.6(c)(3)(ii):* | [The mitigation strategy **shall** include a] section that identifies and analyzes a comprehensive range of specific mitigation actions and projects being considered to reduce the effects of each hazard, with particular emphasis on new and existing buildings and infrastructure. |

| | |
|---|---|
| *Requirement §201.6(c)(3)(iii):* | [The mitigation strategy section **shall** include ] an action plan describing how the actions identified in section (c)(3)(ii) will be prioritized, implemented, and administered by the local jurisdiction. Prioritization shall include a special emphasis on the extent to which benefits are maximized according to a cost benefit review of the proposed projects and their associated costs. |

## Identification

The process to identify mitigation initiatives for the original plan and this plan update were prepared in a similar manner. Each Workgroup member represented their jurisdiction and was responsible for gathering and coordinating the information required for their initiatives. TRPC staff provided planning partners a compact disc containing a variety of data to support the development of their mitigation initiatives:

- The original mitigation initiatives from the 2003 plan
- The updated Regional Risk Assessment
- Jurisdiction-specific hazard maps for each of the profiled hazards that affect their jurisdiction
- Hazard exposure tables including jurisdiction-specific critical infrastructure and public owned assets
- Benefit cost review worksheets and instructions
- Local mitigation initiative template with instructions
- FEMA State and Local Mitigation Planning How to Guide Series 386-1 to 386-8
- FEMA "Mitigation Ideas"

The process for evaluating vulnerabilities and identifying a range of alternative mitigation actions to reduce actual and potential hazard exposures varied among jurisdictions depending upon their capabilities and resources. In general, workgroup members collaborated with staff and or committees within their jurisdictions that were most familiar with their infrastructural systems, facilities, assets, services, or the geographic area being addressed. Local planning partners referenced a variety of materials such as their risk assessment, comprehensive plans, strategic plans, emergency management plans, capital facility plans, after action review debriefings, and other planning documents.

The planning partners' identification processes considered existing initiatives from the original hazards mitigation plan, new and original initiatives identified in this plan update process, and initiatives that have already been identified or documented in a different planning process such as a stormwater utility capital facilities plan.

## Benefit Cost Review

FEMA requires local governments to analyze the benefits and costs of range of mitigation actions that can reduce the effects of each hazard within their community. A hazard mitigation plan must demonstrate that a process was employed that emphasized a review of benefits and costs when prioritizing the mitigation actions. The benefit-cost review must be comprehensive to the extent that

it can evaluate the monetary as well as the non-monetary benefits and costs associated with each action.[2] The benefit-cost review should at least consider the following questions:

- How many people will benefit from the action?
- How large an area is impacted?
- How critical are the facilities that benefit from the action (which is more beneficial to protect, the fire station or the administrative building)?
- Environmentally, does it make sense to do this project for the overall community?

The severity of hazards and their impacts vary among the region's jurisdictions due to their geography, but more so because of the varying range of resources and services that they are responsible for providing their customers. For example, the mission of a rural fire district varies greatly from that of a general purpose municipality. As such, their range of mitigation actions for the same hazard will differ substantially. Each plan partner has to consider their jurisdiction's exposure, their capabilities, their resources, and select an appropriate process to evaluate the benefits and costs of various mitigation actions.

In the 2003 planning process, some of the initiatives underwent a benefit to cost analysis using the Mitigation 20/20™ software provided by the State and FEMA. This analysis was only performed for initiatives if the data was available. The method was not utilized by all of the participating jurisdictions and it was not consistently applied by those that did use it. This analysis generated a benefit to cost ratio and a priority score, but the effort required to input the variables exceeded the output's reliability as an effective analytical tool. The Mitigation 20/20™ software was not used in the 2008/2009 plan update process.

For the plan update process, the Workgroup selected a benefit-cost review method known as STAPLEE. STAPLEE is an acronym for the following criteria that are scored according to benefits or costs of any proposed initiative: social, technical, administrative, political, legal, economic, and environmental. The STAPLEE method is outlined in FEMA's how-to guide, *Developing the Mitigation Plan (FEMA 386-3, 2003).* TRPC provided workgroup members a worksheet and instructions for conducting this process. The worksheet provided general criteria (Table 5.2), but jurisdictions could elect to modify the criteria to fit their needs. Jurisdiction staff scored each mitigation initiative or alternative action according to its benefit (positive score) or cost (negative score) as follows:

| Benefit | | | Cost | | |
|---|---|---|---|---|---|
| Low, +1 | Moderate, +2 | High, +3 | Low, -1 | Moderate, -2 | High, -3 |

The worksheet allowed a jurisdiction to score multiple alternatives mitigation actions to address a particular vulnerability or a hazard, and compare the relative benefits and costs of each of the alternative actions. A final score is tallied for each alternative mitigation initiative by summing the score assigned to each alternative across the criteria. The greater the score, the greater the project benefit. Jurisdictions could use this rating to select a preferred alternative and/or prioritize mitigation actions.

*The STAPLEE evaluation criteria and a sample worksheet are located in Appendix E.*

## Prioritization

The mitigation initiatives are prioritized by the individual jurisdictions based on factors relevant to their local conditions and needs. In general they were prioritized according to their overall benefit and their relationship to the plans' goals and objectives. Some priorities were pre-determined through planning process that preceded the natural hazards mitigation plan update process. The process used to prioritize the county wide mitigation initiatives is described later in this chapter.

**Table 5.2: General STAPLEE Criteria**

| | |
|---|---|
| **Social** | Community Acceptance |
| | Effect on Segment of Population |
| **Technical** | Technical Feasibility |
| | Long-Term Solution |
| | Secondary Impacts |
| **Administrative** | Staffing |
| | Funding Allocated |
| | Maintenance and Operations |
| **Political** | Political Support |
| | Local Champion |
| | Public Support |
| **Legal** | State Authority |
| | Existing Local Authority |
| | Potential Legal Challenge |
| **Economic** | Benefit of Action |
| | Cost of Action |
| | Contributes to Economic Goals |
| | Outside Funding Required |
| **Environmental** | Effect on Land/Water |
| | Effect on Endangered Species |
| | Effect on HAZMAT Waste Sites |
| | Consistent with Community Environmental Goals |
| | Consistent with Federal Laws |

## Categorization

Every mitigation initiative is categorized according to the type of mitigating function it provides. Seven mitigation initiative categories were identified in the original plan and remain the same as follows:

1. **Public Outreach and Information**: Information delivered in a variety of formats intended to inform and educate community members, elected officials, and property owners about the hazards and potential ways to mitigate them. Such actions include websites, outreach projects, real estate disclosure, fairs and expos, and school-age and adult education programs.

2. **Plan Coordination and Implementation**: Activities that support a jurisdiction's natural hazards mitigation planning process and implementation strategy within their organization and in conjunction with neighboring jurisdictions and relevant stakeholders.

3. **Data Collection and Mapping**: Actions that relate to the process of gathering and analyzing new data and then mapping or utilizing the information in such a manner that it improves communities' ability to make informed decisions about increasing their disaster resilience.

4. **Development Regulations**: Government administrative or regulatory actions or processes that influence the way land and buildings are developed and built. These actions also include public activities to reduce hazard losses. Examples include planning and zoning, building codes, capital improvement programs, open space preservation, and storm water management regulations.

5. **Hazard Preparedness**: Advance actions that serve to protect people and property during and immediately after a disaster or hazard event. These could include the development or improvement of warning systems, emergency response services, and the stockpiling of supplies and materials.

6. **Hazard Damage Reduction**: Actions that involve the modification of existing buildings or structures to protect them from a hazard, or removal from the hazard area. Examples include acquisition, elevation, relocation, structural retrofits, storm shutters, and shatter-resistant glass.

7. **Critical Facilities Replacement/Retrofit**: Refers specifically to hazard damage reduction activities targeted specifically at protecting or replacing critical facilities.

## Mitigation Initiative Format

A mitigation initiative template with instructions was provided to every participating jurisdiction. The same format was used by every jurisdiction to prepare their mitigation initiatives, including the county wide initiatives located at the end of this chapter. The format and content of the mitigation initiatives remains the same with the following exception: the Mitigation 20/20™ "Priority Score" and "Final Benefit to Cost Ratio" were omitted from the form as this software package was not used during the plan update process and the score is no longer relevant.

Each mitigation initiative is formatted as follows (a brief description of each field heading is provided):

Priority: the current ranking of the mitigation initiative as assigned by the jurisdiction, for example 1 of 10. If an initiative was completed or removed, a ranking is not applicable and is shown as "N/A"

Status: "New" refers to a mitigation initiative newly created as part of the plan update process; "existing" refers to an unfinished initiative that is carried over the 2003 Natural Hazards Mitigation Plan, or imported from another planning document; "modified" refers to an existing initiative that carried over from the previous plan, but has changed to limit or expand its scope of activities; "completed" refers to an initiative that was successfully fulfilled; and "removed" refers to an initiative that is no longer considered relevant or is replaced by another initiative.

**Hazard Addressed**: refers to the specific hazard, profiled in the risk assessment that the mitigation initiative addresses, for example "earthquake," or "multi-hazard."

**Category**: refers to one of the seven function mitigation categories identified above, for example, "data collection and mapping."

**Mitigation Initiative Identification Number**: this refers to the unique administrative code of each mitigation initiative. The unique code allows local agencies and plan reviewers to monitor the progress of each initiative through its lifecycle. The codes from the 2003 plan will be carried over into the updated plan. The convention of the identification number is as follows:

*Agency Code + Hazard Category Code + Sequential number*.

**Title**: a brief description of the action to be taken.

**Rationale**: A statement of justification as to why the mitigation initiative is necessary.

**Relates to Plan Goal(s) and Objectives**: refers to the specific goal(s) and objective(s) that the mitigation initiative supports.

**Implementer**: refers to the agency department or title of the staff member responsible for implementing the initiative.

**Estimated Cost**: refers to the current estimated cost of the initiative.

**Time Period**: refers to when the agency believes it will be able to accomplish the initiative. For example, 2012 or 2025.

**Funding Source**: refers to the anticipated source of revenue that will be used to fund the initiative.

**Source and Date**: Refers to an agency document from which an initiative may have been originally identified. For example, "2003 Natural Hazards Mitigation Plan for the Thurston Region."

**Adopted Plan Number:** refers to the identifier of the initiative within the sourced adopted document.

**Reference Page**: refers to the page which the initiative can be found in the adopted document.

**Implementation Status**: a narrative assessment of the progress made on the initiative.

## Evaluation of Mitigation Initiatives

Twenty jurisdictions adopted hazard mitigation plans as part of the region's first multi-jurisdictional plan between November 2003 and July 2005. The plan identified 10 county wide mitigation initiatives, and 129 mitigation initiatives were adopted among the individual jurisdictions. Table 5.3 lists the number of initiatives that were adopted by each participating jurisdiction prior to this plan update.

**Table 5.3: Mitigation Initiatives, Adopted by Jurisdiction, in the 2003 (First Edition) Natural Hazards Mitigation Plan for the Thurston Region**

| Jurisdiction | Initiatives |
|---|---|
| County-wide | 10 |
| Thurston County | 28 |
| Town of Bucoda | 5 |
| City of Lacey | 10 |
| City of Olympia | 8 |
| City of Rainier | 2 |
| City of Tenino | 2 |
| City of Tumwater | 18 |
| City of Yelm | 2 |
| Confederated Tribes of the Chehalis Reservation* | 3 |
| Fire District 4 - Rainier | 1 |
| Fire District 9 - McLane | 4 |
| Fire District 13 – Griffin* | 1 |
| Intercity Transit | 1 |
| Providence St. Peter Hospital | 5 |
| School District, North Thurston Public Schools | 6 |
| School District, Olympia | 3 |
| School District, Rainier | 3 |
| School District, Tumwater | 4 |
| School District, Yelm Community Schools | 3 |
| The Evergreen State College | 20 |
| Total Adopted Mitigation Initiatives | 139 |

*Note: Jurisdiction did not participate in the plan update process.

The hazard mitigation planning requirements per 44 CFR Section 201.6(d)(3) requires local governments to assess their previously adopted mitigation initiatives:

*…jurisdictions to review and revise their plans to reflect progress in local mitigation efforts and changes in priorities, and resubmit them for approval every five years. The updated multi-jurisdictional plan* ***must*** *identify the completed, deleted or deferred actions from the previously approved plan as a benchmark for progress. Further, the updated plan* ***shall*** *include any new*

*mitigation actions identified in its evaluation and prioritization since the previous plan was approved or through the plan update process. If the mitigation actions remain unchanged from the previously approved plan, the updated plan* ***must*** *indicate why changes are not necessary.*

Every mitigation initiative that was adopted as part of the original *Natural Hazards Mitigation Plan for the Thurston Region* was reviewed according to the requirements above. Jurisdictions reported their progress in the "implementation status" field on the mitigation initiative form. All of the other preceding fields were updated, if appropriate, to reflect the current conditions. In addition, all mitigation initiatives were reprioritized.

## County Wide Mitigation Initiatives

The county wide initiatives proposed in this plan will require continuous coordination and collaboration among this plan's existing partners and future partners over the next five years and beyond to attain successful implementation. Each individual jurisdiction's adopted mitigation initiatives are located in their local annex. Their content and format is displayed in the same fashion as shown in the subsequent pages following this section.

### Prioritization

The county wide mitigation initiatives were prioritized by the Workgroup. The Workgroup members utilized a numerical ranking process to sort the initiatives. All of the initiatives were listed on a large white board. The workgroup discussed the benefits and the significance of each initiative as they related to the plan's goals and objectives and the most pressing needs of the region. Each workgroup member assigned a numerical ranking to each action. The ranks were summed for each action. The action with the lowest value received the highest priority and so forth. The results of the county wide mitigation initiative prioritization process are shown in Table 5.4.

## Current Adopted Mitigation Initiatives

Current Mitigation Initiatives consist of actions that have not yet begun or require additional work. They consist of new initiatives identified by the planning partners in the plan update process. They also consist of existing initiatives that were carried over in their original form from the first edition of this plan or other plans, or modified from their original form to reflect present needs.

**Table 5.4: Current Adopted County Wide Mitigation Initiatives**

| Priority | I.D. Number | Category | Action | Status |
|---|---|---|---|---|
| 1 of 9 | CW-MH 4 | Hazard Damage Reduction | Create a lifeline transportation route GIS map for the Thurston Region and integrate the data into the Thurston County Emergency Operations Plan | Modified |
| 2 of 9 | CW-MH 7 | Hazard Preparedness | Develop a system for sharing critical resources among emergency managers during disaster events. | New |
| 3 of 9 | CW-SH 1 | Hazard Preparedness | Improve the capabilities of managing debris from severe winter storm events. | Modified |
| 4 of 9 | CW-FH 1 | Data Collection and Mapping | Obtain digital data and create GIS maps of the flood inundation from possible dam failures of the Skookumchuck Dam on the Skookumchuck River, and the Alder and LaGrande Dams on the Nisqually River | Modified |
| 5 of 9 | CW-MH 6 | Public Information | Develop public information and outreach website portal and complementary printed materials to increase the awareness and participation in natural hazards mitigation planning among the region's major employers, small businesses, and residents. | New |
| 6 of 9 | CW-WH 1 | Data Collection and Mapping | Refine methodology to assess high risk wildland fire communities in Thurston County. | New |
| 7 of 9 | CW-MH 1 | Data Collection and Mapping | Continue to refine the list of the region's critical facilities and jurisdictional asset data, geocode these locations, and update their financial value | Modified |
| 8 of 9 | CW-EH 2 | Data Collection and Mapping | Improve the technical analysis of earthquake hazards in the county. | Existing |
| 9 of 9 | CW-MH 8 | Hazard Preparedness | Strengthen the capabilities of the Disaster Medical Coordination Center (DMCC) Hospital. | New |

Hazard Category Codes are as follows: EH=Earthquake Hazard; FH=Flood Hazard; LH=Landslide Hazard; MH=Multi Hazard; SH=Storm Hazard; WH=Wildland Fire Hazard; and VH=Volcanic Hazard.

## Completed or Removed Mitigation Initiatives

Initiatives that were completed in the last five years are included in this plan to provide evidence of progress made. These initiatives are no longer relevant and no longer part of the region's adopted mitigation strategy. These initiatives are not ranked as they are no longer adopted.

**Table 5.5: Completed or Removed County Wide Mitigation Initiatives**

| I.D. Number | Category | Action | Status |
|---|---|---|---|
| CW-EH 1 | Data Collection and Mapping | Obtain digital data and update the GIS map for liquefaction susceptibility, and create new GIS maps for strong ground motion. | Completed |
| CW-MH 5 | Plan Coordination and Implementation | Add "wildfire" and "volcanic hazards" for the next plan update, obtain data necessary for the risk assessment, and create related mitigation initiatives. | Completed |
| CW-SH 2 | Hazard Preparedness | Thurston County and other participating government entities should work with the regional providers of electricity to assess ways to reduce power outages, improve the reliability of the power grid supplying the county, and seek ways to minimize local service problems | Completed |
| CW-MH 2 | Data Collection and Mapping | Develop a more detailed approach to estimating the inventory of assets and potential loss from natural hazards. | Removed |
| CW-MH 3 | Data Collection and Mapping | Update the risk assessment for tribal areas of the county. | Removed |

Hazard Category Codes are as follows: EH=Earthquake Hazard; FH=Flood Hazard; LH=Landslide Hazard; MH=Multi Hazard; SH=Storm Hazard; WH=Wildland Fire Hazard; and VH=Volcanic Hazard.

## Priority: 1 of 9 Status: Modified

**Hazard Addressed: Multi Hazard**
**Category: Hazard Damage Reduction**

**CW-MH 4: Create a lifeline transportation route GIS map for the Thurston region and integrate the data into the Thurston County Emergency Operations Plan and other local planning needs.**

**Rationale:** A "lifeline" transportation route map needs to be created to facilitate post event evaluations of facilities and to support emergency service responder's essential services. This would include both critical facilities (such as bridges) and the transportation links between them. These routes could be impacted by all hazards which could affect the Thurston region (e.g. earthquakes, floods, landslides, and storms) Data to develop this map would come from the list of lifeline critical facilities which only exists in general tabular form. This data needs to be updated and then translated into GIS compatible form to create a useful map.

**Relates to Plan Goal(s) and Objectives:** 3D, 7A

**Implementer:** Thurston County Public Works and Regional Stakeholders

**Estimated Cost:** Unknown

**Time Period:** 2010-2015

**Funding Source:** Unknown

**Source and Date:** 2003 Natural Hazards Mitigation Plan for the Thurston Region

**Adopted Plan Number:** CW-MH 4

**Reference Page:** V25

**Initiative and Implementation Status:** Not completed. This initiative was ranked 7 of 10 in the 2003 plan. A comprehensive database of the region's road network is maintained by Thurston County but no work has been performed to develop a "lifeline" map. Stakeholders including Thurston County, Lacey, Olympia, Tumwater, Rainier, Tenino, Yelm, Bucoda, all tribes, WSDOT, Intercity Transit, TRPC, and other entities in should convene prior to the plan update to identify critical network attributes, analyze hazard vulnerabilities, and prioritize actions to mitigate vulnerabilities. This initiative was modified to update the implementer and timeline.

## Priority: 2 of 9 Status: New

**Hazard Addressed: Multi Hazard**
**Category: Hazard Preparedness**

**CW-MH 7: Develop inter-jurisdictional capabilities to share critical resources during emergencies and natural disasters.**

**Rationale:** During disasters, additional and/or specialized resources may be needed by one or more affected communities to save lives, protect property, and restore critical infrastructure. During recent events, local jurisdictions have shared resources to achieve this goal. By establishing a resource management system that can be accessed by all jurisdictions during disaster, resource requests will be filled more readily and cost tracking improved.

This initiative will identify technological solutions and create systems and procedures to improve resource sharing. It will allow jurisdictions to know what resources each agency has available and where they are located. It will streamline resource requests, tracking, and allocation. Resources shared are likely to include specialized teams, personnel, equipment and volunteers.

**Relates to Plan Goal(s) and Objectives:** 3A, 4E

**Implementer:** Thurston County Emergency Management and Regional Stakeholders

**Estimated Cost:** $150,000

**Time Period:** 2010-2015

**Funding Source:** Unknown

**Source and Date:** N/A

**Adopted Plan Number:** N/A

**Reference Page:** N/A

**Initiative and Implementation Status:** New

## Priority: 3 of 9 Status: Modified

**Hazard Addressed: Severe Storm Hazard**
**Category: Hazard Preparedness**

**CW-SH 1: Improve the capabilities of managing debris from severe winter storm events.**

**Rationale:** Since it is difficult to predict damage from a storm throughout the Thurston region, (e.g. 1993 Inaugural Day Wind Storm, or the 1996 Ice Storm), this initiative would help local jurisdictions and utility providers to better manage the "clean up" efforts. Utility providers, the county and other local public works agencies would need to work to develop a debris management strategy for the entire region. This might include the identification of county pits for debris removal or other staging areas across the region. It may also identify areas where property for a debris pit may need to be acquired and held in reserve for this purpose.

**Relates to Plan Goal(s) and Objectives:** 4D

**Implementer:** Thurston County Public Works

**Estimated Cost:** Unknown

**Time Period:** 2010-2015

**Funding Source:** Unknown

**Source and Date:** 2003 Natural Hazards Mitigation Plan for the Thurston Region

**Adopted Plan Number:** CW-SH 1

**Reference Page:** V29

**Initiative and Implementation Status:** This initiative was ranked 9 of 10 in the 2003 plan. Thurston County Emergency Management successfully implemented debris management systems during the 2006 Winter Storm, the 2007 Winter Flood, and the January 2009 Flood. While substantial progress has been made in Thurston County to manage debris, more work is required to formalize and adopt a comprehensive debris management strategy.

## Priority: 4 of 9 Status: Modified

**Hazard Addressed: Flood Hazard**
**Category: Data Collection and Mapping**

**CW-FH 1: Obtain digital data and create GIS maps of the flood inundation from possible dam failures of the Skookumchuck Dam on the Skookumchuck River, and the Alder and La Grande Dams on the Nisqually River, develop emergency evacuation routes, and update affected agencies comprehensive Emergency Management Plans.**

**Rationale:** Emergency Action Plans are available for the Skookumchuck Dam on the Skookumchuck River, and the Alder and La Grande Dams on the Nisqually River. However, this data has not been evaluated in a comprehensive manner to develop evacuation plans and identify evacuation routes.

**Relates to Plan Goal(s) and Objectives:** 2A

**Implementer:** Thurston County Emergency Management and Regional Stakeholders

**Estimated Cost:** Unknown

**Time Period:** 2010-2015

**Funding Source:** Unknown

**Source and Date:** 2003 Natural Hazards Mitigation Plan for the Thurston Region

**Adopted Plan Number:** CW-FH 1

**Reference Page:** V15

**Initiative and Implementation Status:** This initiative was identified as priority 3 of 10 in the 2003 plan. Flood Inundation data is available from the Emergency Action Plans, but this data has not yet been processed in a GIS format that lends itself to conducting a vulnerability assessment. Once this task has been completed, this data may be used to evaluate the Thurston Region's risk to dam failure. This task may be fulfilled by updating the flood hazard profile preparation of the next plan update cycle prior to 2015. In addition this data should be analyzed to develop evacuation plans and routes.

## Priority: 5 of 9 Status: New

**Hazard Addressed: Multi Hazard**
**Category: Public Information**

**CW-MH 6: Develop public information and outreach website portal and complementary printed materials to increase the awareness and participation in natural hazards mitigation planning among the region's major employers, small businesses, and residents.**

**Rationale:** Thurston County has a need to provide a multi-hazards public education program to include earthquakes, wildland fires and fire prevention, communicable diseases, flooding, winter storms, landslides and volcanic hazards. Citizen preparedness and mitigation measures implemented by private property and business owners have a great impact on the county's overall vulnerability to natural disasters.

**Relates to Plan Goal(s) and Objectives:** 1B, 8A, 8B, 8C

**Implementer:** Thurston County Emergency Management and Regional Stakeholders

**Estimated Cost:** $100,000 (Note: $20,000 Annually)

**Time Period:** 2010-2015

**Funding Source:** Grants, Emergency Management Council funds, and other local funding

**Source and Date:** Natural Hazards Mitigation Plan for the Thurston Region (2003)

**Adopted Plan Number:** N/A

**Reference Page:** N/A

**Initiative and Implementation Status:** New Initiative. This initiative is a combination of three initiatives from the 2003 plan (TC-EH 2, TC-FH 6 and TC-SH 1). The county has a need to provide a multi-hazards public education program that will keep citizens informed and enable them to plan and prepare for disasters. Key activities will include public outreach and continuous education on consequences of hazards (i.e., living in a floodplain); the National Flood Insurance Program and the County's other multi-hazard activities.

This program will prepare and distribute public education materials such as flyers, brochures, fact sheets and pre-packaged educational campaigns regarding protecting life, property and the environment from a variety of hazards. One area of emphasis will be on how individuals and families can be personally prepared to respond to and recovery from disasters. In addition to the printed materials, the information will also be disseminated through a website which will feature links in other local, state and federal resources. Public education will be provided through public presentations, training, an annual Emergency Preparedness Expo and other community events.

## Priority: 6 of 9 Status: New

**CW-WH 1: Refine methodology to assess high risk wildland fire communities in Thurston County.**

**Hazard Addressed: Wildland Fire Hazard**
**Category: Data Collection and Mapping**

**Rationale:** Under previous Natural Hazards Mitigation Plan Item CW-MH-5, wildland fires, or "wildfires", were added as a county wide risk. The initial methodology for determining risk for wildfire was based upon pre-existing data provided by the Washington State Department of Natural Resources (DNR). As part of refining its mitigation planning, local fire districts request a more detailed locally generated process to indicate and map levels of wildfire potential.

**Relates to Plan Goal(s) and Objectives:** 1C and 2A

**Implementer:** Thurston County Association of Fire Chiefs, DNR, Emergency Management Council.

**Estimated Cost:** Unknown.

**Time Period:** 2010-2015

**Funding Source:** In kind resources from local fire districts and DNR

**Source and Date:** N/A

**Adopted Plan Number:** N/A

**Reference Page:** N/A

**Initiative and Implementation Status:** New.

## Priority: 7 of 9 Status: Modified

**Hazard Addressed: Multi Hazard**
**Category: Data Collection and Mapping**

**CW-MH 1: Continue to refine the list of the region's critical facilities and jurisdictional asset data, geocode these locations, and update their financial value.**

**Rationale:** The region continues to grow and critical infrastructure information changes. The maintenance of an accurate and comprehensive critical infrastructure database can serve a variety of essential operational and planning functions in the region.

**Relates to Plan Goal(s) and Objectives:** 2A

**Implementer:** Thurston County Emergency Management and Regional Stakeholders

**Estimated Cost:** $10,000

**Time Period:** 2010-2015

**Funding Source:** Unknown

**Source and Date:** 2003 Natural Hazards Mitigation Plan for the Thurston Region

**Adopted Plan Number:** CW-MH 1

**Reference Page:** V19

**Initiative and Implementation Status:** This initiative was ranked 4 of 10 in the 2003 plan. Significant progress has been made on this initiative. In 2006 a workgroup representing general purpose governments developed a critical infrastructure database (see Chapter 4.8). These records were geocoded and used in the development of the risk assessments for the 2008-2009 hazard mitigation planning process. This measure was modified to exist as an ongoing task to be completed at least every two years. Thurston County Emergency Management was selected to lead this task.

## Priority: 8 of 9 Status: Existing

**Hazard Addressed: Earthquake Hazard**
**Category: Data Collection and Mapping**

**CW-EH 2: Improve the technical analysis of earthquake hazards in the county.**

**Rationale:** This will involve a more detailed evaluation of potential earthquake damage in the county using the HAZUS software. Use the building footprint data layer developed by Thurston GeoData Center.

**Relates to Plan Goal(s) and Objectives:** 2A

**Implementer:** Thurston County Emergency Management and Regional Stakeholders

**Estimated Cost:** Unknown

**Time Period:** 2010-2015

**Funding Source:** Unknown

**Source and Date:** 2003 Natural Hazards Mitigation Plan for the Thurston Region

**Adopted Plan Number:** CW-EH 2

**Reference Page:** V15

**Initiative and Implementation Status:** This initiative was identified as priority 2 of 10 in the 2003 plan. The Thurston Region has not completed this action. Thurston County Emergency Management Staff attended HAZUS training, hosted by Washington State Emergency Management Division, in April 2009. More research is necessary to determine the scope and cost of developing, running, and maintaining a HAZUS model for the Thurston Region.

## Priority: 9 of 9 Status: New

**Hazard Addressed: Multi Hazard**
**Category: Hazard Preparedness**

**CW-MH 8: Strengthen the capabilities of the Disaster Medical Coordination Center (DMCC) Hospital.**

**Rationale:** Providence St. Peter Hospital in Olympia is the Disaster Medical Coordination Center (DMCC) Hospital for a five county region, which includes Grays Harbor, Lewis, Mason, Pacific and Thurston Counties. During disasters, it is the single hospital responsible for coordinating patient movement and hospital communications. When patients are to be received from outside the region in response to an activation of the National Disaster Medical System (NDMS), Providence St. Peter Hospital works with Puget Sound Federal Control Center to coordinate the transfer of patients to the region's hospitals.

This initiative will strengthen the DMCC by providing training and exercise to hospital and emergency medical system personnel throughout the five-county region.

**Relates to Plan Goal(s) and Objectives:** 3A

**Implementer:** Thurston County Emergency Services, Providence St. Peter Hospital

**Estimated Cost:** Unknown

**Time Period:** 2010-2015

**Funding Source:** Grants and Local Match

**Source and Date:** N/A

**Adopted Plan Number:** N/A.

**Reference Page:** N/A.

**Initiative and Implementation Status:** New

## Priority: N/A Status: Completed

**Hazard Addressed: Earthquake Hazard**
**Category: Data Collection and Mapping**

**CW-EH 1: Obtain digital data and update the GIS map for liquefaction susceptibility, and create new GIS maps for strong ground motion.**

**Rationale:** The data for the liquefaction susceptibility map is only available for the northern Thurston County Urban Area. The state Department of Natural Resources is anticipating the release of the liquefaction susceptibility and strong ground motion mapping for all of the Thurston Region within the next three years.

**Relates to Plan Goal(s) and Objectives:** 2A

**Implementer:** Thurston County Emergency Management Council

**Estimated Cost:** N/A

**Time Period:** 2004-2008

**Funding Source:** FEMA/WA EMD

**Source and Date:** 2003 Natural Hazards Mitigation Plan for the Thurston Region

**Adopted Plan Number:** CW-EH 1

**Reference Page:** V13

**Initiative and Implementation Status:** Completed. This action was identified as priority 1 of 10 in the 2003 Natural Hazards Mitigation Plan. In 2007, the Washington State Department of Natural Resources completed mapping liquefaction susceptibility and site class maps (National Earthquake Hazards Reduction Program) for every county in Washington State. This program was funded through a grant from FEMA and Washington State Department of Emergency Management Division. The data for Thurston County was used to estimate this region's vulnerability from earthquake hazards in the 2008-2009 hazard mitigation planning process.

## Priority: N/A Status: Completed

**Hazard Addressed: Multi Hazard**
**Category: Plan Coordination and Implementation**

**CW-MH 5: Add "wildfire" and "volcanic hazards" for the next plan update, obtain data necessary for the risk assessment, and create related mitigation initiatives.**

**Rationale:** Through the development of the initial Natural Hazards Mitigation Plan, it became apparent that the initial plan could not address all possible hazards. Only those hazards where the risk was identified as "high" in the Thurston County HIVA were undertaken in the initial plan.

**Relates to Plan Goal(s) and Objectives:** 2A

**Implementer:** Hazards Mitigation Plan Workgroup

**Estimated Cost:** Part of the Hazards Mitigation Plan Update

**Time Period:** 2009-2009

**Funding Source:** Thurston County Emergency Management

**Source and Date:** 2003 Natural Hazards Mitigation Plan for the Thurston Region

**Adopted Plan Number:** CW-MH 5

**Reference Page:** V27

**Initiative and Implementation Status:** This initiative is complete. It was ranked 8 of 10 in the 2003 plan. A draft hazard profile for wildland fire was developed in January 2006 and the volcanic hazard profile in May 2007. These profiles were refined, hazard delineation zones were identified, and vulnerability analysis was conducted during the 2008-2009 plan update process. These profiles are included in this plan's risk assessment.

## Priority: N/A Status: Completed

**Hazard Addressed: Severe Storm Hazard**
**Category: Hazard Preparedness**

**CW-SH 2: Thurston County and other participating governmental entities should work with the regional providers of electricity to assess ways to reduce power outages, improve reliability of the power grid supplying the county, and seek ways to minimize local service problems.**

**Rationale:** With the increased reliance on computers to manage all parts of local and state government, reducing power outages is a goal for the entire work year and not just when the wind blows. Outages reduce worker productivity, and numerous leased office buildings provide backup power generation for emergency events. Therefore, reducing the likelihood and the extent of power outages will be very important for jurisdictions to be able to respond to natural disasters in a timely and efficient manner. It is anticipated that these discussions will be with Puget Sound Energy and the Bonneville Power Administration.

**Relates to Plan Goal(s) and Objectives:** 4E, 7C

**Implementer:** Thurston County Emergency Management

**Estimated Cost:** Unknown

**Time Period:** 2004-2008

**Funding Source:** Thurston County Emergency Management

**Source and Date:** 2003 Natural Hazards Mitigation Plan for the Thurston Region

**Adopted Plan Number:** CW-SH 2

**Reference Page:** V31

**Initiative and Implementation Status:** As a result of improvement plans from past disasters and state and federal mandates, Puget Sound Energy (the local electrical utility for most of Thurston County) has been working more closely with local governments to accomplish the goals of this mitigation initiative. Examples of the work accomplished to date include participation in a “pre-season” weather forecast briefing and coordination meeting, discussions and planning for combining work crews with utility crews to clear roads and debris more efficiently, and more frequent updates and coordination between EOC’s during the response phase of disasters.

Another area of important collaboration is continued coordination between utility company planners and jurisdictional development review staff to identify and enhance weaknesses in the power grid, underground power lines as a condition of development, and trim trees and limbs to prevent outages. Even though this mitigation initiative has been marked “completed”, it will prove to be an ongoing goal of local governments and the power utilities in the years to come since there will always be room for improvement in preparedness, planning, communication, and response.

## Priority: N/A Status: Removed

**Hazard Addressed: Multi Hazard**
**Category: Data Collection and Mapping**

**CW-MH 2: Develop a more detailed approach to estimating the inventory of assets and potential loss from natural hazards.**

**Rationale:** Inventory Assets: The current plan estimates the inventory of assets using a combination of assessed valuation and national standards on contents value. With additional resources, supplemental data such as function use and displacement cost and occupancy or capacity could be added to the inventory of assets. Additional inventory data which is hazard specific could be collected as well.

Partial Loss: The current plan estimates potential loss as being the total value of the assets. With additional resources, a more detailed analysis of potential loss is possible, such as loss of function and building damage ratios.

**Relates to Plan Goal(s) and Objectives:** 2A

**Implementer:** Emergency Management Council

**Estimated Cost:** $50,000

**Time Period:** 2004-2008

**Funding Source:** Unknown

**Source and Date:** 2003 Natural Hazards Mitigation Plan for the Thurston Region

**Adopted Plan Number:** CW-MH 2

**Reference Page:** V21

**Initiative and Implementation Status:** This initiative was ranked 5 of 10 in the 2003 plan. This initiative was only partially fulfilled with the 2008-2009 plan update. In regards to inventory of assets, local governments provided more detailed information regarding the replacement value of their infrastructure. National standards were used only if local data was not available. A reliable method for estimating potential losses, including partial loss of infrastructure or loss of function and services, remains to be developed for the purpose of enhancing each community's understanding of their vulnerabilities and potential risks. The Hazard Mitigation Planning Workgroup decided that this level of detail is beyond the capabilities of the regional workgroup and must be fulfilled by individual jurisdictions. Furthermore mitigation initiative CW-EH 2 may partially or fully fulfill this task. A local agency may include this initiative if it will serve their planning needs.

## Priority: N/A Status: Removed

**Hazard Addressed: Multi Hazard**
**Category: Data Collection and Mapping**

**CW-MH 3: Update the risk assessment for tribal areas of the county.**

**Rationale:** The Buildable Lands analysis is the primary data foundation for the risk assessment. However, the Buildable Lands analysis was done only for those jurisdictions required to plan under the state Growth Management Act. The tribal areas in particular should have an equivalent analysis done. In the current plan, the risk assessment for tribal lands is not as accurate as for the cities and county because of more limited inventory data.

**Relates to Plan Goal(s) and Objectives:** 1A, 2A

**Implementer:** Emergency Management Council

**Estimated Cost:** N/A

**Time Period:** 2004-2008

**Funding Source:** N/A

**Source and Date:** 2003 Natural Hazards Mitigation Plan for the Thurston Region

**Adopted Plan Number:** CW-MH 3

**Reference Page:** V23

**Initiative and Implementation Status:** This initiative is no longer relevant and is therefore removed. It was ranked 6 of 10 in the 2003 plan. The Confederated Tribes of the Chehalis Reservation conducted an independent hazards mitigation planning process and the Nisqually Tribe participated in this plan update. TRPC has revised its method to conduct vulnerability assessments by consistently analyzing the same type of data for both jurisdictions and tribes.

# Endnotes

[1]Washington State Emergency Management Division. 2007. Washington State Hazard Mitigation Plan.

[2] Federal Emergency Management Agency. 2007. Using Benefit-Cost Review in Mitigation Planning. State and Local Mitigation Planning How-To Guide Number Five. FEMA 386-5, May 2007. Department of Homeland Security.

# Chapter 6: Adoption, Implementation, Monitoring, and Maintenance

## Local Adoption Process and Federal Approval

Once a jurisdiction receives notification from the Federal Emergency Management Agency (FEMA) that their plan is *approvable pending adoption*, it has one year to adopt the plan. As with single jurisdictional plans, in order for FEMA to give approval to a multi-jurisdictional plan, at least one participating jurisdiction **must** formally adopt the plan within one calendar year of FEMA's designation of the plan as *approvable pending adoption*.

**Regulatory Review Process**

All plans must be reviewed prior to adoption. Washington State requires 30 days to review the plan. FEMA requires 45 days.

See Chapter 2 for more information regarding the regulatory review process.

### Adoption by the Local Governing Body

Each jurisdiction or entity seeking approval of its plan through the multi-jurisdictional planning process must have its governing body adopt the entire plan and their local annex. Each jurisdiction/entity will ensure that proper process is followed according to the laws or rules of their organization including adequate public notice and public hearings.

Adoption by the local governing body demonstrates the jurisdiction's commitment to fulfilling the mitigation goals and objectives outlined in the general plan and in their annex. Adoption legitimizes the plan and authorizes responsible agencies to execute their responsibilities. The plan shall include documentation of plan adoption, usually a resolution. A copy of each participating agency's adoption resolution is located in their respective annex.

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|---|---|
| ***Requirement §201.6(c)(5):*** | [The local hazard mitigation plan shall include] documentation that the plan has been formally adopted by the governing body of the jurisdiction requesting approval of the plan (*e.g.*, City Council, County Commissioner, Tribal Council). |
| ***Requirement §201.6(c)(5):*** | For multi-jurisdictional plans, each jurisdiction requesting approval of the plan must document that it has been formally adopted. |

### Adoption Requirements

All entities which are part of the *Natural Hazard Mitigation Plan for the Thurston Region,* or an update thereof, must adopt the portions of the natural hazards mitigation plan which apply to all the participating entities. This includes the entire multi-jurisdictional core plan including chapters 1 through 6. In addition, each agency must also adopt their jurisdiction's annex. The core plan plus the jurisdiction's annex represents a complete hazards mitigation plan.

### Federal Approval

Once a jurisdiction provides FEMA with a copy of their adoption resolution, FEMA will certify the approval of the plan. FEMA sends each adopting agency a letter that includes the approval date and the expiration date of the plan. The first jurisdiction to formally adopt the plan initiates the five-year approval period and sets the expiration date for the plan for all participating plan partners regardless of when they adopt their plan.

#### *Revisions to Adoption Process*

The original plan's adoption process description was only relevant to the original plan. This section was revised to describe a more general plan adoption and approval process that is consistent with federal requirements and relevant to all local plan participants.

## Implementation

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| ***Requirement §201.6(c)(4)(ii):*** | [The plan **shall** include a] process by which local governments incorporate the requirements of the mitigation plan into other planning mechanisms such as comprehensive or capital improvements, when appropriate. |

Each governmental entity will be responsible for implementation of their individual mitigation initiatives based on funding availability, availability of resources, and entity priorities. Because the *Natural Hazards Mitigation Plan for the Thurston Region* is a multi-jurisdictional plan, the mechanism for implementation through existing programs will vary between jurisdictions and also between special purpose districts. This section is intended to give an overview of the mechanisms available in Thurston County and the municipalities for plan implementation.

In Chapter 5, Goal 6 indicates that local governments will "support natural hazard mitigation, planning, and implement the mitigation initiatives…" As noted in Objective 6A, it is expected that many of the mitigation initiatives will be incorporated into existing jurisdictional planning programs such as comprehensive plans, critical areas ordinances, and capital facilities plans. Thurston County and the municipalities are required to update their comprehensive plans and review the Growth Management Act development regulations, at a minimum, every seven years.

In addition to plans, programs, and regulations, the entities may also incorporate the mitigation measures into their capital facilities plans (CFP's). The CFP's identify major infrastructure developments or facilities which have been identified in a six, ten or twenty year time frame. This identifies those major infrastructure developments or facilities which the entity has identified as needing in a six, ten, or twenty year plan.

Only some of the jurisdictions have comprehensive emergency management plans (CEMP's). When the CEMP's are updated, they should include relevant parts of this plan, if appropriate, or be linked back to this document by reference.

Local jurisdictions often adopt special purpose or "functional plans" separately from their comprehensive plan. These plans deal with a specific function or service such as stormwater, sewage, or in this case, a natural hazards mitigation plan. These plans are officially adopted by the jurisdiction and provide a level of detail that may not be found in the comprehensive plan.

***Revisions to Implementation***

*Many local governments are succeeding in completing or making progress on their mitigation initiatives. No revisions were made to the process for implementing mitigation initiatives.*

## Plan Stewardship

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| ***Requirement §201.6(c)(4)(i):*** | [The plan maintenance process **shall** include a] section describing the method and schedule of monitoring, evaluating, and updating the mitigation plan within a five-year cycle. |

In order to fulfill the goals and objectives outlined in Chapter 5, the plan must be monitored and maintained throughout its five year cycle. A multi-jurisdictional plan requires coordination and collaboration among its partners. The Emergency Management Council (EMC) of Thurston County is a formally organized intergovernmental board that is familiar with a variety of key community stakeholders involved with disaster preparedness, response, recovery, and hazard mitigation. As such, the EMC has agreed to serve as the steward for the *Natural Hazards Mitigation Plan for the Thurston Region*. As it did in 2003 through 2008, the EMC assumes the lead role for maintaining the plan's viability, and promoting its relevancy among the plan stakeholders.

The remaining sections of this chapter describe how the monitoring and maintenance functions will be fulfilled between 2010 and 2015.

### Plan Monitoring

#### Annual Natural Hazards Mitigation Assessment

The plan will be monitored at least once a year as part of the EMC's regularly scheduled October meeting (the schedule may be revised to accommodate exceptional circumstances). The EMC will include a special work session agenda item dedicated to a region wide assessment of the plan. The EMC will invite all plan partners to attend the meeting. This annual work session will assess the following:

1. Progress towards the plan's goals and objectives
2. Progress towards county wide and jurisdiction specific mitigation initiatives
3. Implementation problems such as technical, legal, or coordination issues among local agencies, the State, or FEMA
4. Financing the multi-jurisdiction plan update

5. Public involvement activities.
6. General information sharing (best practices) related to mitigation planning among the plan partners

***Revisions to Plan Monitoring Process***

*Although the EMC did discuss components of the plan (see Chapter 2: Plan Process and Development), no formal assessment of the plan's process was carried out between 2003 and the expiration of the original plan. The previous plan specified that only the EMC would review the plan every two years. The EMC and the Workgroup reviewed the monitoring process during the plan update. The current plan process, as described above, will allow the plan to be monitored on a routine basis with all relevant stakeholders.*

### Assessment after a Significant Disaster Event

It is routine practice for the Thurston County Emergency Management Council to conduct an after action review within 60 to 80 days following a Federal Disaster Declaration or a significant emergency event that occurred within the County. As part of this meeting, a specific agenda item will be added to the after action review process to capture any lessons learned for the purpose of enhancing the usability of the hazard mitigation plan (see objective 1D). The Emergency Management Council will assess:

1. The characteristics and severity of the hazard to determine if the region's risks have changed
2. Direct and indirect damage as well as any response and recovery costs.
3. The type and extent of the damages to determine any new mitigation initiatives that should be incorporated into the plan to avoid similar losses due to future hazard events.

The results of the assessment will be provided to all hazards mitigation planning partners for their review. This information can be used for evaluating (if applicable) modifications to existing initiatives or new initiatives following the disaster event or during the next plan update cycle.

***Revisions to Assessment after a Significant Disaster Event***

*The meeting time period was extended up to 80 days to allow emergency managers more time to effectively recover from disaster events. The new process creates a specific agenda item and provides specific, but simple assessment criteria for the EMC and after action review participants to consider.*

## Plan Maintenance

Plan maintenance should be an ongoing task. If done properly, it is executed throughout the plan's five year cycle. Plan maintenance ensures that information is current and accurate. Furthermore, by revising the plan on a periodic basis to reflect current conditions, the five year plan update process is simplified for all involved in a routine maintenance cycle.

Changes to the mitigation plan are initiated based on outcomes that are realized as part of annual plan monitoring, events after a major disaster, or on an as needed basis to suit the needs of individual jurisdictions. Changes are also made when new planning partners join the hazard mitigation planning

process and adopt their plans. Each individual jurisdiction is responsible for maintaining its annex once they adopt their plan. Thurston County Emergency Management assumes responsibility for executing all revisions to the core multi jurisdictional plan (all sections except for local annexes).

### Minor Revisions

Corrections regarding spelling and sentence structure that are minor in nature will be handled by the Thurston County Emergency Management staff.

### Technical Revisions

Requests for changes that would alter the technical content of the general plan such as additions or deletions of data or alterations to the hazard profiles and the risk assessments will be the responsibility of Emergency Management staff. Any changes of this type would require a review by the EMC and the Workgroup, or if applicable, the affected jurisdiction/organization.

### Substantive Revisions

If the State or FEMA request significant changes or analysis to the general plan, it will require a meeting of the Natural Hazards Mitigation Plan Workgroup. Substantive changes to the general plan will require review and approval of the Workgroup. Substantive changes to the jurisdiction/organization specific mitigation initiatives would require review of the changes by the entity's approving body and may possibly require re-adoption of the mitigation initiative depending on the complexity and scope of the change.

### Distribution of Revisions

Thurston County Emergency Management staff will be responsible for maintaining a master copy of the plan and distributing relevant updates to all adopted plan holders. For any revisions made to the general plan, copies of any correspondence from the State or FEMA, along with supporting analysis and revised plan pages, will be sent to all of the entities and holders of the plans. Conversely, any local agency that makes changes to the contents of its local annex should provide Thurston County Emergency Management a copy of its revised annex and documentation of the process that was used to revise its annex.

When at all possible, plan updates will be distributed electronically via email or some other form of electronic media such as a compact disc. Printed copies can be requested by contacting Thurston County. A current version of the plan and all adopted annexes will be accessible online through Thurston County Emergency Management Division's website at: http://www.co.thurston.wa.us/em/.

***Revisions to Plan Maintenance***

*Minor revisions were made to clarify the role of the EMC, Thurston County Emergency Management Division staff, the Hazard Mitigation Planning Workgroup and the local agencies.*

## Procedure to Add a Community to the Natural Hazards Mitigation Plan for the Thurston Region

Local governments and special purpose districts are encouraged to develop hazards mitigation plans and may do so through this plan's framework. The plan update process is the best time for an agency, interested in developing a local hazard mitigation plan, to join the multi-jurisdictional plan. However, an entity can choose to develop a plan when it suits their needs. Plans can be developed in between plan update cycles.

The following steps outline the process by which local governments, special purpose districts, tribes, or non-profit entities can develop and adopt their local natural hazard mitigation plan through the Thurston Region's hazard mitigation planning framework.

1. The community wishing to join the plan contacts the Thurston County Emergency Management Division with a request to become a plan participant.
2. Thurston County Emergency Management will provide the new entity with a copy of the Natural Hazards Mitigation Plan for the Thurston Region, local planning requirements, forms and instructions for their annex, and any other pertinent information.
3. The new entity reviews the plan and the plan requirements. The entity develops a plan that coordinates with the regional plan and meets all of the planning requirements specified in 44 CFR Section 201.6 (201.7 for tribes) of the Disaster Mitigation Act of 2000. Portions of the regional plan that meet the planning requirements for that entity could be referenced in the plan eliminating the need for redundancy.
4. The new entity would then submit their draft plan to The Emergency Management Council of Thurston County for review to ensure conformance with the regional plan.
5. Thurston County Emergency Management staff forwards the new plan to the Washington State Hazard Mitigation Program Manager for review (30 days minimum). If the new community plan does not meet the required standards, the State Hazard Mitigation Program Manager will work with the community to resolve issues that require improvement.
6. The State Hazard Mitigation Program Manager forwards the plan to FEMA Region X for review and approval (45 days minimum).
7. Upon approval from FEMA Region X, the new community must adopt their plan. Once adopted, the new entity is considered part of the Natural Hazards Mitigation Plan for the Thurston Region and will comply with the update schedule of the plan and join the Hazards Mitigation Plan Workgroup.

***Revisions to Procedure to Add a Community to the Natural Hazards Mitigation Plan for the Thurston Region***

*The procedures were revised to clarify the roles and responsibilities of the jurisdiction seeking plan approval, the EMC, Thurston County Emergency Management Division staff, the State, and FEMA.*

## Future Plan Updates

If a plan update is deemed necessary, the EMC will be responsible for establishing a work program, budget, and time frame for updating the plan. At that time, the EMC will also announce that the plan is under review and identify and carry out appropriate public process. New planning partners will be encouraged to participate in the plan update process to develop and adopt their own plans. Without any intervening circumstances, the natural hazards mitigation plan is to be updated at a minimum every five years.

### Hazard Profiles

During a future update of the natural hazard mitigation plan, consideration will be made to expand the plan to address additional hazard profiles. For example, hazard profiles could be developed for pandemic flu, dam failure, or certain elements of climate change such as sea level rise. As this information is developed, local governments can utilize these profiles to consider additional mitigation initiatives as well as incorporate the newly developed information into their hazard inventory vulnerability assessments (HIVA).

### Community Rating System

Thurston County is enrolled in the Community Rating System (CRS), a program for communities that demonstrate flood hazard management and mitigation practices above and beyond the minimum National Flood Insurance Program standards for flood plain regulation. Thurston County was accepted into the CRS program in 2000. It attained a rating of Class 5, which provides for a 25 percent reduction for private flood insurance premiums. To maintain this rating, the County must recertify its CRS participation every three years.

This plan will become Thurston County's Flood Hazard Management Plan. As a separate plan review process, Thurston County will submit this plan to the Insurance Services Office (ISO) for their review. The ISO scores plans and awards points for public involvement process and development and implementation of flood hazard mitigation initiatives. Future updates to this plan will be made to improve Thurston County's CRS classification.

### Continued Public Involvement

The Emergency Management Council, as well as all of the entities that participated in this plan, are committed to continued public involvement and education. It will be important that natural hazards mitigation becomes integrated into existing programs and becomes part of the way jurisdictions make decisions about land use and facilities planning. As mentioned in the preceding section, in the city and county jurisdictions, comprehensive plan amendment processes as well as capital facilities planning both have elements of public notification and involvement. These local plans require updating every six to seven years but are often amended yearly with an associated public process. These processes will provide a venue that promotes public dialogue regarding the importance of hazard mitigation.

As was the case in the compilation of this plan, when there is a plan update (at least every 5 years) the comprehensive plans and capital facilities plans will need to be reviewed to assure consistency between all planning efforts. It will be important to identify where and how hazard mitigation planning initiatives have been integrated in comprehensive and capital facilities plans.

Many of the mitigation initiatives in this plan contain elements of public education should the funds become available to implement those initiatives. As an example, the City of Lacey has identified an initiative to develop, enhance, and implement education programs aimed at mitigating natural hazards and reducing the risk to citizens, public agencies, private property owners, businesses and schools.

The Emergency Management Council will also need to encourage its governmental entities to combine the natural hazards plan elements into existing emergency preparedness activities and information in order to continue to educate the public on the importance of managing the risk for natural hazards. If there are efforts to re-write emergency preparedness public information pieces such as brochures, integration of natural hazards mitigation information will be considered. Jurisdictions that have existing Comprehensive Emergency Management Plans will work to integrate natural hazards mitigation planning into that document and associated public education efforts.

Copies of the Natural Hazards Mitigation Plan will be maintained in the offices of all of the entities that adopt their plan. The plan will be posted on the Thurston County Emergency Management web site. Copies of the plan have also been provided to the Timberland Regional Library for addition to their collection.

# Appendix A: Natural Hazards Mitigation Plan for the Thurston Region (2003), Chapter II, Plan Purpose and Development

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# CHAPTER II
# Plan Purpose and Development

## Plan Purpose

Early in the planning process, the Natural Hazards Mitigation Planning Workgroup identified several purposes for the plan. These include the following:

- **Provide a Methodical Approach to Mitigation Planning**

  The process used by the planning partners identifies vulnerabilities to future disasters and proposes the mitigation initiatives necessary to avoid or minimize those vulnerabilities. Each step in the planning process builds upon the previous, providing a high level of assurance that the mitigation initiatives proposed by the participants have a valid basis for both their justification and priority for implementation.

- **Enhance Public Awareness and Understanding of Natural Hazards**

  This plan contains data and information that can be used in a variety of ways to enhance public awareness about natural hazards. Chapter IV of the plan identifies the four most prevalent natural hazards threatening the Thurston region and provides an assessment of where the region is vulnerable to those hazards. There is also data that estimates what the potential costs would be to property should there be a significant event. This information gives members of the community a better understanding of what the most prevalent hazards are historically and how those hazards impact or threaten the public health, safety, economic vitality of businesses and the operational capability of important institutions.

  The mitigation initiatives identified in Chapter 5 will also help the public become aware of some important steps that can be taken in their community to manage risk, protect lives and property and promote community sustainability.

  The planning partners have provided opportunities for public involvement and information. This multi-jurisdictional effort has reached out to stakeholders from municipalities, academia, and special purpose districts as well as county and tribal government. The planning partners have also solicited ideas and input during informational sessions as the plan was being drafted.

- **Create a Decision-making Tool for Policy and Decision Makers**

  This document is intended to provide basic information needed by managers and leaders of local government, business and industry, community associations and other key institutions and organizations to take actions to address vulnerabilities to future natural disasters. It also

provides proposals for specific projects and programs that are needed to eliminate or minimize those vulnerabilities.

These proposals, called "mitigation initiatives" and identified in Chapter 5, are related to the needs of each jurisdiction. They have been evaluated as to their economic benefits, and have been prioritized for implementation. This approach is intended to provide a decision-making tool for the management of participating organizations and agencies regarding why the proposed mitigation initiatives should be implemented, which should be implemented first, and the economic and public welfare benefits of doing so.

- **Promote Compliance with State and Federal Program Requirements**

  A number of state and federal grant programs, policies, and regulations encourage or mandate local government to develop and maintain a comprehensive natural hazards mitigation plan. The Federal Disaster Mitigation Act of 2000 established a requirement that for all disasters declared on or after November 1, 2004, applicants for grants for disaster mitigation funds must have an approved local mitigation plan. This plan is specifically intended to assist the participating local governments with complying with these requirements, and to enable them to more fully and quickly respond to state and federal funding opportunities for mitigation-related projects.

  Because the plan defines, justifies and prioritizes mitigation initiatives that have been formulated through a technically valid hazard analysis and vulnerability assessment process, the participating organizations are better prepared to more quickly and easily develop the necessary grant application materials for seeking state and federal funding.

- **Assure Inter-Jurisdictional Coordination of Mitigation-Related Programming**

  A key purpose of the planning process is to ensure that proposals for mitigation initiatives are reviewed and coordinated among the participating jurisdictions within the county. In this way, there is a high level of confidence that mitigation initiatives proposed by one jurisdiction or participating organization, when implemented, will be compatible with the interests of adjacent jurisdictions and unlikely to duplicate or interfere with mitigation initiatives proposed by others.

- **Create Jurisdiction Specific Hazard Mitigation Plans for Implementation**

  A key purpose of the plan is to provide each participating local jurisdiction with a specific plan of action that can be adopted and implemented pursuant to its own authorities and responsibilities. Chapter V of the plan contains separate sections that identify the mitigation initiatives for each participating entity. The jurisdictions and organizations can then adopt and implement the plan and the corresponding mitigation initiatives for their organization according to their individual needs and schedule. In this way, the format of the plan and

the operational concept of the planning process ensure that proposed mitigation initiatives are coordinated and prioritized effectively among jurisdictions and organizations, while nonetheless allowing each jurisdiction to adopt only the proposed mitigation initiatives that it actually has the authority or responsibility to implement when resources are available. Appendix A outlines the jurisdictions and organizations that have adopted the plan.

## Plan Development

The above purposes have guided the plan development. As a State Hazard Mitigation Grant Program recipient, The Emergency Management Council of Thurston County served as lead entity to develop the plan. The Thurston Regional Planning Council provided staff on contract to support the work of the Council and the Hazards Mitigation Planning Workgroup. The members of the Thurston County Emergency Management Council served as the steering committee and the convening body for the plan. The Council met monthly from January to July, 2003 to guide development of the mitigation plan and the following outlines their activities:

| Date | Activity | Subject |
|---|---|---|
| February 20, 2003 | Meeting | Reviewed Plan Goals and Objectives |
| March 20, 2003 | Meeting | Reviewed Hazard Vulnerability and Risk Assessment |
| April 17, 2003 | Meeting | Reviewed Mitigation Initiatives<br>Discussed Public Process |
| May 15, 2003 | Meeting | Reviewed Draft Plan |
| May, 2003 | Public Meetings | Sponsored and Attended Two Public Meetings In North and South Thurston County |
| June 19, 2003 | Meeting | Reviewed Draft Final Plan |
| July 17, 2003 | Meeting | Made Recommendation on Final Plan to Thurston County Board of Commissioners |
| July 17 forward | Plan Approval | Took Plan Through Approval Process in Individual Jurisdictions |
| August 15, 2003 | Plan Delivery | Delivered Plan to State Emergency Management and Federal Emergency Management Agency (FEMA) |

The Emergency Management Council of Thurston County consists of representatives from the following jurisdictions:

Thurston County
City of Lacey
City of Olympia
City of Rainier
City of Tenino
City of Tumwater
City of Yelm

The names of those serving on the Council are listed in Appendix B.

The Hazards Mitigation Planning Workgroup acted as the planning committee and consisted of representatives from the jurisdictions as well as from taxing entities in the region. The workgroup met monthly from January to June, 2003. Their role was to:

- Provide technical input and information specific to their jurisdiction/entity to be incorporated into the plan.
- Develop mitigation plan goals based on local hazards to provide a long-term vision reducing our region's vulnerability to natural hazard events.
- Identify, analyze, and prioritize the mitigation initiatives for the region as well as for their jurisdiction.
- Analyze the cost and benefit of the mitigation initiatives.
- Identify appropriate public involvement opportunities and participate in or host a public meeting.
- Review plan elements in draft and final form.

The workgroup carried out the following plan development tasks and activities:

| Date | Activity | Subject |
|---|---|---|
| January 14, 2003 | Initial Meeting | Reviewed scope of work. Background information |
| February 18, 2003 | Meeting | Identified plan goals and objectives. Began work on risk assessment. |
| March 18, 2003 | Meeting | Finalized Hazard Vulnerability and Risk Assessment. Received background information on Mitigation Strategies |
| April 15, 2003 | Meeting | Finalized Mitigation Initiatives. Received background information on Cost/Benefit Analysis and Prioritization |
| April 28-May 2, 2003 | Draft Plan Review | Reviewed Draft Plan in Preparation for Public Workshops |
| May 19-30, 2003 | Public Meetings/ Comment | Attended Public Meetings and Took Comment from the Public Regarding Plan |
| June 9-20, 2003 | Plan Revision | Plan Revised Based on Public Comment |
| June 24-July 1, 2003 | Plan Review | Reviewed Final Plan and Forwarded to Emergency Management Council |

Members of the Hazards Mitigation Planning Workgroup were from the following jurisdictions and taxing entities:

Thurston County
City of Lacey
City of Olympia
City of Tumwater
City of Tenino
City of Yelm
Confederated Tribes of the Chehalis Reservation
Intercity Transit
Olympia School District
Rainier School District
The Evergreen State College
Thurston County Fire Chiefs Association (on behalf of Fire Districts #4, 9, and 13)
Tumwater School District

Representatives of the Hazards Mitigation Planning workgroup are named in Appendix B.

## Public Participation

A variety of methods were used to encourage public participation in the planning process as well as to educate the public about hazard mitigation efforts in their communities. Documentation of these efforts appears in Appendix C. Since formal natural hazards mitigation planning had not previously been undertaken in the Thurston Region, much of the public participation efforts were directed at education and awareness. On February 26, 2003, a press release went to all media announcing the beginning of the planning effort. This release outlined the requirements of the Disaster Mitigation Act of 2000 and the community's response to this requirement. This press release resulted in two public education activities. First, a public service announcement aired on KGY Radio March 3-14, 2003. KGY is based in Olympia and has a listener base in both Thurston and Lewis Counties. Second, a feature story appeared in "The Chronicle" which is the major newspaper in Lewis County. With both of these efforts, information was disseminated that educated the public about natural hazards mitigation and what the intent of the plan would be.

During this beginning stage, it was also important that various elected officials and decision-makers in the community that were not directly involved in the planning effort receive information on natural hazards mitigation planning. On January 29, 2003, a meeting was held to invite taxing jurisdictions from the region to join the planning effort. This meeting provided information about the Disaster Mitigation Act of 2000 and the importance of joining a multi-jurisdictional effort to address natural hazards in order to mitigate their effects. There were seven attendees. On January 14, 2003, a letter was sent to all of the mayors of the jurisdictions in Thurston County outlining the new planning effort, and their jurisdiction's involvement in it. On March 7, 2003 the Thurston Regional Planning Council which is a multi-jurisdictional board made up of elected officials was briefed on the subject and received information about the Disaster Mitigation Act of 2000. There were 23 attendees.

The Internet proved to be a valuable tool to disseminate information regarding the plan to the public in a quick and efficient manner. Information was posted at www.trpc.org which is Thurston Regional Planning Council's agency site. The draft plan received 86 visits during the month of May 13 through June 13. The average visit was five minutes. On February 16, 2003 introductory natural hazards mitigation planning information was posted. This information was up-dated and the draft plan was posted on May 19, 2003. The site gave contact information in order for the public to give input to the plan by e-mail or by calling the Thurston Regional Planning Council office.

The Disaster Assistance Council (DAC), acted as a community stakeholder group who provided input into the plan as it was being written. The DAC is made up of representatives from community-based groups who have emergency management planning/assistance functions. This body represents a diverse range of organizations such as the Thurston County Food Bank, the Crisis Clinic and the Volunteer Center. (See Appendix C for a list of DAC member organizations.) There were two joint meetings held with the DAC and the Emergency Management Council where plan sections were reviewed and both councils gave input to the plan.

Mid-way in the planning process, the Disaster Assistance Council sponsored a meeting with neighborhood groups on disaster planning. Materials were available on hazard mitigation. Staff contact information was also provided should attendees have questions or want to follow up on the information received. There were 40 attendees.

When the plan reached the draft stage, a second press release went out that announced that there would be two public meetings held on consecutive evenings in different communities to elicit comments and suggestions on the plan. The press release was followed with an article in "The Olympian" on May 17, 2003 as well as public service announcements that ran on KGY Radio hourly on May 19 and 20.

The public meetings were structured to provide information about mitigation planning, provide attendees an opportunity to read the plan, and also ask questions of staff and members of the Emergency Management Council who were present. The first meeting was held on May 19, 2003 at the County Courthouse with eight attendees. The second meeting was held on May 20, 2003 at the Tenino City Hall with 12 attendees. Input on the plan was solicited during a three week period following these meetings. The public was given the option of commenting on the plan by mail, over the e-mail or by calling the project manager. Two comments were received.

Following the public meetings, a third press release was done on May 23, 2003 to all media that solicited public comment on the draft plan. An article ran in "The Olympian" on May 27. Three members of the public called to request plans for review following this article. Two comments were received.

The following provides a synopsis of the public participation and education efforts and location of the associated documentation in Appendix C:

| Date | Activity | Appendix Page |
|---|---|---|
| January 14, 2003 | Letter to mayors of all jurisdictions regarding beginning of hazard mitigation planning. | C-1 |
| January 29, 2003 | Meeting with taxing jurisdictions to provide information on mitigation planning and inviting them to join multi-jurisdictional planning effort. | C-2 |
| February 26, 2003 | Established web site at www.trpc.org that gave information regarding mitigation planning as well as draft plan. | |
| February 26, 2003 | Press release to all media announcing beginning of planning effort. | C-3 |
| March 3-14, 2003 | Public service announcement aired on KGY Radio. | |
| March 7, 2003 | Thurston Regional Planning Council was briefed on planning effort. | C-5 |
| March 14, 2003 | Feature story appeared in “The Chronicle”. | C-11 |
| March 22, 2003 | Neighborhood Emergency Preparedness Workshop (provided information to attendees.) | C-12 |
| April 17 and May 15, 2003 | Joint meetings with Emergency Management Council and Disaster Assistance Council | C-12 |
| May 12, 2003 | Press release to all media announcing draft plan and public meetings. | C-14 |
| May 17, 2003 | Article in “The Olympian” announcing public meetings on May 19 and 20, 2003. | C-15 |
| Week of May 19, 2003 | Public service announcement ran on KGY Radio hourly during news. | |
| May 19 and 20, 2003 | Public meetings. (Invitation to learn more about hazards mitigation planning and give input to draft plan.) | |
| May 19, 2003 | E-mailed draft plan to various stakeholder groups that serve on Thurston County Disaster Assistance Council with request for comment and input. | |
| May 19, 2003 | Draft plan posted on web site. | C-16 |
| May 23, 2003 | Press release to all media announcing draft plan availability and soliciting public comment. | C-18 |
| May 27, 2003 | Article in “The Olympian” to seek public comment on draft plan. | C-20 |

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# Appendix B: Public Participation and Outreach Materials

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# EMERGENCY MANAGEMENT COUNCIL OF THURSTON COUNTY

**Bucoda • Lacey • Olympia • Rainier • Tenino • Thurston County • Tumwater • Yelm**

May 8, 2008

Mr. Brian VanCamp, Chief
Fire District 8
3506 Schincke Rd. SE
Olympia, WA 98506

Dear Chief VanCamp:

On behalf of the Emergency Management Council of Thurston County, I want bring to your attention a very important date. **On October 5, 2008 the *Natural Hazards Mitigation Plan for the Thurston Region* will expire**. I want to invite Fire District 8 to participate in the five year update to this multi-agency plan. Having a locally adopted and federally approved hazard mitigation plan is required to apply for pre- and post disaster Hazard Mitigation Grant Program funds administered by the Federal Emergency Management Agency. These funds are available to help finance a variety of projects that can aid your community/organization to become more resilient to natural disasters such as earthquakes, severe storms, floods, landslides, and wildfires.

The Emergency Management Council is responsible for maintaining and updating the *Natural Hazards Mitigation Plan for the Thurston Region*. Because we believe this project is very important, Thurston County is leading the effort by financing the update to the plan at no cost to your jurisdiction, aside from your in-kind participation. It may be more cost effective for your organization to develop its hazard mitigation plan through the multi-agency regional planning process we are about to begin.

Please take a moment to review the attached brochure for an overview of Hazard Mitigation Planning. Should you have questions about whether a hazard mitigation plan is appropriate for your organization, please contact Paul Brewster, Associate Planner, Thurston Regional Planning Council, at (360) 741-2526 or brewstp@trpc.org.

If your organization determines that development of your own plan through the regional development process will not serve your interests at this time, we still welcome your participation as a stakeholder to comment on the draft plan during its development cycle.

Sincerely,

Lester Olson, Chair
Emergency Management Council of Thurston County

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**2703 Pacific Avenue SE, Suite B • Olympia, WA 98501-2036**
**Phone (360) 754-3360 • Fax (360) 704-2775**

TRPC
Thurston Regional Planning Council

**MEMBERS:**
City of Lacey
City of Olympia
City of Rainier
City of Tenino
City of Tumwater
City of Yelm
Town of Bucoda
Thurston County
Intercity Transit
LOTT Alliance
Thurston County PUD No. 1
Griffin School District
North Thurston Public Schools
Olympia School District
Confederated Tribes of the Chehalis Reservation
Nisqually Indian Tribe

**Associate Members:**
Economic Development Council of Thurston County
Puget Sound Regional Council
Timberland Regional Library

**Charter Member Emeritus:**
The Evergreen State College

1967 - 2007
40 years of
VISIONARY LEADERSHIP

**Lon D. Wyrick**
Executive Director

2424 Heritage Court SW Suite A
Olympia, WA 98502-6031

(360) 956-7575
FAX (360) 956-7815
www.trpc.org

# News Release

**FOR IMMEDIATE RELEASE:** June 13, 2008

SUBJECT: Hazard Mitigation Planning

CONTACT: Paul Brewster
Associate Planner
(360) 956-7575

## THURSTON COUNTY BEGINS UDATE TO MULTI-JURISDICTIONAL HAZARD MITIGATION PLAN

Thurston County is susceptible to a variety of natural disasters which pose significant human, economic, and environmental risks for its residents and community members. When hazard events threaten people's safety and overwhelm the capacity of responders from local governments and the State of Washington, the Governor can call upon the President of the United States for federal assistance. A federal disaster declaration provides federal assistance and financial support to help communities recover from the devastation. In fact, Thurston County has been declared a federal disaster area 21 times since 1962. Since then, this region has endured 17 floods and severe storms, two earthquakes, one major windstorm, and the volcanic eruption of Mount Saint Helens.

--MORE--

*Providing Visionary Leadership on Regional Plans, Policies and Issues*

In 2003, Thurston County Emergency Management Council and 20 local government entities developed the region's first "Natural Hazard Mitigation Plan for the Thurston Region." This Federal Emergency Management Agency (FEMA) certified plan identifies earthquake, flood, severe storm, landslide, volcanic lahar, and wildfire as the region's most significant natural hazards. The plan outlines a mitigation strategy aimed at increasing people's safety and promoting community sustainability by reducing the physical, financial, and social impacts and losses caused by these disasters. Hazard mitigation planning reduces future disaster losses through land use planning, site design, engineering, and retrofitting of homes, structures, schools, public buildings, and businesses.

The hazard mitigation plan is an important tool because it enhances community awareness and understanding of natural hazards, it creates a decision making tool for policy and decision makers, it assures inter-jurisdictional coordination of mitigation related activities, it identifies specific measures, actions, and programs for implementation, and lastly it fulfills state and federal compliance to maintain the region's eligibility for federal mitigation grant programs.

A planning workgroup composed of county, municipal, tribal, and other special purpose district staff and officials, has reconvened to meet monthly through the fall to evaluate and perform a five year update to the plan as required by the federal Disaster Mitigation Act of 2000. This workgroup will reassess the region's risks and consider adding other hazards such as pandemic flu and hazardous materials contamination. In addition, each participating entity will assess its

--MORE--

performance in implementing the mitigation measures and action items included in the plan.

The Emergency Management Council of Thurston County is hosting an open house meeting and invites the public to participate in the update to the "Natural Hazards Mitigation Plan for the Thurston Region." Three evening meeting are scheduled from 6 to 8 p.m. to accommodate community participation as follows:

1. June 25, Olympia, Thurston Regional Planning Council,
   Conference Room A, 2424 Heritage Ct SW, 98502
2. June 26, Tenino, Tenino Elementary School, Multi-Purpose Room,
   301 Old Highway 99 North, 98589
3. June, 30, Rochester, Rochester Community Center, Multi-Purpose Room,
   10140 Highway 12 SW, 98579

For more information, please visit www.trpc.org or contact Paul Brewster, Associate Planner at Thurston Regional Planning Council, (360) 956-7575.

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# County to update Hazard Mitigation Plan

Thurston County is susceptible to a variety of natural disasters which pose significant human, economic and environmental risks for its residents.

When hazard events threaten people's safety and overwhelm the capacity of responders from local governments and the State of Washington, the Governor can call upon the President of the United States for federal assistance. A federal disaster declaration provides federal assistance and financial support to help communities recover from the devastation.

Thurston County has been declared a federal disaster area 21 times since 1962. Since then, this region has endured 17 floods and severe storms, two earthquakes, one major windstorm, and the volcanic eruption of Mount St. Helens.

In 2003, Thurston County Emergency Management Council and 20 local government entities developed the region's first "Natural Hazard Mitigation Plan for the Thurston Region." This Federal Emergency Management Agency (FEMA) certified plan identifies earthquake, flood, severe storm, landslide, volcanic lahar, and wildfire as the region's most significant natural hazards. Hazard mitigation planning seeks to reduce future disaster losses through land use planning, site design, engineering, and retrofitting of homes, structures, schools, public buildings, and businesses.

The hazard mitigation plan is an important tool because it enhances community awareness and understanding of natural hazards; it creates a decision-making tool for policy and decision makers; it assures inter-jurisdictional coordination of mitigation-related activities; it identifies specific measures, actions, and programs for implementation, and it fulfills state and federal compliance to maintain the region's eligibility for federal mitigation grant programs

A planning workshop composed of county, municipal, tribal, and other special-purpose district staff and officials, has reconvened to meet monthly through the fall to evaluate and perform a five-year update to the plan as required by the federal Disaster Mitigation Act of 2000. This workgroup will reassess the region's risks and consider adding other hazards such as pandemic flu and hazardous materials contamination. In addition, each participating entity will assess its performance in implementing the mitigation measures and action items included in the plan.

The emergency Management Council of Thurston County will host three evening meeting to accommodate community participation in updating the Natural Hazards Mitigation Plan for the Thurston Region. All three meetings will run from 6-8 p.m.

The first meeting will be June 25 in Thurston Regional Planning Council Conference Room A, 2424 Heritage Ct. SW in Olympia.

The second meeting will be at Tenino June 26 in the Tenino Elementary School Multipurpose Room, while the third will be June 30 in Rochester, in the Rochester Community Center Multipurpose Room.

For more information, check the Web site at www. trpc.org or contact Paul Brewster, Associate Planner at the TRPC by telephone

# Summer hours for Roch. library

The Rochester Community

help in order to keep the Library

# Plans for natural disasters will be topic of events

A series of three public meetings to discuss ways of protecting Thurston County in the event of a natural disaster begins Wednesday.

The series, "Natural Hazards Mitigation Plan for the Thurston Region," is hosted by the Emergency Management Council of Thurston County.

The meetings will run from 6 to 8 p.m. on the following days and at the locations below:

- **Wednesday**, Thurston Regional Planning Council, Conference Room A, 2424 Heritage Court S.W., Olympia.
- **Thursday**, Tenino Elementary School, multipurpose room, 301 Old Highway 99 North, Tenino.
- **June 30**, Rochester Community Center, multipurpose room, 10140 Highway 12 S.W., Rochester.

For more information, call 360-956-7575 or go to www.trpc.org.

Sign up to get today's news first:
Your Name:
Your E-mail:
OK

Monday, June 30, 2008

# Help Get Ready For Catastrophes

*TENINO -- The public is being invited to participate in updating the plans for preparing for natural disasters.*

Posted June 24, 11:04 am. E-mail this article to a friend.

By The Chronicle

TENINO -- The public is being invited to participate in updating the plans for preparing for natural disasters in Thurston County with three upcoming meetings. Two will be held in South Thurston County.

A workgroup of county, municipal, tribal and other officials has reconvened for monthly meetings through the coming autumn to reassess the region's risks, and complete the required five-year update. They will consider adding pandemic flu and hazardous materials contamination to the list of significant potential catastrophes like earthquake, flood, severe storm, landslide, volcanic layer and wildfire.

The area's first Natural Hazard Mitigation Plan was developed in 2003 in response to the federal Disaster Mitigation Act of 2000. Among other purposes, the existence of the plan helps keep the region eligible for federal money related to large-scale hazards.

For information, call Paul Brewster at 360-956-7575 or visit www.trpc.org. The meetings are:

On Thursday, from 6 p.m. until 8 p.m. at Tenino Elementary School's multipurpose room, 301 Old Highway 99 North.

Next Monday, same time, at the Rochester Community Center, 10140 U.S. Highway 12 Southwest.

Add a comment to this article:
Your Name:
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# Classified C5

Wednesday, August 12, 2009

## MEDICAL AND DENTAL

**EVERGREEN NURSING & REHABILITATION CENTER HAS A NEED FOR REGISTERED NURSES!**

**Evergreen Nursing & Rehab** is looking for outgoing, enthusiastic Registered Nurses to join our management team. We are looking for a full time Resident Care Mgr with prior long-term care experience. You will be eligible for company paid health insurance upon date of hire along with our extensive benefit package and competitive wages reflected in our new wage scale. If this sounds like the right environment for you, please apply in person at 430 Lilly Road NE. EOE

**Medical Social Worker**

**Assured Hospice** team looking for FT - MEDICAL SOCIAL WORKER to manage patients in their Olympia area homes. Bachelors Degree in social work req. Masters Degree & prior hospice exp desired. Great Benefits & competitive pay. EOE and proud member of LHC Group. **Fax resume to 360-807-7790 or call Wilma at 360-330-2640.**

## LEGALS

Legal #7540

**NOTICE OF PUBLIC REVIEW AND COMMENT ON DRAFT NATURAL HAZARDS MITIGATION PLAN FOR THE THURSTON REGION**

NOTICE IS HEREBY GIVEN THAT in accordance with the Code of Federal Regulations 44 Part 201.6 and the Disaster Mitigation Act, the Emergency Management Council of Thurston County invites all interested stakeholders to review and comment on the *Draft Natural Hazards Mitigation Plan for the Thurston Region*. This plan has been prepared through the cooperative effort of local government entities. The plan contains proposals to mitigate the region's vulnerabilities to the effects of natural hazards.

The public review and comment period is from August 24 to September 4, 2009. The plan will be available at all Timberland Regional Libraries in Thurston County and online at www.trpc.org. Two open house meetings will be held as follows:

August 26, 2009, 6 to 8 p.m. Thurston Regional Planning Council. Conference Room A, 2424 Heritage Court SW, Olympia.

September 2, 2009, 6 to 8 p.m. The Tenino Quarry House. 199 Park Ave West, Tenino.

Please submit all comments in writing to Thurston Regional Planning Council, 2424 Heritage Court SW, Suite A, Olympia, WA 98502.

For more information contact Paul Brewster at brewstp@trpc.org or (360) 956-7575.

If you need special accommodations to participate in this process, please call us at 360-956-7575 by 5:00 p.m. on Thursday, August 20, 2009. Ask for the ADA Coordinator. For TDD users, please use the state's toll-free relay service, (800) 833-6388, and ask the operator to dial 360-956-7575. Arrangements can be made to review and comment in other languages.

**THURSTON REGIONAL PLANNING COUNCIL**

Publish: August 12, 16, 2009

## LEGALS

## MEDICAL AND DENTAL

**HOSPICE VOLUNTEER/COMFORT THERAPY COORDINATOR** to join our caring team of Hospice professionals. Will recruit, screen, train and assign Assured Hospice agency volunteers, conduct monthly support meetings and maintain agency documentation. Part time position works out of both the Centralia and Olympia branch offices and serves Lewis, Mason and Thurston Counties. Fax qualifications to 360-807-7790 or call the Hospice Director at 360-330-2640. "It's all about helping people"

## STUFF FOR SALE

## ANTIQUES/ COLLECTIBLES

**ANTIQUES:** Buy-Sell. 3 bldgs full, Refinish/repair furn. Open 7 days Summit Lake Antiques 866-0580

## AUCTIONS

**Aband** Veh Auct RCW 46.55.130 Bayside Tow, 600a Ronlee Ln nw, Oly 8/14/09 12pm view @ 11am 88 Topz,88 Carav,79 Van 1ton

## AUCTIONS

**Pilgrim Antiques & Country Things Store**
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Presented by
Menger Auctions & Appraisals
Saturday, Aug. 15, 10:00 am,
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Treasures from 40+ years of scouting primitives across the US.
Absentee bids accepted.
Visa/MC/debit/cash accepted.
Food sales benefit BHH sports.
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Pictures & details at:
**www.MengerAuction.com**
LMenger2655 (360) 754-7720

## BUILDING MATERIALS

**Laminate Wood Flooring.** Lots left over, Must sell now! 360-539-5967

## FUEL AND FIREWOOD

**DUMPTRUCK LOAD** 2-3 cords $440. Cut, split, delivered. **253-310-7134**

## FUEL AND FIREWOOD

**PREMIUM** firewood, $65-$95 a cord. Delivery $1 per mile. 360-751-4466

## FURNISHINGS

**BBF=Beautiful Belgian Furniture**

Rustic dark oak table, 6 chairs, china cabinet PLUS 11' German Shrank. $3600. 360-570-0775

## FURNISHINGS

**Very Nice** couch for sale. Good condition and very clean with just a few scratches on the side. Located in Hawks Prairie area. $75. Call 360-584-9008.

## LEGALS

## FURNISHINGS

**Kitchen Table** 6 ch/3 lvs $100. 3kitchen bar stools $30 ea. 3piece Entertainment Center $700. 866-9392

## JEWELRY

**We Buy Diamonds**
& gold. GL Kluh Jewelers. South Sound Center, Lacey 491-3530

## LAWN/GARDEN SUPPLIES

**Craftman** 18.5 hp garden tractors, w/ Auto trans., 46" mower deck & 4ft. dozer blade attachment. $650 obo.360-264-4919

## MISCELLANEOUS ARTICLES

**$50 FOR ANY complete car or truck. Free removal of junk vehicles. 360-943-2800**

**$55 and up** for complete car or truck running or not. 360-701-2235

**AC/DC** tickets. Good seats. Face value. 459-2345 or 790-9935

**Records** 33 1/3. '50's & '60's. Good cond. in jackets. Call 360-412-5195

**Singer** Industrial sewing machine. Paid $800, asking $500 or trade/obo. 360-456-3456

## MISCELLANEOUS ARTICLES

**XLT** Sport BowFlex. $400. Like new. Pick up only. 360-426-1906

Cedar Flats Rd., December 2007. Photo courtesy of Thurston County

# FOR THE THURSTON REGION

**The Thurston County Emergency Management Council is responsible for updating the region's hazard mitigation plan. The Council is seeking community input on how governments, businesses, and residents can work together to plan for a safer, more resilient, and more sustainable future for the Thurston Region.**

## COMMUNITY OPEN HOUSES

**Wednesday, June 25**
6:00 – 8:00 p.m.
Thurston Regional Planning Council
2424 Heritage Ct SW, Olympia

**Thursday, June 26**
6:00 – 8:00 p.m.
Tenino Elementary School
301 Old Hwy 99 North, Tenino

**Monday, June 30**
6:00 – 8:00 p.m.
Rochester Community Center
10140 Hwy 12 SW, Rochester

*Three identical open houses.*
*Pick the night that works best for you!*
*Drop by anytime between 6:00 and 8:00,*
*no scheduled presentations.*

*Communities that take steps to conduct advance planning for inevitable disasters can identify vulnerabilities and take appropriate steps to reduce or mitigate those vulnerabilities. Mitigation planning can serve to reduce threats to peoples' safety and minimize the financial losses from the effects of natural and human induced hazards.*

*Over twenty local and tribal governments are partnering in discussions and analysis to evaluate goals, objectives, and mitigation activities that are intended to make the region more resilient to natural hazards such as floods, earthquakes, severe storms, landslides, wildfires, and volcanic activity. This information is compiled in a multi-jurisdictional plan titled, "Natural Hazards Mitigation Plan for the Thurston Region." This plan was approved by the Federal Emergency Management Agency (FEMA) in October 2003, and the plan is due for a federally required five-year update.*

*Updating the plan is required for local governments to remain eligible for federal mitigation grant programs that can be used to fund a variety of mitigation projects that could include site design, engineering, and retrofitting of homes, structures, schools, public buildings, and businesses.*

**QUESTIONS?** Visit the website at www.trpc.org or contact Paul Brewster at 360.956.7575 or brewstp@trpc.org

# COMMENT FORM

The Thurston County Emergency Management Council is seeking community input on how governments, businesses, and residents can work together to plan for a safer, more resilient, and more sustainable future for the Thurston Region. Please share your ideas and comments with us.

**MAIL TO:**
Hazard Mitigation Planning
c/o Thurston Regional Planning Council
2424 Heritage Court SW #A
Olympia, WA 98502

**OR EMAIL:**
brewstp@trpc.org

## Hazard Mitigation Planning Partners

Town of Bucoda
City of Lacey
City of Olympia
City of Tumwater
City of Rainier
City of Tenino
City of Yelm
Thurston County
Intercity Transit
Olympia School District
North Thurston Public Schools
Rainier School District
Tumwater School District
Yelm Community Schools
The Evergreen State College
South Puget Sound Community College
Providence Saint Peter Hospital
Nisqually Indian Reservation
LOTT Alliance
Thurston PUD
Timberland Regional Library
Thurston County Fire Districts
Port of Olympia

## What Is Natural Hazards Mitigation Planning?

Thurston County is susceptible to a variety of natural hazards such as earthquakes, floods, landslides, volcanic eruptions, severe storms, and wildfires. Since 1962, Thurston County has received 21 Federal Disaster Declarations.

Although it is difficult to predict when the next disaster will occur, or the extent of an event, communities can take action. Local governments, private sector organizations, and community members can engage in decision making processes that incorporate community sustainability and disaster resistance principles into community development practices. This process is known as hazard mitigation planning. Natural hazard mitigation planning serves to reduce or eliminate the immediate and long-term impacts to people and property from natural hazards and their effects.

## What is Being Done in Thurston County?

Over twenty local and tribal governments are partnering in discussions and analysis to evaluate goals, objectives, and mitigation activities that are intended to make the region more resilient to such hazards as floods, earthquakes, severe storms, landslides, wildfires, and volcanic activity. This information is compiled in the multi-jurisdictional "Natural Hazards Mitigation Plan for the Thurston Region."

The purpose of the plan is to:

- Provide a methodical approach to mitigation planning
- Enhance public awareness and understanding of natural hazards
- Create a decision-making tool for policy and decision makers
- Promote compliance with state and federal program requirements
- Assure inter-jurisdictional coordination of mitigation related programming
- Create jurisdiction-specific hazard mitigation plans for implementation

This plan was approved by the Federal Emergency Management Agency (FEMA) in October 2003, and is due for a federally required five-year update. The update is required for local governments to remain eligible for federal mitigation grant programs. The 2008 planning process will consider projects or programs from the following six broad categories of mitigation actions:

**Prevention:** planning and zoning, building codes, capital improvement programs, open space preservation, and storm water management regulations.

**Property Protection:** acquisition, elevation, relocation, structural retrofits, storm shutters, and shatter-resistant glass.

**Public Education and Awareness:** outreach projects, real estate disclosure, hazard information centers, and school-age and adult education programs.

**Natural Resource Protection:** sediment and erosion control, stream corridor restoration, watershed management, forest and vegetation management, and wetland restoration and preservation.

**Emergency Services:** warning systems, emergency response services, and protection of critical facilities.

**Structural Projects:** dams, levees, floodwalls, seawalls, retaining walls, and safe rooms.

### the hazard mitigation planning process

Hazard mitigation planning is the process of determining how to reduce or eliminate the loss of life and property damage resulting from natural hazards such as floods, earthquakes and severe storms. Four basic phases of the hazard mitigation planning process are shown in this diagram.

For illustration purposes, this diagram portrays a process that appears to proceed sequentially. However, the process is rarely linear. It is not unusual that ideas developed while assessing risks should need revision and additional information while developing the mitigation plan, or that implementing the plan may result in new goals or additional risk assessment.

**organize resources**
From the start, communities should focus on the resources needed for a successful mitigation planning process. Essential steps include identifying and organizing interested members of the community as well as the technical expertise required during the planning process.

**assess risks**
Next, communities need to identify the characteristics and potential consequences of hazards. It is important to understand how much of the community can be affected by specific hazards and what the impacts would be on important community assets.

**develop a mitigation plan**
Armed with an understanding of the risks posed by hazards, communities need to determine what their priorities should be and then look at possible ways to avoid or minimize the undesired effects. The result is a hazard mitigation plan and strategy for implementation.

**implement the plan and monitor progress**
Communities can bring the plan to life in a variety of ways ranging from implementing specific mitigation projects to changes in the day-to-day operation of the local government. To ensure the success of an on-going program, it is critical that the plan remains relevant. Thus, it is important to conduct periodic evaluations and make revisions as needed.

**QUESTIONS?** Visit www.trpc.org or contact Paul Brewster at 360.956.7575 or brewstp@trpc.org

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## Environment

### The Natural Hazards Mitigation Plan for the Thurston Region

**A Disaster Can Strike at Anytime**

Thurston County, Washington is susceptible to a variety of natural hazards such as earthquakes, floods, landslides, volcanic eruptions, severe storms, and wildfires.

**Since 1962, Thurston County has received 21 Federal Disaster Declarations**

**This site is a resource for decision makers, staff, and members of the community to learn more about hazard mitigation planning in the Thurston Region.**

### Natural Hazard Mitigation Planning in the Thurston Region

Twenty local governments, special districts, colleges, and other public agencies have participated in the development of the multi-jurisdictional "Natural Hazards Mitigation Plan for the Thurston Region" (see the **list of participants here**). This plan was approved by the Federal Emergency Management Agency on October 6, 2003. The purpose of the plan is to:

- Provide a methodical approach to mitigation planning
- Enhance public awareness and understanding of natural hazards
- Create a decision-making tool for policy and decision makers
- Promote compliance with state and federal program requirements
- Assure inter-jurisdictional coordination of mitigation related programming
- Create jurisdiction specific hazard mitigation plans for implementation

The current plan is set to expire October 5, 2008. **The Emergency Management Council of Thurston County** is responsible for the plan's monitoring, maintenance, and five year update. **Thurston County Emergency Management Division** is sponsoring the update to the plan and has contracted Thurston Regional Planning Council to manage and coordinate the plan's update. The region's hazard mitigation planning partners are in the process of updating the plan.

**For further information, please contact: Paul Brewster, Associate Planner, at 360-956-7575**

More information about the plan and the planning process can be accessed through these links:

## Internal Links

"Natural Hazards Mitigation Plan for the Thurston Region" (2003) – Download the Plan

What Is Natural Hazards Mitigation Planning?

The Hazard Mitigation Grant Program (HMGP)

Hazard Mitigation Planning Requirements

Hazard Mitigation Planning Approval Process

## External Links

Federal Emergency Management Agency Hazard Mitigation Website

FEMA Mitigation Planning Guidance and "How-To" Guides

Washington State Emergency Management Division HMGP Website

Municipal Research and Services Center of Washington: Hazard Mitigation Planning in Washington (general information, references, and links to other plans).

### What Is Natural Hazards Mitigation Planning?
### A Strategy for Community Sustainability and Resiliency

In an effort to manage risks, contain costs, and promote sustainable communities, the federal government outlined new mitigation planning requirements for states, tribes, and local governments in the Disaster Mitigation Act of 2000 (DMA 2000). This act emphasizes planning for disasters before they occur.

Although it is difficult to predict when the next disaster will occur, or the extent of an event, communities can take action. Local governments, private sector organizations, and community members can engage in decision making processes that incorporate community sustainability and disaster resistance principles into community development practices. This process is known as hazard mitigation planning. Natural hazard mitigation planning serves to reduce or eliminate the immediate and long-term impacts to people and property from natural hazards and their effects.

All states, tribes, and local governments must develop, adopt, and receive federal approval of their hazard mitigation plan in order to apply for Hazard Mitigation Grant Program funds.

### The Hazard Mitigation Grant Program

The Hazard Mitigation Grant Program (HMGP) is available to states following a Presidential declaration of a major disaster. The program is administered by the State of Washington and overseen by the Federal Emergency Management Agency. This program is enacted by the Robert T. Stafford Disaster Relief and Emergency Assistance Act. Section 404 of Public Law 93-288, as amended. Eligible applicant include State government, local governments, Indian tribes, special districts, and certain private non-

government, local governments, Indian tribes, special districts, and certain private non-profit organizations that provide like-government services and facilities. The purpose of the Hazard Mitigation Grant Program is to:

- Significantly reduce or permanently eliminate future risks to lives and property from severe natural hazards
- Provide funds to implement projects identified in state or local hazard mitigation plans
- Enable mitigation measures to be implemented during the immediate recovery from a disaster

**Hazard Mitigation Planning Requirements**

A hazard mitigation plan must meet specific federal terms of compliance that are reviewed by the Federal Emergency Management Agency (FEMA). The planning process is basically broken into the following steps:

1. Organize and engage planning participants such as local governments, technical experts, businesses, community members, and other appropriate stakeholders
2. Identify hazards that pose significant dangers to a jurisdiction/community
3. Assess the jurisdiction's risks and vulnerabilities for each hazard based on historical events and other reliable data sources
4. Determine what populations, community assets, and critical facilities are potentially in harm's way
5. Estimate potential financial losses for each type of hazard
6. Create appropriate goals and objectives to respond to the risks and vulnerabilities identified
7. Develop a prioritized list of mitigation initiatives or action items that can bolster a community's resilience to the effects of hazards – they must be cost effective and environmentally sound solutions
8. Solicit public input on the draft plan
9. Adopt, Implement, and monitor the plan
10. Evaluate and update the plan at least every five years

**Hazard Mitigation Plan Approval Process**

A local government and tribal hazard mitigation plan is developed and approved as follows:

- A draft plan is developed with community-wide stakeholder input and public process
- The draft plan is submitted to the Emergency Management Division of the Washington State Military Department for preliminary review
- The State forwards the plan to the Federal Emergency Management Agency, Region X, for preliminary review
- If the State and FEMA find the plan satisfactory, they will grant the draft plan a preliminary approval (if the reviewers recommend improvements, the local plan is modified and returns to step 2)
- Local governments adopt the plan through their governing bodies
- The final plan is resubmitted to the State for final review
- The State forwards the final plan to FEMA where it is processed for federal approval

**Local Approved Plans in Thurston County**

The following Jurisdictions have a federally approved hazard mitigation plan through the "Natural Hazards Mitgation Plan for the Thurston Region":

**Local Approved Plans in Thurston County**

The following Jurisdictions have a federally approved hazard mitigation plan through the "Natural Hazards Mitgation Plan for the Thurston Region":

**Existing Planning Partners**

Town of Bucoda
City of Lacey
City of Olympia
City of Tumwater
City of Rainier
City of Tenino
City of Yelm
Thurston County
Intercity Transit
Olympia School District
North Thurston Public Schools
Rainier School District
Tumwater School District
Yelm Community Schools
Thurston County Fire District 4
Thurston County Fire District 9
Thurston County Fire District 13
The Evergreen State College
South Puget Sound Community College
Providence Saint Peter Hospital
Confederated Tribes of the Chehalis Reservation*

**New Planning Partners for 2008 Update**

Nisqually Indian Reservation
LOTT Alliance
Thurston PUD
Timberland Regional Library
South Puget Sound Community College
All Thurston County Fire Districts
Port of Olympia

***Note**: The Chehalis Tribe is conducting an independent update to their Tribal Hazard Mitigation Plan. For more information, contact Lennea Magnus at (360) 858-1505.

TRPC 2424 Heritage Court SW, Suite A Olympia, WA 98502 info@trpc.org (360) 956-7575

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# EARTHQUAKE

## HAZARD DESCRIPTION

Earthquakes are one of nature's most damaging hazards. They usually occur without warning and after just a few seconds can cause massive damage and extensive casualties. The effects of an earthquake can be felt far beyond the site of its occurrence.

Giant plates, called tectonic plates, make up the earth's crust and move very slowly over the surface of the globe. In areas where the plates are in contact, stresses build up. An earthquake is a sudden motion or trembling that is caused by a release of strain accumulated within or along the edge of tectonic plates.

**Spotlight: 2001 Nisqually Earthquake**

On February 28, 2001, a 6.8 magnitude earthquake occurred 30 miles below the Nisqually wetland, causing damage across much of the state. In the days after the quake, a state of emergency and a Presidential Disaster Declaration were issued.

**Impacts**

- Death and injury: 400 injuries, 1 death
- Federal disaster aid applicants: 41,414
- Total damage estimates: $1 - $4 billion
- Federal assistance to date: $334 million
- Building Damage:
  - Downtown Olympia and Seattle's Pioneer Square area hit hard.
  - Several of the government buildings in Olympia, including the capitol, were significantly damaged.
  - Damage to residences came in a variety of forms; the most common damage was to chimneys.
- Transportation Damage:
  - Serious damage to Seattle-Tacoma International Airport
  - 4th Avenue Bridge and Deschutes Parkway in Olympia were destroyed and remained closed until rebuilt.
- Other Impacts: landslides, power outages, some damage to dams, landline and wireless communications were overwhelmed by user demand.

## ASSESSING VULNERABILITY

**Summary Assessment**

History suggests a **high probability of occurrence** of another damaging earthquake sometime in the next 25 years. Damage from previous earthquakes indicate that a large earthquake could have a catastrophic impact on Thurston County suggesting **high vulnerability**. Accordingly, the **high risk rating** is assigned.

**Delineation of Earthquake Liquefaction Hazard Area**

Liquefaction occurs when ground shaking causes loose soils to act like viscous fluid. Much of the urban areas of Lacey, Olympia and Tumwater are rated as having "low to moderate risk." In general, the land area along the Puget Sound waterfront has been rated "very low risk," with exceptions including the Port Peninsula in Olympia, the Deschutes Falls upstream to approximately the Rich Road bridge, the Nisqually Valley and delta, and the head of eld inlet in Mud Bay south of Perry Creek.

For more information on liquefaction, see the "Liquifaction Susceptibility Map of Thurston County, Washington."

**Population and Assets in Hazard Area**

While the data is not inclusive of the entire county, estimates show that in 2000, over 114,000 residents of Thurston County (58% of study population) were living in liquefaction hazard areas. By 2025, over 186,000 people are expected to live in liquefaction hazard areas.

The majority of buildings in Lacey, Olympia and Tumwater were situated in the earthquake liquefaction hazard areas in 2000, a trend that will continue through 2025.

**Examples of Earthquake Mitigation Strategies from 2001 Natural Hazards Mitigation Plan**

| Hazard Code | Initiative | Priority | Cost |
|---|---|---|---|
| CW-EH 1 | Obtain digital data and update the GIS map for liquefaction susceptibility, and create a new GIS map for strong ground motion. | 1 of 10 | $50,000* |
| L-EH 2 | Pursue seismic upgrades to water and wastewater facilities that do not meet current seismic codes. | 1 of 10 | Unknown |
| RSD-EH 1 | Contract with structural engineer to perform structural review of the high school and elementary buildings to determine seismic stability. Implement changes necessary to bring buildings up to current codes, where possible. | 1 of 3 | $1,000,000 |

For further information or to view the current "Natural Hazards Mitigation Plan for the Thurston Region," visit www.trpc.org.

# STORM

## HAZARD DESCRIPTION

Thurston County is subject to a variety of storms that deliver wind, rain, ice, snow, and combinations of the above. Nearly all destructive local storms occur from November through April when the jet stream is over the U.S. west coast and Pacific low-pressure systems are more frequent. The more southerly trajectories bring heavy rains while the more northerly ones bring cold air and the potential for snow and ice. Storms can pack high winds. Generally, winds above about 30 miles per hour can cause widespread damage and those above about 50 miles per hour can be disastrous. High winds of short duration, such as tornados and strong gusts from thunderstorms, though destructive, are less common in our region.

**Storm - Historical Occurrences and Impacts**

Storms are frequent in Thurston County. Between 1962 and 2007, Thurston County was declared a federal disaster area 16 times for events related to storm activity. The majority of these were combination events with high winds, heavy rain, snow or ice, and subsequent flooding. The following are examples of the type of impacts from recent storms.

**November 1981 Strong Winds and Rain**

- Thurston County Commissioners declared the county a disaster area
- Private property damage estimated at $3.4 million throughout the county
- Governor Spellman declared a state of emergency for Western Washington
- 60,000 people in Thurston County were without electricity
- In Budd Inlet, 150 boats broke loose and a stream of boat debris was strewn for miles

**January 1986 Strong Winds and Rain**

- In a 24-hour period, the area was hit with 70 m.p.h. winds and over 3 inches of rain
- About 20,000 Puget Sound Power and Light customers lost electricity
- Recurring winds and rain caused mud slides
- City storm drains were unable to handle the run-off; damage to roads and storm drains was estimated at $186,000
- City of Olympia Fire Department received 30-40 calls every half hour during one day

**January 1993 Inaugural Day Storm**

- Affected all of Western Washington and 870,000 people lost power
- Citizens were ill-prepared for such an event
- There were five fatalities area-wide
- 60 dwellings were destroyed

**December 1996 Wind and Ice Storm**

- PNW Region recorded wind gusts of 70 to 100 m.p.h.
- 14 people killed in western Washington
- Cost Washington State $170 million in damages
- Cost Thurston County nearly $1 million in non-flood related costs mostly debris removal and road repairs
- Caused power outages to 1.2 million state-wide, and one-half of the county population for several days
- Cost Puget Sound Energy $10 million in repairs to the power distribution system
- Resulted in an estimated $3 million in uninsured losses to private property

The entire county is vulnerable to the following effects of storms:

- High winds bring down trees, telephone and electrical lines, and interrupt transportation, communications and power distribution
- Prolonged heavy rains cause ground saturation, rivers and streams to rise, and result in local flooding and landslides in rural areas.
- In urbanized areas, city storm drains become overwhelmed by stormwater run-off and lead to flooding
- Wastewater treatment facilities can also be overwhelmed by excessive rainfall and force plants to discharge untreated stormwater
- Mudslides and debris can block streets and severely disrupt transportation systems
- Freezing rain or ice can overload trees, utility lines, and cause structures to fall or break
- Snow storms primarily impact the transportation system and the availability or timing of public safety services
- Blizzards affect visibility, create large snow drifts, and can strand residents for up to several days
- Melting snow adds to river loading and can turn an otherwise benign situation into a local disaster
- Power outages in winter months leave people without primary heating sources which can lead to use of unsafe heating sources like BBQ's which in turn can lead to fires and carbon monoxide poisoning or death

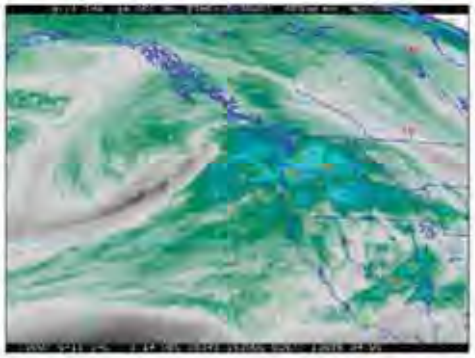
## VULNERABILITY

**Summary Assessment**

Storm history suggests a **high probability of occurrence** - severe wind storms are likely to reoccur about every five years. Historical damage and cumulative costs of destructive storms suggest **high vulnerability**. Accordingly, a **high risk rating** is assigned.

**Delineation of Storm Hazard Area**

The entire county is vulnerable to the effects of storm events.



For further information or to view the current "Natural Hazards Mitigation Plan for the Thurston Region," visit www.trpc.org

# FLOOD The Region's Most Pervasive Hazard

## HAZARD DESCRIPTION

Flooding is a natural cycle of streams and rivers. It occurs when the volume of precipitation or melting glacier water exceed the capacity of river banks to keep flowing waters contained. Floodplains are relatively flat lowland area that borders a river, usually dry, but subject to flooding.

Of all natural hazards that affect Thurston County, floods are the most common and, on an annual average basis, the most costly. **Thurston County has been declared a major Federal Disaster Area 17 times for flood since 1962.**

**Several factors determine the severity of floods:**

- Precipitation intensity and duration
- Soil saturation conditions
- Topography and ground cover

**Four types of flooding occur in Thurston County:**

1. River or stream building floods: occur with prolonged heavy rainfall, a rapidly melting snow pack or a combination of these. Historically, Thurston County must experience two or three days of rainfall averaging 2-5 inches per day for this type of flooding to occur.

2. Flash floods: result from intense storms dropping large amounts of rain within a short period of time onto watersheds that cannot absorb or slow the flow. Although flash floods are less common in Thurston County, the Deschutes River and many smaller streams react in a "flashy" manner, making them more difficult to forecast. As development continues, increasing the distribution and proportion of impervious surfaces, the threat from flash floods will increase.
3. Tidal floods: result when extremely high tides combine with low atmospheric pressure, excessive run-off, or strong northerly winds. The tides can also enhance flooding in delta areas when rivers or creeks are at or near flood stage. The Olympia waterfront , the low lying farm lands in the Nisqually Valley, and McLane Creek near Mud Bay are at greatest risk from tidal floods.

4. Groundwater flooding: occurs when there is a high water table and persistent heavy rains. The situation is caused in areas where an upper, thin layer of permeable soils overlays an impermeable layer of hard pan. As the ground absorbs more and more rain water, the groundwater table rises and shows itself as flooding in areas where the land surface is below the water table. The 1998-1999 is the groundwater flood of record and this event is likely to occur in the next 25 to 30 years.

## ASSESSING VULNERABILITY

### Summary Assessment

Flooding in Thurston County has a **high probability of occurrence.** Because of the relative land area and population affected, the county is exposed to **moderate vulnerability.** On a jurisdictional basis, an exception is the Town of Bucoda, which has a **high vulnerability** to flooding due to its location within a 100-year floodplain. Although the vulnerability is moderate, the frequency of flooding, the potential for simultaneous flooding events, plus the historical record of recurrent flooding and cumulative costs, all suggest the assignment of a **high risk rating.**

### Delineation of Flood Hazard Area

The Thurston County Flood Plain Map delineates the boundaries of the 100*- and 500-year floodplains, and areas of high groundwater flooding. Flooding has and will continue to occur outside of these boundaries.

*Note: The term "100-year flood" is a statistical designation that there is a 1-in-100 chance that a flood of a particular magnitude will happen in any given year. Designated or mapped flood boundaries will shift over time as flood events occur and data is analyzed.

### Population in Hazard Area

As of the year 2000, 13% of the total County population resided in a flood hazard area. By 2025 19% of the population or 63,505 people are forecasted to reside in a flood hazard area. The future population growth assigned to the flood hazard area is likely overestimated. The analysis associates parcels within the flood hazard area even though only a fraction of the parcel is affected and the remainder of the parcel is developable. Special development regulations apply to new structures being built in areas prone to high groundwater flooding.

### Inventory of Assets and Dollar Value in Hazard Area

The "Natural Hazards Mitigation Plan for the Thurston Region," provides estimates of potential losses by jurisdiction for properties, assets, and critical facilities in flood hazard areas. However the estimates are not based on hypothetical scenarios , but rather for total loss or 100% devastation. A review of past flood events offers a more pragmatic view of financial losses (see sidebar to the right).

### The Effects and Costs of Floods

The effects of floods can be devastating. Aside from inundation of lands and property with sediment-filled waters, floods can result in:

- Death or injury to people, pets, and livestock
- Leave people stranded or isolated for long periods of time
- Physical destruction of buildings and other structures
- Contamination of water sources and treatment systems
- Foul Septic Systems
- Destroy electrical and heating systems
- Damage, Destroy, or close bridges, transportation routes, railroads, and pipelines and utility systems
- Limit access for emergency responders and critical personnel

**The potential consequences are enormous as the following summaries of damages from flooding in 1996, 1997 and 2007 demonstrate:**

The December 1996 and March 1997 winter storm and ground water flooding:

- Inundated approximately 200 homes countywide
- Contaminated approximately 200 drinking water wells
- Caused wide spread failures of on-site septic systems
- Severely impacted a number of business operations
- Cost Thurston County government in excess of $340,000
- Cost other government entities & utilities in excess of $750,000
- Cost uninsured private property losses in excess of $1.75 million

The December 2007 Flood and Severe Storm*

- 25 Rescue Missions (17 by Helicopter) to rescue 63 people
- 400 properties affected, 90 households isolated by washout of Cedar Flats Rd
- 44 Road and Bridge Closures with damages likely to exceed $2.7 million
- LOTT Alliance Wastewater Treatment Facility overloaded by runoff and forced to discharge one million gallons of untreated stormwater per hour into Budd Inlet

*Note: Data for the 2007 Flood is still being analyzed

For further information or to view the current "Natural Hazards Mitigation Plan for the Thurston Region," visit www.trpc.org.

# LANDSLIDE

## HAZARD DESCRIPTION

Landslides are the movement of rock, soil, or other debris, down a slope. The term landslide includes rock falls, deep failure of slopes, and shallow debris flows. Gravity acting on an overly steep slope is the primary cause of a landslide. However, they are influenced by both natural factors (geology, topography, weather, and hydrology) and human activity (mining and construction). Landslides are activated by storms, fires, earthquakes, volcanoes, and various human activities. They vary greatly in size and composition, and can be miles across.

**Landslide - Historical Occurrences and Impacts**

The State of Washington rates landslide losses second to flood losses for the state as a whole with the Puget Sound area having the greatest vulnerability. In Thurston County, as development continues in high risk areas, vulnerability will increase.

**September 1990:** A major landslide occurred on the Nisqually River approximately five miles downstream from La Grande Dam. The river's course shifted several hundred yards to the north.

**February 1996:** Flooding caused sections of bluff to slide into the Nisqually River near Yelm; several residences were declared unsafe to occupy. Another landslide broke the two main sewer lines that carried the majority of Tumwater's and the former Olympia Brewery's wastewater to the LOTT treatment plant in Olympia. A landslide removed a section of Flumerfelt Road, southwest of Bucoda, which was closed for several months.

**1997:** After rain storms that occurred in December 2006 and March 2007, sections of bluff near Hunter Point across from Squaxin Island slid a few feet resulting in two residences being declared unsafe to occupy.

**Winter 1998-99:** Three years of above average winter rainfall contributed to a massive slide in the Carlyon Beach area. The 66-acre landslide left 40 homes uninhabitable.

## VULNERABILITY

**Summary Assessment**

Thurston County has a history of landslides and their numbers seem to be increasing, suggesting a **high probability of occurrence**. Landslides tend to occur in isolated, sparsely developed areas, suggesting **low vulnerability**. Because of the high probability of occurrence and the trend to more frequent landslides a **moderate risk rating** is assigned.

**Delineation of Landslide Hazard Area**

The Landslide Hazard Area has been defined as those parcels in the county on which slopes of 40 percent or more occur. The majority of these areas are in unpopulated areas in the south and west county, though bluffs in Olympia, Tumwater and Lacey also feature steep slopes.

**Population and Assets in Hazard Area**

As of 2000, a small percentage of the county's residents (approximately 2.5%) lived in landslide hazard areas. This proportion is expected to grow to 5.7% by 2025. Overall, assets (homes, other buildings and their contents) in landslide hazard areas in 2000 are found in Olympia. More structures may be in harm's way by 2025 not only in Olympia but also in Yelm and unincorporated Thurston County, as properties on or near steep slopes develop.

**Examples of Landslide Mitigation Strategies from 2001 Natural Hazards Mitigation Plan**

| HAZARD CODE | INITIATIVE | PRIORITY | COST |
|---|---|---|---|
| OLY-LH 1 | Protect the roads and buildings along Lakeridge Drive and the east side of Capitol Lake from landslide hazards. | 7 of 8 | $1,800,000 |
| TC-LH 2 | Prepare a landslide vulnerability index for county roads. | 15 of 28 | $100,000 |
| TUM-LH 2 | Reevaluate development regulations in regards to steep slopes. | 17 of 18 | Unknown |

For further information or to view the current "Natural Hazards Mitigation Plan for the Thurston Region," visit www.trpc.org.

# WILDFIRE / FOREST FIRE

## HAZARD DESCRIPTION

Wildland fires are any instance of uncontrolled burning in grasslands, brush, woodlands, or forest. Although these fires are sometimes ignited by lightning, most in fact are caused by human error. These fires are capable of destroying open areas and natural resources, but these fires also pose a significant threat to people who have homes or businesses that intermingle with wildland vegetation. This area is termed the Wildland-Urban Interface (WUI).

### Historical Occurrences and Impacts

There have been over 2400 wildfires countywide in the last 35 years; the average fire is approximately one acre.

The largest wildfire recorded in Thurston County burned approximately 140 acres near Offut Lake north of Tenino in 1998. This fire was suppressed by Tenino Fire District 12 and East Olympia Fire District 6.

Three open space undevelopable areas are of special concern for fire risk:

1. Capital Forest in the west
2. Fort Lewis Military Reservation in the east
3. Commercial forest lands in the southeast

All open spaces within the county are vulnerable to a wildfire, especially those areas surrounded by brush and grass which tend to dry out in the hotter months.

The impact of a major fire would be amplified by collateral effects such as loss of ground cover which could exacerbate runoff, flooding and landslides, loss of commercial and aesthetic value of the forest, destruction of wildlife habitat, and damage to power lines, pipelines and the communications and transportation infrastructure.

## VULNERABILITY

### Summary Assessment

Although not a historical problem, the existence of large forested areas, increasing population and recreational activities, and the uncertain impact of a changing climate combine to suggest a **moderate probability of occurrence**. The destruction of large tracts of forest land would have immediate economic impact to the community through lost jobs, reduced taxes, and increased public support while collateral economic and social effects could impact the County for years, suggesting **moderate vulnerability**. Accordingly, a **moderate risk rating** is assigned.

### Risk Factors

The "Washington State Hazard Mitigation Plan," lists three factors that contribute to wildfires. They are as follows:

**Fuel:** Grasses, leaves, and needles quickly expel moisture and burn rapidly. Heavier fuels such as tree branches, logs, and snags take longer to heat and ignite.

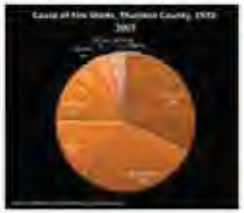
**Weather:** West of the Cascades, strong, dry, east winds in late summer and early fall produce extreme fire conditions. Thunderstorm activity, which typically begins in June with wet storms, turns dry with little or no precipitation reaching the ground, as the season progresses into July and August.

**Terrain:** Topography of a region or a local area influences the amount and moisture of fuel. Barriers, such as highways and lakes, can affect the spread of fire. Elevation and the slope of the land allows a fire to spread more easily as it moves uphill than downhill.

In the Thurston region, there are additional factors that influence wildfire or forest fire as follows:

**Soil Conditions:** The Thurston Region has large land areas formed by glacial outwash. These prairie soils drain by the summer months (usually May through October). In Thurston County, the location of these areas closely corresponds with the Natural Resource Conservation Service (NRCS) designation of Category 1 soil types (excessively-drained, glacial-outwash - see map).

**Vegetation Type:** Vegetation types are closely related to soil conditions in that certain soils tend to grow certain vegetation. In a wildfire, many times the underlying layer of vegetation burns, leaving the timber. Since this understory varies widely in Thurston County, fuel for a wildfire could vary widely throughout the County. The threat of fire increases in years following those in which there is a large amount debris on the ground surface that can fuel the intensity and duration of fires.

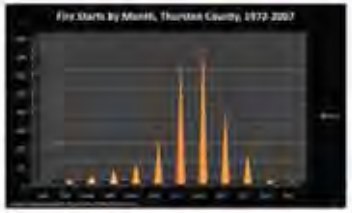



**Access:** Access for emergency vehicles to suppress wildfires is a factor. The Wildland Fires map to the left illustrates roads and streets in Thurston County, which are less than 24 feet wide and could hinder access. Such access adds to the response time or limits the ability to successfully fight a fire when necessary equipment cannot reach it.

**Slope:** An additional factor that plays into the risk for wildfire is the topography—specifically slope. Generally, the steeper the slope of the land, the faster a fire can spread up the slope (see slope map).

### Population in the Hazard Area

In general, households, businesses, and other private and public structures that are adjacent to vegetated open spaces and undeveloped lands, particularly in the WUI are susceptible to the risk of wildfire. Susceptibility is not limited to unincorporated portions of the county. Properties within city limits that border on wooded urban parks, greenways, and large undeveloped sections of vegetated property are also susceptible.




For further information or to view the current "Natural Hazards Mitigation Plan for the Thurston Region," visit www.trpc.org.

# VOLCANIC LAHAR (Mudslides & Debris Flows)

## HAZARD DESCRIPTION

Historically, lahars have been one of the most destructive volcanic hazards. Lahar is an Indonesian word describing mudflows and debris flows that originate from the slopes of a volcano. They originate on volcano flanks and can surge tens or even hundreds of miles downstream from a volcano. The major hazard to human life is from debris flows with the potential to bury or smash those in its path. Lahars can occur anytime, not just during eruptions.

Lahars are commonly initiated by:

- Large landslides of water-saturated debris,
- Heavy rainfall eroding volcanic deposits,
- Sudden melting of snow and ice near a volcanic vent by radiant heat or on the flanks of a volcano by pyroclastic flows, or
- Breakout of water from glaciers, crater lakes, or from lakes dammed by volcanic eruptions.

### Historical Occurrences and Impacts

The greatest local threat is from lahars which could inundate the Nisqually Valley in a worst case scenario. The potential destruction of Alder and LaGrande Dams would add significantly to the destructive impact of the debris flows. A more likely potential is the displacement of water in the Alder reservoir, with potential flooding effects in the Nisqually Valley.

There is evidence (dated to have occurred approximately 300 years ago), that lahars have buried forests near what are now the City of Yelm and the Nisqually Indian Reservation. Historically, lahars originating from Mount Rainier have been a fairly common occurrence; they vary in size and magnitude and are fairly unpredictable.

## VULNERABILITY

### Summary Assessment

History suggests a **low probability of occurrence**. There is a **moderate to high vulnerability**. Because Mt. Rainier has been quiet for the past 1,000 years with no indication of change, this hazard is assigned a **low risk rating**.

### Examples of Volcanic Lahar Mitigation Strategies

No volcanic lahar mitigation strategies currently exist for Thurston County. The following strategies, taken from the 2004 Pierce County Natural Hazard Mitigation Plan, are included here as examples.

- Lahar Flow Control
  - Coordinate research to identify projects that can reduce the volume of lahars over time.
  - May include erosion control structures, which can inhibit the flow of lahars as they flow. Examples include various types of dams and dikes.
- Dam Draw-Down Agreement
  - Develop an agreement with various facility managers to lower reservoir levels in the Nisqually region if there is a threat of volcanic activity from Mt. Rainier.
  - Could impede or contain major flows.
- Public Education
  - Pierce County will provide education on the threats of lahars, and how to recognize and respond to emergency situations.

For further information or to view the current "Natural Hazards Mitigation Plan for the Thurston Region," visit www.trpc.org.

# HAZARD MITIGATION PLANNING

## A Coordinated, Comprehensive and Continuous Response to Natural Disasters

### A DISASTER CAN STRIKE ANYTIME

Since 1962, Thurston County has been declared a Federal Disaster Area 21 times. Thurston County is susceptible to a variety of natural hazards such as earthquakes, floods, landslides, volcanic activity, severe storms, and wildfire.

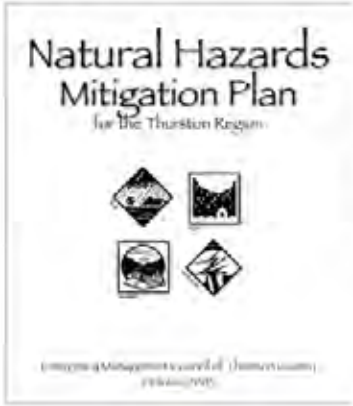
**The Natural Hazards Mitigation Plan For The Thurston Region**

Twenty local governments, special districts, colleges, and other public agencies have participated in the development of a multi-jurisdictional "Natural Hazards Mitigation Plan for the Thurston Region." This plan was approved by the Federal Emergency Management Agency on October 6, 2003.

**The purpose of the plan is to:**

- Provide a methodical approach to mitigation planning
- Enhance public awareness and understanding of natural hazards
- Create a decision-making tool for policy and decision makers
- Promote compliance with state and federal program requirements
- Assure inter-jurisdictional coordination of mitigation related programming
- Create jurisdiction specific hazard mitigation plans for implementation

The current plan is set to expire October 5, 2008. The *Emergency Management Council of Thurston County* is responsible for the plan's monitoring, maintenance, and five year update. The region's hazard mitigation planning partners are in the process of updating the plan and anticipate completing a draft plan by the end of the year.




### 2008 Hazard Mitigation Plan Partners

Town of Bucoda
City of Lacey
City of Olympia
City of Tenino
City of Tumwater
City of Rainier
City of Yelm
Thurston County
Nisqually Indian Reservation
Intercity Transit
Olympia School District
North Thurston Public Schools
Rainier School District
Tumwater School District
Yelm Community Schools
The Evergreen State College
South Puget Sound Community College
Providence Saint Peter Hospital
LOTT Alliance
Thurston PUD
Timberland Regional Library
Thurston County Fire Districts
Port of Olympia

**What Is Natural Hazards Mitigation Planning?**

In an effort to manage risks, contain costs, and promote sustainable communities, states, tribes, and local governments are required to coordinate efforts and follow planning procedures outlined by the Federal Disaster Mitigation Act of 2000 (DMA 2000). This act emphasizes planning for disasters before they occur.

Local governments, private sector organizations, and community members work together to identify:

- Hazards, community vulnerabilities, and risks
- Disaster resistance objectives
- Actions to reduce or mitigate the short- and long-term impacts of hazard events

All states, tribes, and local governments must develop, adopt, and receive federal approval of their hazard mitigation plan in order to apply for a variety of federal mitigation grant program funds.

**Public Participation**

The Public is invited to participate in the planning process. Formal opportunities to comment on the plan will take place at both the beginning of the planning process and when a draft plan is released for public review.

### the hazard mitigation planning process

Hazard mitigation planning is the process of determining how to reduce or eliminate the loss of life and property damage resulting from natural hazards such as floods, earthquakes, and severe storms. Four basic phases of the planning process are shown in this diagram.

This diagram portrays a sequential process. However, the process is typically very dynamic. It is not unusual that ideas developed while assessing risks should need revision and additional information while developing the mitigation plan, or that implementing the plan may result in new goals or additional risk assessment.

For Further information or to view the current "Natural Hazards Mitigation Plan for the Thurston Region," visit www.trpc.org.

Thurston Regional Planning Council, 2008

# Appendix C: Hazard Mitigation Capability Assessments

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## Washington State Hazard Mitigation Capabilities[1]

The following matrix, excerpted from the *Washington State Hazard Mitigation Plan*, identifies the most significant state funded or state administered practices, policies, programs and regulations related to hazard mitigation or loss reduction. This matrix was developed as part of Washington State's hazard mitigation capability assessment.

| Agency | Programs, Plans, Policies, Regulations, Funding or Practices | Effect on Loss Reduction (X) | | | Provides Funding for Mitigaiton Initiatives | Description |
|---|---|---|---|---|---|---|
| | | Support | Facilitate | Hinder | | |
| Department of Community Trade and Economic Development, Growth Management Services | Critical Areas Ordinance (RCW 36.70A, WAC 365-190-080) | X | | | Yes, for developing plans and regulations | Growth Management Act requires all cities and counties in the state to identify critical areas including frequently flooded areas and geologically hazardous areas, and to establish regulations that limit development in those areas. |
| Department of Community Trade and Economic Development, Growth Management Services | Natural Hazard Reduction Element of Local Comprehensive Plan (RCW 36.70A, WAC 365-190-080) | | X | | | Growth Management Act allows local planning jurisdictions to add optional elements to their comprehensive land-use plans, including an element dealing with natural hazard reduction. |
| Department of Community Trade and Economic Development, State Building Code Council | State Building Code (RCW 19-27, WAC 51) | X | | | | State Building Code Act adopted in 1974; set 1973 UBC codes as statewide minimum. The Legislature approved use of the IBC 2003 building codes during the 2003 legislative session. The State Building Code Council adopted the codes, and made amendments that took effect July 2004 and July 2007. |

| Agency | Programs, Plans, Policies, Regulations, Funding or Practices | Effect on Loss Reduction (X) | | | Provides Funding for Mitigaiton Initiatives | Description |
|---|---|---|---|---|---|---|
| | | Support | Facilitate | Hinder | | |
| Department of Community Trade and Economic Development, State Building Code Council | Earthquake Construction Standards (RCW 70.86) | | | X | | Approved in 1955. Requires newly constructed schools, hospitals, and places of public assembly to withstand a lateral force of 5 percent of the building weight. Law did not keep up with changes in code criteria; outdated by time 1973 building codes adopted. Remains on the books. |
| Department of Community Trade and Economic Development, Local Government Division | Community Services Block Grant loan and grant programs | | X | | Yes | Several of the eight CSBG programs fund projects in eligible communities that improve, repair or rehabilitate housing or infrastructure systems to meet urgent needs or to deal with an imminent threat to public health and safety. |
| Department of Community Trade and Economic Development, Public Works Board | Public Works Trust Fund – Construction Loans, Emergency Loans (RCW 43.155, WAC 399-30) | | X | | Yes | Trust fund construction loans allow for rehabilitation and reconstruction of eligible public works systems. |
| Department of Ecology | Flood Control Assistance Account Program (RCW 86.26, WAC 173-145) | X | | | Yes | Provides financial assistance to local agencies to prepare comprehensive flood control management plans and flood control maintenance projects. |
| Department of Ecology | Flood Plain Management Act (RCW 86.16, WAC 173-158). | X | | | | Requires development to avoid the floodway and minimize harm to floodplains and wetlands. |
| Department of Ecology | Shoreline Management Act (RCW 90.58, WAC 173-18 and -20). | | X | | Yes | Citizens passed the Shoreline Management Act in 1971 to restrict development in shoreline areas to “reasonable and appropriate uses” and to protect shoreline resources and aquatic life. |

| Agency | Programs, Plans, Policies, Regulations, Funding or Practices | Effect on Loss Reduction (X) | | | Provides Funding for Mitigaiton Initiatives | Description |
|---|---|---|---|---|---|---|
| | | Support | Facilitate | Hinder | | |
| Department of Ecology | Coastal Zone Management Act (PL 104-150). Section 306/306A supports Shoreline Management Act. | | X | | Yes | Grant funds are available to eligible local governments for planning, environmental inventories, land-use designation mapping, and policy development related to shorelines. |
| Department of Ecology | Water Resources Program – Drought Response (RCW 43.83B.400 to -430, WAC 173-166) | X | | | Yes | Provides emergency water permits, financial assistance and temporary transfer of water rights during a state-declared drought emergency. |
| Department of Ecology | Emergency Agricultural Water Supply Funds (RCW 43.83B.415, WAC 173-166) | X | | | Yes | Provides grants and loans for emergency water supply projects in declared drought areas to help irrigated crops and fisheries survive. |
| Department of Natural Resources | Forest Practices Act (RCW 76.09, WAC 222). | | | | | Among other things, the act requires owners of forestlands to prevent landslides caused by logging or other uses. |
| Department of Natural Resources | Division of Geology and Earth Resources (State Geological Survey) | | X | | | Evaluates geologic hazards, develops hazard maps, conducts damage assessment following disasters, and provides advice on mitigation measures. |
| Department of Natural Resources | Firewise Program | X | | | | Helps landowners in eligible communities remove trees and brush that pose a fire hazard to homes that border forestlands. Property owners who pay fees to the department for fire protection are eligible to participate. |
| Department of Natural Resources | Forest Stewardship Program (FSP) | X | | | Yes | Helps family forestland owners with hazard reduction training and funding to assist with thinning and other actions to reduce wildfire hazard. |

| Agency | Programs, Plans, Policies, Regulations, Funding or Practices | Effect on Loss Reduction (X) | | | Provides Funding for Mitigaiton Initiatives | Description |
|---|---|---|---|---|---|---|
| | | Support | Facilitate | Hinder | | |
| Department of Natural Resources | Forest Land Enhancement Program | X | | | Yes | Provides education, on-site advice and cost-share assistance to help non-industrial private forest landowners develop Forest Stewardship Plans, complementary to FSP |
| University of Washington, and various partner organizations | Pacific Northwest Seismograph Network | | X | | | Operates network of seismographs whose data help scientists understand Pacific Northwest earthquake hazards and predict volcanic eruptions at Mount St. Helens. Network scientists are active in public outreach and education for these hazards. |
| Governor's Office | Evaluation of Flood Hazard in Locating State Facilities, and Reviewing and Approving Sewage and Water Facilities and Subdivisions, Executive Order 77-11. | X | | | | Requires state agencies to avoid locating and building state facilities, roads, and campgrounds in floodplains, requires agencies to flood proof existing facilities, and to consider reduction of potential flood damage when reviewing plans for water and wastewater facilities and residential subdivisions and trailer parks. |
| Governor's Office | State Agency Risk Management, Executive Order 01-05 | | X | | | Requires state executive agencies to reduce and minimize loss from tort claims against the state; it includes language that could apply to reducing threats posed by natural hazards through mitigation. |

| Agency | Programs, Plans, Policies, Regulations, Funding or Practices | Effect on Loss Reduction (X) | | | Provides Funding for Mitigaiton Initiatives | Description |
|---|---|---|---|---|---|---|
| | | Support | Facilitate | Hinder | | |
| Governor's Office | Sustainable Practices by State Agencies, Executive Order 02-03. | | X | | | Requires state executive agencies to establish sustainability objectives regarding facility construction, operation and maintenance; it includes language that could apply to reducing threats posed by natural hazards through mitigation. |
| Military Department (Emergency Management Division) | Hazard Mitigation Grant Program | X | | | Yes | This program, available after a Presidential disaster declaration, funds hazard mitigation plans and cost-effective projects that reduce or eliminate the effects of hazards and/or vulnerability to future disaster damage. Typically, the state provides a portion of the required non-federal match. |
| Military Department (Emergency Management Division) | Public Assistance Program | | X | | Yes | This program, available after a Presidential disaster declaration, allows mitigation measures to be designed into projects to repair or restore public facilities damaged by the disaster event. |
| Military Department (Emergency Management Division) | Pre-Disaster Mitigation Grant Program | X | | | Yes | This annual, nationally competitive program funds hazard mitigation plans and cost-effective projects that reduce or eliminate the effects of hazards and/or vulnerability to future disaster damage. |
| Military Department (Emergency Management Division) | Flood Mitigation Assistance Program | X | | | Yes | This program funds flood mitigation plans, provides technical assistance, and funds construction projects that reduce flood risk to insured, repetitive loss properties. |

| Agency | Programs, Plans, Policies, Regulations, Funding or Practices | Effect on Loss Reduction (X) | | | Provides Funding for Mitigaiton Initiatives | Description |
|---|---|---|---|---|---|---|
| | | Support | Facilitate | Hinder | | |
| Military Department (Emergency Management Division) | Repetitive Flood Claims Program | X | | | Yes | This program provides funding to reduce or eliminate the long-term risk of flood damage to structures insured under the NFIP that have had one or more claim payments for flood damages. |
| Military Department (Emergency Management Division) | Severe Repetitive Loss | X | | | Yes | This program provides funding to reduce or eliminate the long-term risk of flood damage to structures that are insured under NFIP and meet the definition of severe repetitive loss. |
| Military Department (Emergency Management Division) | National Tsunami Hazard Mitigation Program | X | | | Yes | This program provides tsunami modeling for preparedness planning, mitigation initiatives, and public education; provides warning guidance to local jurisdictions; and facilitates installation of all-hazard alert systems in coastal areas. |
| Military Department (Emergency Management Division) | Earthquake Program | | X | | | Provides coordination and oversight of seismic safety programs, supports public education and mitigation planning, and provides tools to support seismic hazard reduction. |
| Military Department (Emergency Management Division) | HAZUS (Hazards United States) | | X | | | The division provides training and facilitates local and state use of HAZUS to support mitigation planning and development of mitigation strategies for areas at risk to earthquake. |

| Agency | Programs, Plans, Policies, Regulations, Funding or Practices | Effect on Loss Reduction (X) | | | Provides Funding for Mitigaiton Initiatives | Description |
|---|---|---|---|---|---|---|
| | | Support | Facilitate | Hinder | | |
| Military Department (Emergency Management Division) | Volcano Program | | X | | | The division coordinates the efforts of workgroups for each of the state's five volcanoes, and helps in the development of response, preparedness and mitigation initiatives. |
| Department of Fish and Wildlife | Hydraulic Code (RCW 77.55, WAC 220-110). | | X | | | This law requires development in shorelines of marine and fresh waters of the state to include mitigation measures that protect aquatic habitat and fish. Work also must comply with the State Environmental Policy Act. |
| Department of Transportation | Highway Bridge Replacement and Rehabilitation Program | X | | | Yes | Funds repair and rehabilitation of eligible locally owned bridges, to include seismic retrofit and scour mitigation. |
| | Emergency Relief Program | X | | | Yes | Funds temporary and permanent repairs to federal-aid roads and bridges damaged by natural disaster. Also funds "betterments" that provide a reasonable assurance of preventing future disaster damage. |
| Transportation Improvement Board | Six grant programs for local transportation projects (RCW 47.26, WAC 479) | | X | | Yes | Grant funds can reimburse local jurisdictions for mitigation items that do not exceed state or federal requirements. |
| County Road Administration Board | Rural Arterial Program (RCW 46.68, WAC 136-163) | | X | | Yes | Under Emergency and Emergent Provisions, the program provides funding for temporary or permanent restoration work on rural roads and bridges to pre-disaster condition; it may include reconstruction to current design standards. |

## Endnote for Washington State Hazard Mitigation Capabilities

[1] Washington State Emergency Management Division. 2007. Washington State Hazard mitigation Plan, pp Tab 6-8 to Tab 6-15.

# Local Government Hazard Mitigation Capabilities[1]

Each jurisdiction has its own unique set of policies, programs, and resources that it can utilize to minimize losses from natural hazard events. The Washington State Hazard Mitigation Plan includes an assessment of local governments' capabilities for mitigating or assisting in the mitigation of the impacts of hazard events on communities. The following assessment (excerpted from the state plan) summarizes local government capabilities that are related to hazard reduction and mitigation.

## Building Codes

### Description

Adoption of building codes initially was the discretion of individual cities and counties. Passage of the State Building Code Act in 1974 mandated the use of 1973 UBC building codes throughout the state. Since this time, local jurisdictions can make amendments to the code but changes cannot diminish code requirements.

The State Building Code Council now adopts building, fire and mechanical codes for the state of Washington. These codes set minimum performance standards for buildings. The council amends the codes to meet state needs, but only if changes improve upon the original codes.

The council adopted and amended the 2003 editions of the International Code Council building, residential, mechanical and fire codes published by the International Code Council, and the 2003 edition of the Uniform Plumbing Code published by the International Association of Plumbing and Mechanical Officials. The council also amended the state energy code.

Adoption of 2003 building, mechanical, fire, and plumbing codes brings Washington State's building codes to the highest level nationwide and they address the state's seismic hazard.

### Applicability

Since 1974, building codes adopted by the State Building Code Council have been applicable statewide.

Counties and cities can amend the state codes, but they cannot diminish the minimum performance standards of the codes.

State amendments to the 2003 Building Codes drafted in 2006 took effect July 1, 2007. All structures built after that date must comply with the new building codes, which includes provisions for the state's seismic hazard.

### Effectiveness

Before adoption of a statewide building code in 1974, there was a wide variation of minimum standards, as well as variation in use of requirements to address hazards including earthquake and winter storm.

The state building code is updated regularly to account for new knowledge of hazards and changes in construction methods and materials, and to incorporate new designs and technologies. Despite 30 years of uniform building codes, consistent enforcement remains a problem.

Local building departments are responsible for enforcing federal, state and local codes related to building construction projects. A study of structural failures following the December 1996 – January 1997 winter storms recommended more education and better communication for all parties involved in construction of buildings, including construction plans examiners and local building inspectors.

## Land Use Planning

### Description

The Planning Enabling Act provides the framework for guiding and regulating the physical development of a county or region.

Comprehensive plans prepared under this act must include a land-use element to designate the general distribution, location and extent of various land uses (i.e., agriculture, housing, commerce, industry, education, recreation), and a circulation element with the location, alignment and extend of various transportation routes.

Optional elements of comprehensive plans prepared under this act cover conservation of natural resources, use of solar energy, recreation, transportation, public services and facilities, housing, renewal and redevelopment, and capital improvements.

### Applicability

This land-use planning law applies to all local jurisdictions in the state – including counties, cities and towns, school districts, public utility districts, housing authorities, and port districts.

As a practical matter, only the state's smaller, slow-growing, rural counties are planning under this state law.

### Effectiveness

The Planning Enabling Act provides the basic framework for local jurisdictions to develop land-use plans and development regulations.

Planning under this law is not as comprehensive as required by the Growth Management Act (see below). It does not address ties between transportation and housing, and other factors required under GMA planning.

The Planning Enabling Act is silent on the need for comprehensive plans to address hazard avoidance or hazard reduction.

Local compliance with state requirements of this law is better than under the much more comprehensive Growth Management Act.

# Critical Areas Protection

## Description

The Growth Management Act of 1990 requires all cities, towns and counties in the state to identify and protect the functions and values of critical areas. The act defines critical areas as frequently flooded areas (including areas prone to tsunamis), geologically hazardous areas (including areas prone to erosion, landslide, seismic activity, volcanic activity, etc.), fish and wildlife habitat conservation areas, wetlands, and recharge areas for aquifers used for potable water.

The concept of protecting the function and values of critical areas includes protecting humans from flood and geologic hazards.

Critical areas regulations must be reviewed and evaluated every seven years; amendments can be made annually.

## Applicability

All counties, cities and towns in the state must develop regulations to designate and protect critical areas.

Legislation approved in 2003 established a schedule requiring cities and counties to update their critical areas regulations every seven years beginning in 2004. All updates must be complete by December 1, 2008.

## Effectiveness

Cities and counties since 1995 must use best available science to develop policies and regulations to protect the function and values of critical areas. Most initial critical are regulations did not take into account best available science.

Among the issues facing local jurisdictions preparing critical area regulations are balancing the use of scarce available resources for detailed planning and regulation development versus providing other services, and balancing the protection of critical areas with rights of owners to use or develop their property. Some believe that critical area protection requires communities to prevent development on too much land.

Most jurisdictions have prepared critical area regulations that meet minimum state standards, but their effectiveness varies, depending upon local resources and local political considerations.

As of October 2007, only 88 percent of jurisdictions required to have their critical areas regulations completed by the end of 2004 had done so. The completion percentage drops to 40 percent for 2005 jurisdictions and 16 percent for 2006 jurisdictions.

# Growth Management Act: Land Use Planning

## Description

The Growth Management Act, which became law in 1990, builds on the Planning Enabling Act by requiring all cities and counties in the state to:

- Designate and protect critical areas (see above).
- Designate farmlands, forestlands and other natural resource areas.
- Determine that new residential subdivisions have appropriate provisions for public services and facilities.

Additionally, fully planning counties (and their cities) must agree on countywide landuse policies, plan for growth within designated urban growth areas, identify lands for public purposes and essential public facilities, and adopt development regulations to carry out comprehensive plans.

Comprehensive plans are built around 14 goals, and must provide for 20 years of growth and development needs. Plans must include elements on land use, utilities, housing transportation, capital facilities, rural lands, and shorelines.

Comprehensive plans must identify hazard prone areas, and include policies to reduce vulnerability of housing, public facilities, transportation and utilities to identified hazards. Plans can address hazard reduction or hazard avoidance in one of two ways – through the required planning elements or through a separate but optional natural hazard reduction element.

## Applicability

Counties that meet one of the following criteria must fully plan under the Growth Management Act:

1. Counties with a population greater than 50,000 and:
    - Before May 1995 had a 10 percent increase in population in the previous 10 years; or
    - After May 1995 had a 17 percent increase in population in the previous 10 years.
2. Counties whose population increased 20 percent in the previous 10 years.

Counties that do not fit the above criteria can voluntarily choose to plan under the Growth Management Act.

Under legislation passed in 2003, must review every 10 years their designated urban growth areas, and review every 7 years their comprehensive plans and development regulations.

## Effectiveness

Twenty-nine of the state's 39 counties are fully planning under GMA; 218 cities within these counties also must fully plan.

Land-use plans and regulations developed under GMA requirements are much more comprehensive than those developed under the Planning Enabling Act.

Among the issues facing local jurisdictions preparing GMA plans and regulations include balancing the use of scarce available resources for detailed planning and regulation development versus providing other services, and balancing the protection of critical areas with rights of owners to use or develop their property.

Most jurisdictions have prepared land-use plans and regulations that meet minimum state standards, but their effectiveness varies, depending upon local resources and local political considerations.

As of October 2007, 94 percent of jurisdictions required to have their comprehensive plans completed by the end of 2004 had done so. The completion percentage drops to 74 percent for 2005 jurisdictions and 51 percent for 2006 jurisdictions. Percentages for completion of development regulations range from 83 percent of 2004 jurisdictions to 38 percent of 2006 jurisdictions.

## Flood Plain Management

### Description

Three state laws govern floodplain management:

RCW 86.12, Flood Control by Counties, gives counties the power to levy taxes, condemn properties and undertake flood control activities directed toward a public purpose. RCW 86.26, State Participation in Flood Control Maintenance, established the Flood Control Assistance Account Program (FCAAP) to provide state funding for local flood hazard management planning and implementation efforts. RCW 86.16, Floodplain Management, states that prevention of flood damage is a matter of statewide public concern and placed regulatory control within the responsibilities of the Department of Ecology.

The state's floodplain management law allows local governments to adopt floodplain management requirements that exceed National Flood Insurance Program requirements, and requires local governments to enforce restrictions prohibiting new residential construction or reconstruction of substantially damaged residential structures in mapped floodways. Allowed under certain circumstances is reconstruction or replacement of substantially damaged farmhouses in the floodway.

### Applicability

RCW 86.12 applies to all counties of the state. Participation in the Flood Control Assistance Account Program requires local jurisdictions to participate and be in good standing in the National Flood Insurance Program, and their activities must be approved by the Department of Ecology in consultation with the Department of Fish and Wildlife.

Grants are available for up to 75 percent of the cost of flood hazard management planning, and 50 percent for the cost of flood damage reduction projects, including purchase of flood prone properties, limited flood mapping, and flood warning systems.

Flood damage reduction projects must be consistent with local comprehensive flood hazard management plans.

Emergency grants are available to respond to unusual flood conditions.

### Effectiveness

Despite a lack of funding, communities continue making floodplain management a priority.

The State Flood Control Assistance Account Program is funding 26 local projects in the 2007-09 biennium. Grants for these projects total approximately $2.1 million.

Washington has 27 communities participating in the Community Rating System, ranking Washington 14th among the 50 states. King County has a CRS rating of 3, making it the highest ranked county in the nation, behind only the municipality of Tulsa in overall CRS ranking. Many communities have created innovative floodplain management techniques, such as:

- Higher freeboard standards than federal regulations require (e.g., Everett and Chelan County).
- Prohibiting fill for structural support of residential buildings in floodplains (e.g., Skagit and King Counties.)
- Providing storage to compensate for filling floodplains (many localities).
- Prohibiting new residential structures in the floodplain (Thurston County).
- Exceeding federal standards for floodways (Pierce County).

## Shoreline Management

### Definition

A public referendum adopted the Shoreline Management Act in 1971 to prevent the "inherent harm in an uncoordinated and piecemeal development of the state's shorelines." Implementing regulations were updated in late 2003 for the first time in 30 years.

The act covers three basic policy areas:

1. Accommodation of reasonable and appropriate uses. The act prefers uses consistent with control of pollution and prevention of damage to the natural environment, or uses that are unique to or dependent upon shorelines.
2. Protection of the shoreline environmental resources. The act intends to protect shoreline natural resources including the land and its vegetation and wildlife, and the waters of the state and their aquatic life, against adverse impacts.
3. Protection of the public's right to access and use the shorelines. The act requires local shoreline master programs to include provisions for public access and recreational opportunities at publicly owned shorelines.

State shoreline regulations were updated in 2003; they are more comprehensive than before and include a greater basis in science; they take into consideration protection of critical resources and physical and biological processes and functions.

### Applicability

The Shoreline Management Act applies to 39 counties and more than 200 cities with shorelines created from:

- Marine waters (Pacific Ocean, Strait of Juan de Fuca, Puget Sound).
- Streams and rivers with a mean annual flow greater than 30 cubic feet per second. • Lakes and reservoirs greater than 20 acres in areas.
- Upland areas called shorelands that extend 200 feet landward from the edge of these waters.
- Biological wetlands and river deltas, and some or all of the 100-year floodplain when associated with one of the above.

The act establishes a balance of authority between local and state government. Cities and counties are the primary regulators.

### Effectiveness

Unlike land-use plans prepared under the Growth Management Act, presumed valid upon local adoption, local shoreline regulations must be approved by the Department of Ecology before they are considered valid and implemented.

Strength of local shoreline regulations are avoiding development on unstable shoreline slopes and in frequently flooded areas.

Obstacles to successful development of shoreline master plans include local political will to develop regulations sufficient to protect shorelines via buffers, setbacks, and appropriate design criteria.

With adoption of new state regulations for local shoreline master plans in December 2003, all communities must revise their master plans by 2013. The Department of Ecology made $2 million in planning grants available to 12 early adopters during the 2003-05 biennium, and will have about $4 million in each successive biennium through 2014 to fund planning and regulation development efforts. An estimated $4.5 million in grants is available in the current 2007-09 biennium.

## State Environmental Policy Act

### Definition

The State Environmental Policy Act was adopted in 1971 to provide a regulatory framework for state and local agencies to address environmental issues in their decisions. The act provides information to agencies, applicants and the public to encourage the development of environmentally sound proposals. The environmental review process involves the identification and evaluation of probable environmental impacts and the development of mitigation measures that will reduce adverse impacts.

SEPA was modeled after the National Environmental Policy Act. The act ensures that environmental values are considered during decision making by state and local agencies. When the act was adopted, the Legislature identified four primary purposes:

4. To declare state policy which will encourage productive and enjoyable harmony between man and the environment.
5. To promote efforts which will prevent or eliminate damage to the environment.
6. To stimulate the health and welfare of man.
7. To enrich the understanding of the ecological systems and natural resources important to the state and nation.

## Applicability

The law requires local governments to:

Utilize a systematic, interdisciplinary approach that ensures the integrated use of natural and social sciences and the environmental design arts in planning and decision making that may affect the environment.

Ensure that environmental amenities and values are given appropriate consideration in decision making along with economic and technical considerations.

## Effectiveness

SEPA provides a process to give local decision makers information on environmental protection and hazard reduction related to new development. In its early years, this law was the only mechanism that provided for mitigation from natural hazards such as flooding and landslides. Today, critical area regulations required by the Growth Management Act have taken much of this responsibility.

SEPA's effectiveness depends upon its application by local jurisdictions. Many communities face the issue of balancing environmental protection with rights of owners to use or develop their property.

Larger and more sophisticated counties use SEPA in combination with their own critical area regulations to provide a holistic approach to environmental protection and hazard avoidance. Thurston County, for example, uses SEPA to fill gaps in local regulations related to mitigating hazards. However, this county is the exception rather than the rule throughout the state.

Communities that take the SEPA process seriously can use it to improve their mitigation efforts. A checklist helps communities determine the environmental impact of a proposed development.

# Endnote for Local Government Hazard Mitigation Capabilities

## (Endnotes)

[1]Washington State Emergency Management Division. 2007. Washington State Hazard mitigation Plan, pp Tab 6-16 to Tab 6-23.

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# Appendix D: Federal Hazard Mitigation Assistance Grant Programs

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# FACT SHEET

## PRE-DISASTER MITIGATION GRANT PROGRAM

Washington State Military Department Emergency Management Division Camp Murray, WA 98430

The Pre-Disaster Mitigation program, authorized by Section 203 of the Robert T. Stafford Disaster Assistance and Emergency Relief Act (Stafford Act), provides technical and financial assistance to states, local and tribal governments to assist in the implementation of cost-effective hazard mitigation measures designed to reduce injuries, loss of life, and damage and destruction of property. The State Emergency Management Division administers this program for the State of Washington.

Annual funding depends upon Congressional appropriation; in recent years, about $100 million has been available on a nationally competitive basis for mitigation plans and projects. An application window of about 90 days has opened the past couple of years in mid fall. EMD announces application procedures as well as details of the annual funding and program guidance and as soon as FEMA makes them available.

**ELIGIBLE PLANS, PROJECTS:**

***Mitigation Planning***: Developing a new hazard mitigation plan, upgrading an existing FEMA-approved plan, or conducting a comprehensive review and update of an existing FEMA-approved plan, are eligible activities. The result must be a FEMA-approved hazard mitigation plan within three years of award that meets planning criteria outlined in 44 CFR Part 201. Funding for new plans is limited to $1 million federal share, while funding for revising existing plans is limited to $500,000 federal share.

***Mitigation Projects:*** Multi-hazard mitigation projects must focus on natural hazards but also may address hazards caused by non-natural forces. Funding is limited to a $3 million federal share per project sub-application. **Sub-applicants must have an adopted, FEMA-approved hazard mitigation plan by the federal application deadline to be eligible to receive project grant funding.** For the State of Washington's selection process, those sub-applicants with existing approved plans receive priority over those that have not completed their planning process.

Among the eligible mitigation projects are (see Program Guidance, Section 4.1):

- Acquisition or relocation of hazard-prone property for conversion to open space in perpetuity;
- Elevation of existing public of private structures to avoid coastal or riverine flooding;
- Structural and non-structural retrofitting of existing buildings and facilities to meet or exceed applicable building codes relative to hazard mitigation;
- Protective measures for utilities, water and sanitary sewer systems, and / or infrastructure.
- Storm water management projects to reduce or eliminate long-term risk from flood hazards;
- Localized flood control projects, such as certain ring levees and floodwall systems, designed specifically to protect critical facilities and that do not constitute a section of a larger flood control system.

**ELIGIBILITY REQUIREMENTS**

Projects should be technically feasible and meet the following federal and state criteria:

1. Be cost-effective and substantially reduce the risk of future damage, hardship, loss, or suffering resulting from a major disaster, and have a benefit-cost ratio of 1.0 or greater.
2. Be in conformance with the current FEMA-approved State Hazard Mitigation Plan;
3. Solve a problem independently or constitute a functional portion of a solution where there is assurance that the project as a whole will be completed.
4. Be in conformance with federal floodplain management and wetlands protection regulations.
5. Not duplicate benefits available from another source for the same purpose, including assistance that another Federal agency or program has the primary authority to provide.

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6. Be located in a community participating in, and in good standing with, the National Flood Insurance Program, and in a community in compliance with the state's Growth Management Act.
7. Meet the requirements of applicable Federal, State, and local laws.

**INELIGIBLE MITIGATION ACTIVITIES:**

Ineligible planning activities (see Program Guidance, Section 3.2):

- Flood studies or flood mapping, and other mapping activities that are not part of a risk assessment;
- Risk assessments, technical assistance, studies, or workshops not resulting in a FEMA-approved hazard mitigation plan;
- Information dissemination activities that exceed 10 percent of the total planning sub-application, or that not tied directly to a PDM planning sub-application; and
- Limited revisions and amendments that do not result in comprehensive hazard mitigation plan update.

Ineligible project activities (see Program Guidance, Section 4.2):

- Major flood control / erosion projects such as the construction or repair of dikes, levees, floodwalls, seawalls, groins, jetties, or dams, waterway channelization, and beach nourishment or re-nourishment.
- Localized flood control projects that do not protect a critical facility or constitute a part of a larger project.
- Water quality infrastructure projects.
- Projects that address ecological issues related to land and forest management (i.e., insects, diseases, weather-related damages or infestations).
- Response and communication equipment, and warning and alert notification systems.
- Phased or partial projects, including engineering designs, feasibility or drainage studies not integral to the proposed project.
- Dry flood-proofing of residential structures.
- Generators and related equipment, such as hook-ups, for critical facilities that are not part of a larger eligible mitigation project sub-application and that is not directly tied to the hazard(s) that threaten the critical facility.
- Demolition / rebuild projects.
- Projects that solely address maintenance or repairs of existing structures, facilities or infrastructure.
- Projects that solely address a manmade hazard.

The state (program applicant) may be limited to the number of sub-applications it submits annually, depending upon annual program guidance. EMD will use a pre-application process, FEMA's on-line *eGrants* application system, and supplemental information (e.g., NFIP and Growth Management Act compliance) to prioritize sub-applications. In recent years, FEMA guaranteed each state at least $500,000 for eligible sub-applications; remaining eligible sub-applicants competed nationally for remaining PDM funds. Each state is limited to a total of $15 million federal in PDM funds annually.

***PDM program guidance is available at http://www.fema.gov/government/grant/pdm/index.shtm.***

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# FACT SHEET

## HAZARD MITIGATION GRANT PROGRAM

Washington State Military Department Emergency Management Division Camp Murray, WA 98430

The Hazard Mitigation Grant Program (HMGP) is available to the State of Washington following a Presidential declaration of a major disaster. This state-administered program is authorized by the Robert T. Stafford Disaster Relief and Emergency Assistance Act, Section 404 of Public Law 93-288, as amended.

HMGP funds projects designed to reduce or eliminate the effects and costs of future disaster damage. Unlike the Federal Emergency Management Agency's more familiar public agency disaster assistance program that helps pay for permanent repair and restoration of existing facilities, the HMGP goes beyond fixing the damage. The HMGP– within the limits of federal and state program guidelines – helps fund a wide range of new projects that reduce hazard vulnerability and the potential of damage or used to develop or update a local or tribal Hazard Mitigation Plan.

### ELIGIBLE APPLICANTS

| | | |
|---|---|---|
| State Government | Certain Private Nonprofit Organizations providing | Special Districts |
| Local Government | Like-Government Services and Facilities | Indian Tribes |

Applicants must be jurisdictions that are participating and in good standing in the National Flood Insurance Program and in compliance with State Growth Management Act requirements, or located in a community that is.

### FUNDING CONSTRAINTS

The grants are available to eligible applicants on a competitive basis on the following cost share: 75 percent federal and 25 percent non-federal (applicant and state normally split this share, based on legislative approval). The amount available for the HMGP is based on a percentage of FEMA expenditures on disaster assistance, which may limit the size of projects and grant awards. All mitigation project proposals will be evaluated against federal and state program criteria and they must be must be cost-effective.

### APPLICATION, FUNDING PROCESS

1. Potential applicants submit "Letters of Intent" (LOI) to participate in the program.
2. Following review of LOI's, State Emergency Management Division (EMD) provides application packets to eligible applicants with potentially eligible projects.
3. EMD reviews submitted applications for eligibility, with site visits conducted as necessary.
4. A review committee of state and local representatives evaluates and scores the applications. Local representatives are from outside the declared disaster area(s), if possible.
5. EMD recommends projects to FEMA for approval and funding based upon score and available funds.
6. FEMA makes grant awards following its review, to include environmental and historic preservation considerations, as required.
7. Upon notification of approval and funding, EMD prepares a grant funding agreement with the applicant and provides a notice to proceed.

### ELIGIBLE PLANS, PROJECTS:

Following are examples of activities that the HMGP can fund:

- Development or revision of Hazard Mitigation Plans using 44 CFR 201 criteria.
    - **NOTE**: Applicants must have a FEMA-approved Hazard Mitigation plan in order to be eligible to apply for and to receive project grant funds.

- Structural hazard control, such as debris basins and retention ponds;
- Retrofitting structures such as water storage tanks, schools and bridges from seismic, flood or wind hazards.
- Acquisition, elevation or relocation of structures in areas of high hazard.
- Construction activities resulting in protection from hazards, such as rerouting or placing utility lines underground, and upgrading storm drainage and culverts.

Generally, projects should:

- Present the most practical, effective, and environmentally sound alternative;
- Provide cost-effective protection over the expected project life;
- Substantially reduce the risk of future damage, hardship, loss, or suffering from a major disaster;
- Conform with federal floodplain, wetland, and environmental regulations;
- Conform to the goals of the Growth Management Act; National Flood Insurance Program; and
- Solve a problem, or part of a problem when there is assurance that the whole project will be completed;
- Address a problem that is repetitive or that poses a significant risk if left unsolved;
- Contribute substantially to the problem's long-term solution;
- Have manageable future maintenance requirements;
- Have the documented support of the local community.

Among reasons previous projects were ineligible for funding:

- Project application failed to meet National Environmental Policy Act (NEPA) requirements for adequate public involvement in the development of the alternatives.
- Project is for operation and maintenance or deferred maintenance.
- Facility benefiting from the project falls under the authority of another federal agency such as the U.S. Department of Transportation, U.S. Army Corps of Engineers, or the Natural Resources Conservation Service.
- FEMA benefit-cost methodology determines project is not cost-effective.
- When HMGP project is part of a larger effort, applicant made no assurance that the entire project will be completed.

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# FACT SHEET

## FLOOD MITIGATION ASSISTANCE PROGRAM

Washington State Military Department Emergency Management Division Camp Murray, WA 98430

The Flood Mitigation Assistance program (FMA) is available on an annual basis for cost-effective measures that reduce the risk of flood damage to structures that have flood insurance coverage. Funding is available for flood mitigation planning and implementation of flood mitigation projects. The State Emergency Management Division (EMD) administers the program and is responsible for selecting projects for funding. The State forwards selected applications to FEMA for eligibility determination. Individuals cannot apply directly for FMA funds, although their local government may submit an application on their behalf.

**AVAILABLE FUNDING**

Annual funding is through the National Flood Insurance Program, and can vary from year to year. In FFY 2007, FEMA notified EMD that Washington would receive the following federal funds for planning and projects. The state also received funding for technical assistance. All grants require a 25 percent applicant match, only half of which can be provided by in-kind contributions.

| 2007 FMA | Total Funds | Federal Share | Applicant Share |
|---|---|---|---|
| **Project** | $ 271,800 | $ 203,580 | $ 68,220 |
| **Planning** | $ 27,733 | $ 20,800 | $ 6,933 |

The FFY 2007 FMA priority is to fund flood mitigation projects that reduce the number of repetitive loss structures currently insured by the National Flood Insurance Program (NFIP), although any cost-effective flood mitigation activity that reduce flood losses to any NFIP-insured property will be considered.

An application window of about 90 days has opened the past couple of years in mid fall. EMD will use a pre-application process, FEMA's on-line *eGrants* application system, and supplemental information (e.g., NFIP and Growth Management Act compliance) to prioritize sub-applications. EMD will announce application procedures as well as details of the annual funding and program guidance as soon as FEMA makes it available.

**ELIGIBLE PROJECTS:**

For a community to be considered for project funds, it must have 1) a FEMA-approved flood hazard reduction plan or a FEMA-approved Hazard Mitigation Plan that meets the criteria of 44 CFR Part 78.5, and 2) be a participant in good standing in the NFIP. EMD also requires communities to comply with state Growth Management Act requirements. Additionally, communities must have both zoning and building code authority for their community.

FMA funds can be used for the following plans and projects:

- Developing flood mitigation plans that meet criteria outlined in 44 CFR Part 78.5 (for those communities without a plan) or to revise an existing FEMA-approved hazard mitigation plan to meet the criteria of 44 CFR Part 78.5.
- Acquiring or relocating insured structures to reduce claims on the NFIP.
- Elevating insured residential structures above the 100-year flood.
- Elevating or dry flood proofing insured non-residential structures.

All properties involved in an FMA-funded project must have NFIP insurance at the time of project application.

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**INELIGIBLE PROJECTS:**

In addition to the specific ineligible project activities listed below, any proposed activity that duplicates benefits received for the same purpose or that is within the primary authority of another federal program are ineligible for funding under FMA. The following project activities are not eligible for the FMA grant program:

- Major flood control and/or erosion projects such as the construction or repair of dikes, levees, floodwalls, seawalls, groins, jetties, breakwaters, dams, and waterway channelization.
- Dry flood proofing of residential structures.
- Phased or partial project that is dependent on another phase or part to be effective and/or feasible.
- Demolition of an existing structure and rebuilding a new structure on the same site (i.e., demolition-rebuilding).
- Studies that do not result in a completed mitigation project (e.g., engineering designs, feasibility studies, or drainage studies that are not integral to the proposed project).
- Flood studies or flood mapping.
- Projects that solely address maintenance or repairs of existing structures, facilities or infrastructure (e.g., debris removal, dredging).
- Generators, and related equipment, such as generator hook-ups, for non-critical facilities or as a stand-alone activity.
- Response and communication equipment, and warning and alert notification systems (e.g., NOAA weather radios).

**ELIGIBILITY CRITERIA**

The project sub-application must demonstrate:

- Cost-effectiveness using a FEMA-approved Benefit-Cost Analysis (BCA). A project with a benefit-cost ratio of 1.0 or greater is considered cost effective.
- All individual properties to be mitigated must have NFIP insurance at the time of project application.
- Conformance with 44 CFR Part 9, Floodplain Management and Protection of Wetlands, and 44 CFR Part 10, and any applicable environmental laws and regulations.
- Technical feasibility and the ability to be implemented.
- Conformance with the minimum standards of the NFIP Floodplain Management Regulations.
- Conformance with the FEMA-approved flood mitigation plan or flood hazard component of the community's FEMA-approved multi-hazard mitigation plan, (the type of project being proposed must be identified in the plan), where the plan is approved by FEMA by the application deadline.
- Located in a community participating and in good standing in the NFIP.
- Solving of a problem independently or constituting a functional portion of a solution where there is assurance that the project as a whole will be completed.
- Meeting the requirements of applicable Federal, State, Indian tribal, and local laws, implementing regulations, and executive orders.

***See http://www.fema.gov/government/grant/fma/index.shtm for FMA program guidance.***

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# FACT SHEET

## REPETITIVE FLOOD CLAIMS PROGRAM

Washington State Military Department Emergency Management Division Camp Murray, WA 98430

The Repetitive Flood Claims program (RFC) provides funding to acquire structures insured under the National Flood Insurance Program (NFIP) that have had one or more flood damage claims payments. The State Emergency Management Division (EMD) administers the program. Funds may only mitigate structures that are located within a state or community that cannot meet the requirements of the Flood Mitigation Assistance (FMA) program for either cost share or capacity to manage the activities.

Annual funding depends upon Congressional appropriation; $10 million was available on a nationally competitive basis in Federal Fiscal Year 2007 for projects to acquire insured properties that demolish or relocate the structures out of the flood hazard zone and then convert the property to open space by deed restriction. All RFC grants are eligible for 100 percent federal assistance, i.e., there is no cost share required.

An application window of about 90 days has opened the past couple of years in mid fall. EMD will announce application procedures as well as details of the annual funding and program guidance as soon as FEMA makes them available. Eligible applicants are states, and local and tribal governments. Individuals cannot apply directly for RFC funds, although their local government may submit an application on their behalf.

While the FEMA guidance does not require specific planning conditions on sub-applicants as do the Pre-Disaster Mitigation or Hazard Mitigation Grant Program, EMD will continue to utilize the criteria in the *State Hazard Mitigation Plan*, June 2007. This means a sub-applicant must have or be part of a FEMA-approved Hazard Mitigation Plan in order for the state to consider its project for submission to FEMA.

Projects must be cost-effective according to FEMA-approved methodology. Sub-applications are ranked nationally in order of their greatest savings to the NFIP as verified by a benefit-cost analysis. FEMA may select individual properties from project sub-applications for grant award where appropriate to achieve the greatest savings to the NFIP.

As in other mitigation programs, sub-applicants also must be participating and in good standing in the National Flood Insurance Program (NFIP) and comply with requirements of the state of Washington's Growth Management Act (GMA).

FEMA guidance requires that the state must certify that either:

- The state or sub-applicant cannot meet the 25 percent non-federal match that would otherwise make the activity eligible under the Flood Mitigation Assistance (FMA) program, **OR**
- The state or sub-applicant does not have the capacity to manage the activities under the FMA program.

Because the state has the capacity to meet both of these requirements, sub-applicants will be required to document that they meet this "Reduced Capacity Requirement."

***See http://www.fema.gov/government/grant/rfc/index.shtm for RFC program guidance.***

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# FACT SHEET

## SEVERE REPETITIVE LOSS PROGRAM

Washington State Military Department Emergency Management Division Camp Murray, WA 98430

The Severe Repetitive Loss (SRL) grant program is authorized by the Bunning-Bereuter-Blumenauer Flood Insurance Reform Act of 2004 to provide funding to reduce or eliminate the long-term risk of flood damage to severe repetitive loss structures insured under the National Flood Insurance Program (NFIP). SRL properties are residential properties:

a. That have at least four NFIP claim payments greater than $5,000 each, with at least two such claims having occurred within any 10-year period, and the cumulative amount of such claims payments exceeding $20,000; OR
b. For which at least two separate claim payments have been made with the cumulative amount of the building portion of such claims exceeding the value of the property, when two such claims have occurred within any 10-year period.

As of May 2007, there were 41 residential properties and 3 non-residential properties in 10 counties listed as severe repetitive loss in Washington, with another 17 properties pending SRL validation. The number could grow following future floods.

**Funding**: Congress authorized up to $40 million for each fiscal year 2005 through 2009.

**Purpose**: Reduce or eliminate claims under the NFIP through activities that will result in the greatest savings to the National Flood Insurance Fund.

**Eligible applicants:** States, and local and Indian tribal governments.

**Eligible activities:** Flood-proofing (historical properties only); relocation; elevation; acquisition; mitigation reconstruction (demolition-rebuild); and minor physical localized flood control projects.

**Federal / Non-Federal cost share:** 75 percent federal / 25 percent applicant. Up to 90 percent federal / 10 percent applicant cost-share funding available for projects in states and federally recognized Indian tribes with FEMA-approved Hazard Mitigation Plans that include a strategy for mitigating existing and future severe repetitive loss properties.

**Program Status**: The Severe Repetitive Loss Program remains under development, with FEMA writing rules that are projected to be available for review in the Fall of 2007. Roll-out of the program will follow publication of rules in the Federal Register.

**Application Procedures, Program Guidance:** EMD will announce application procedures as well as details of funding and program guidance as soon as FEMA makes it available.

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FEMA

# GRANT PROGRAM COMPARISON

## Mitigation Division Grant Programs

**During FY 2008, FEMA will offer five hazard mitigation assistance programs  the Hazard Mitigation Grant Program, the Pre-Disaster Mitigation program, the Flood Mitigation Assistance program, the Severe Repetitive Loss pilot program and the Repetitive Flood Claims program. Although all five programs have unique statutory authorities, program requirements and triggers for funding, all of the programs also have the common goal of providing funds to States and local communities to reduce the loss of life and property from future natural hazard events.**

**This chart will help illustrate the similarities and differences among the grant programs.**

| PROGRAM ELEMENT | HAZARD MITIGATION GRANT PROGRAM (HMGP) | FLOOD MITIGATION ASSISTANCE (FMA) | PRE-DISASTER MITIGATION (PDM) | REPETITIVE FLOOD CLAIMS (RFC) | SEVERE REPETITIVE LOSS (SRL) PILOT PROGRAM |
|---|---|---|---|---|---|
| **Authorities** | Authorized by §404 of the Robert T. Stafford Disaster Assistance and Emergency Relief Act (Stafford Act), 42 U.S.C. 5170c | Section 1366 of the National Flood Insurance Act of 1968 (NFIA, or "the Act"); 42 USC 4104c, as amended by the National Flood Insurance Reform Act of 1994 (NFIRA), Public Law 103-325; and the FIRA 2004, Public Law 108-264. | Authorized by §203 of the Robert T. Stafford Disaster Assistance and Emergency Relief Act (Stafford Act), 42 U.S.C. 5133 | Section 1323 of the Act, 42 U.S.C. 4030, as amended by the FIRA 2004, Public Law 108-264. | Section 1361A of the Act, 42 U.S.C. 4102a, as amended by the FIRA 2004, Public Law 108-264. |
| **Purpose** | To provide funds to States, territories, Indian Tribal governments, and communities to significantly reduce or permanently eliminate future risk to lives and property from natural hazards. HMGP funds projects in accordance with priorities identified in State, Tribal or local hazard mitigation plans, and enables mitigation measures to be implemented during the recovery from a disaster. | To implement cost-effective measures that reduce or eliminate the long-term risk of flood damage to buildings, manufactured homes, and other structures insured under the National Flood Insurance Program (NFIP). | To provide funds to states, territories, Indian Tribal governments, and communities for hazard mitigation planning and the implementation of mitigation projects prior to a disaster event. Funding these plans and projects reduces overall risks to the population and structures, while also reducing reliance on funding from actual disaster declarations. | To reduce or eliminate the long-term risk of flood damage to structures insured under the National Flood Insurance Program (NFIP) that have had one or more claim payment(s) for flood damages. | To reduce or eliminate the long-term risk of flood damage to severe repetitive loss residential properties and the associated drain on the National Flood Insurance Fund (NFIF) from such properties. |
| **FY 2007 Priorities** | HMGP priorities are set by the State under each disaster declaration that includes authorized HMGP assistance. | Mitigation activities that reduce or eliminate the long-term risk of flood damage to insured properties. | Provide funds to states, territories, Indian Tribal governments, and communities for hazard mitigation planning and the implementation of mitigation projects prior to a disaster event. | Acquisition of insured properties that have had one or more NFIP claims. | Mitigation activities that reduce or eliminate the long-term risk of flood damage to severe repetitive loss properties. |

| PROGRAM ELEMENT | HAZARD MITIGATION GRANT PROGRAM (HMGP) | FLOOD MITIGATION ASSISTANCE (FMA) | PRE-DISASTER MITIGATION (PDM) | REPETITIVE FLOOD CLAIMS (RFC) | SEVERE REPETITIVE LOSS (SRL) PILOT PROGRAM |
|---|---|---|---|---|---|
| **Applicant Eligibility** | (Grantee) State emergency management agencies or a similar State office (i.e., the office that has primary emergency management or floodplain management responsibility), the District of Columbia, the U.S. Virgin Islands, American Samoa, the Commonwealth of Puerto Rico, the Commonwealth of the Northern Mariana Islands, and Federally recognized Indian Tribal governments. Each State, Territory, or Tribal government shall designate one agency to serve as the Grantee for the program. | State emergency management agencies or a similar State office (i.e., the office that has primary emergency management or floodplain management responsibility), the District of Columbia, the U.S. Virgin Islands, American Samoa, the Commonwealth of Puerto Rico, the Commonwealth of the Northern Mariana Islands, and Federally-recognized Indian Tribal governments. Each State, Territory, or Tribal government shall designate one agency to serve as the Applicant for the program. | State emergency management agencies or a similar office (i.e., the office that has emergency management responsibility) of the state, the District of Columbia, the U.S. Virgin Islands, the Commonwealth of Puerto Rico, Guam, American Samoa, and the Commonwealth of the Northern Mariana Islands, as well as Federally recognized Indian Tribal governments | Same as FMA, but only those States or communities that cannot meet the requirements of the FMA program for either cost share or capacity to manage the activities. | Same as FMA. |
| **Sub-Applicant Eligibility** | (Applicant/Subgrantee) State and local governments, certain private non-profit organizations or institutions, Indian tribes or authorized Tribal organizations, and Alaska native villages or organizations. Individuals or businesses may not apply directly to the State or FEMA, but eligible local governments or private non-profit organizations may apply on their behalf. | State-level agencies, Federally recognized Indian Tribal governments, and local communities (to include State-recognized Indian Tribes, authorized Indian Tribal organizations, and Alaska Native villages) are eligible to apply to the Applicant for assistance. Private individuals and private non-profit (PNP) organizations are not eligible sub-applicants. However, a relevant State agency or local government may apply to the Applicant for assistance to mitigate private or private non-profit (PNP) structures. | State-level agencies including state institutions (e.g., state hospital or university); Federally recognized Indian Tribal governments; local governments, including state-recognized Indian tribes, authorized Indian Tribal organizations, and Alaska Native villages; public colleges and universities; and Indian Tribal colleges and universities. Private non-profit (PNP) organizations and private colleges and universities are not eligible Sub-applicants; however, an eligible, relevant State agency or local government may apply to the Applicant as the Sub-applicant for assistance to benefit the private entity. | Same as FMA, but only those States or communities that cannot meet the requirements of the Flood Mitigation Assistance (FMA) program for either cost share or capacity to manage the activities. | Same as FMA. |

| PROGRAM ELEMENT | HAZARD MITIGATION GRANT PROGRAM (HMGP) | FLOOD MITIGATION ASSISTANCE (FMA) | PRE-DISASTER MITIGATION (PDM) | REPETITIVE FLOOD CLAIMS (RFC) | SEVERE REPETITIVE LOSS (SRL) PILOT PROGRAM |
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| **Eligible Project Grants** | **The HMGP can be used to fund projects to protect either public or private property, as long as the project fits within State and local government mitigation strategies to address areas of risk, and complies with program guidelines. Examples of projects include:**<br>• Acquiring and relocating structures from hazard-prone areas<br>• Retrofitting structures to protect them from floods, high winds, earthquakes, or other natural hazards<br>• Constructing certain types of minor and localized flood control projects<br>• Constructing safe rooms inside schools or other buildings in tornado-prone areas | **Project grants are available for:**<br>• Acquisition, structure demolition, or structure relocation with the property deed restricted for open space uses in perpetuity;<br>• Elevation of structures;<br>• Dry floodproofing of non-residential structures; and,<br>• Minor structural flood control activities.<br><br>*All properties must be insured at the time of application.* | **Project grants are available for:**<br>• Voluntary acquisition of real property (i.e. structures and land, where necessary) for open space conversion;<br>• Relocation of public or private structures;<br>• Elevation of existing public or private structures to avoid flooding;<br>• Structural and non-structural retrofitting (e.g., storm shutters, hurricane clips, bracing systems) of existing public or private structures to meet/exceed applicable building codes;<br>• Construction of safe rooms (tornado and severe wind shelters) for public and private structures that meet requirements in FEMA 320 and FEMA 361;<br>• Hydrologic and Hydraulic studies/analyses, engineering studies and drainage studies for the purpose of project design and feasibility determination directly related to the proposed project;<br>• Vegetation management for natural dune restoration, wildfire, or snow avalanche; | **Project grants are available for:**<br>• Acquisition, structure demolition, or structure relocation with the property deed restricted for open space uses in perpetuity.<br><br>*All properties must be insured at the time of application.* | **Project grants for flood mitigation activities such as:**<br>• Acquisition, structure demolition, or structure relocation with the property deed restricted for open space uses in perpetuity;<br>• Elevation of structures;<br>• Dry floodproofing of historic structures;<br>• Minor physical localized flood control projects; and,<br>• Mitigation Reconstruction (Demolition and rebuilding of structures).<br><br>*All properties must be insured at the time of application.* |

| PROGRAM ELEMENT | HAZARD MITIGATION GRANT PROGRAM (HMGP) | FLOOD MITIGATION ASSISTANCE (FMA) | PRE-DISASTER MITIGATION (PDM) | REPETITIVE FLOOD CLAIMS (RFC) | SEVERE REPETITIVE LOSS (SRL) PILOT PROGRAM |
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| **Eligible Project Grants (cont.)** | | | • Protective measures for utilities (e.g. electricity, gas); water and sanitary sewer systems and/or infrastructure (e.g. roads and bridges);<br>• Storm water management projects (e.g., culverts, retention basins) to reduce or eliminate long-term risk from flood hazards; and,<br>• Localized flood control projects (certain ring levees, bank stabilization, floodwall systems) that are designed specifically to protect critical facilities and that do not constitute a section of a larger flood control system. | | |
| **Eligible Planning Grants** | **Planning grants are available for:** Developing State, local, or Tribal mitigation plans<br><br>Funding is available for up to 7% of total State grant | **Planning grants are available for:** Flood mitigation planning activities. | **Planning grants are available for:**<br>• New Plan development<br>• Plan upgrades<br>• Comprehensive Plan Revisions | **Planning grants are not available.** | **Planning grants are not available.** |
| **Eligible Management Costs** | The HMGP provides three categories of "direct administrative costs": State management, Grantee administrative and Sub-grantee administrative. | Management Costs (also known as Technical Assistance Grants) allowed to support planning and project activities. See FY 2007 Program Guidance. | Management costs are available to support the planning and project sub-applications; Grantees up to 10%, Sub-grantees up to 5%. | Same as FMA, except only available for project activities. Grantees up to 10%, Sub-grantees up to 5%. | Management costs available to support project sub-applications. Grantees up to 10%, Sub-grantees up to 5%. |

| PROGRAM ELEMENT | HAZARD MITIGATION GRANT PROGRAM (HMGP) | FLOOD MITIGATION ASSISTANCE (FMA) | PRE-DISASTER MITIGATION (PDM) | REPETITIVE FLOOD CLAIMS (RFC) | SEVERE REPETITIVE LOSS (SRL) PILOT PROGRAM |
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| **Planning Requirements** | Applicants must have a FEMA-approved local mitigation plan in accordance with 44 C.F.R. Parts 201.6 and 206.434(b) to be eligible to receive project grant funding under the HMGP. All activities submitted for consideration must be consistent with the Grantee's State/Tribal standard or enhanced hazard mitigation plan and the Applicant's Tribal/local/university hazard mitigation plan for the local jurisdiction in which the activity is located. | Local Flood Mitigation Plan meeting 44 CFR Part 78.5 required prior to award as condition of receiving project grants.<br><br>**No State plan requirement.** | In order to receive project grants, all Applicants MUST have a FEMA-approved State/Tribal Standard or Enhanced hazard mitigation plan in accordance with 44 CFR Part 201 by the application deadline. In addition, all Sub-applicants MUST have a FEMA-approved hazard mitigation plan in accordance with 44 CFR Part 201 to be eligible to receive project grant funding under the PDM program. PDM planning grants will continue to be available to Applicants and Sub-applicants that do not have a FEMA-approved hazard mitigation plan to enable them to meet the planning requirements. | State/Tribal Standard or Enhanced hazard mitigation plan approved by FEMA in accordance with 44 C.F.R. Part 201 required by application deadline.<br><br>**No local plan requirement.** | State/Tribal Standard or Enhanced hazard mitigation plan approved by FEMA in accordance with 44 C.F.R. Part 201 required by application deadline.<br><br>**Local plan requirements will be addressed in Regulations**. |
| **Application Process** | The primary responsibility for selecting and administering mitigation activities resides with the State. The State sets mitigation priorities and selects project applications that are developed and submitted by local jurisdictions. Although individuals may not apply directly to the State for assistance, local governments may sponsor an application on their behalf. After its eligibility review, the State forwards applications consistent with State mitigation planning objectives to FEMA for review and approval. | Applicants must apply electronically via FEMA's *e*Grants application, available at https://portal.fema.gov.<br><br>Sub-applicants apply directly to the State, Tribal, or Territory Applicant, who reviews and prioritizes sub-applications. The Applicant submits the Grant application with sub-applications to FEMA for review and approval. | Applicants must apply electronically via FEMA's eGrants application, available at https//:portal.fema.gov<br><br>Sub-applicants apply directly to the State, Tribal, or Territory Applicant, who reviews and prioritizes sub-applications. The Applicant submits the Grant application with sub-applications to FEMA for review and approval. | Applicants must apply using paper OMB and FEMA forms, including the *e*Grants project sub-application, available at www.fema.gov/government/grant/rfc or www.grants.gov<br><br>Sub-applicants apply directly to the State, Tribal, or Territory Applicant, who reviews and prioritizes sub-applications. The Applicant submits the Grant application with sub-applications to FEMA for review and approval. | To be described in Regulations. |

| PROGRAM ELEMENT | HAZARD MITIGATION GRANT PROGRAM (HMGP) | FLOOD MITIGATION ASSISTANCE (FMA) | PRE-DISASTER MITIGATION (PDM) | REPETITIVE FLOOD CLAIMS (RFC) | SEVERE REPETITIVE LOSS (SRL) PILOT PROGRAM |
|---|---|---|---|---|---|
| **FY 2007 Available Funds** | Federal funding under the HMGP is available following a major disaster declaration, if requested by the Governor. As of October 4, 2006, if a State has a FEMA-approved *Standard* State Mitigation plan, HMGP funds are available based on up to 15% for amounts not more than $2 Billion of the total of Public and Individual Assistance funds authorized for the disaster; up to 10% for amounts of $2 Billion to not more than $10 Billion; 7.5% for amounts of $10 Billion to not more than $35.333 Billion. If a State has a FEMA-approved *Enhanced* Mitigation plan, HMGP funds are available based on up to 20% of the total of Public and Individual Assistance funds authorized for the disaster. | $31 million | $100 Million | $10 million | FEMA is combining the $40 million FY 2006 and $40 million FY 2007 funds for a total of $80 million available. |
| **Cost-Share Requirements** | HMGP grant funds may be used to pay up to 75 % of the eligible project costs. The non-Federal match does not need to be cash; in-kind services or materials may be used. | Up to 75% Federal, minimum 25% non-Federal match required. Of the total non-Federal share, not more than one-half may be provided from in-kind contributions.<br><br>Reduced match (10% non-Federal) allowed for States with approved State mitigation plans meeting the hazard mitigation planning requirements under section 322 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act (42 U.S.C. 5165) that specifies how the State reduces the number of repetitive loss properties. | Up to 75% Federal, minimum 25% non-Federal match required. Small, impoverished communities may be eligible for up to a 90% Federal cost-share. | Up to 100% Federal (no non-Federal match requirement). | Up to 75% Federal, minimum 25% non-Federal match required.<br><br>Reduced match (10% non-Federal) allowed for States with approved State mitigation plans meeting the hazard mitigation planning requirements under section 322 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act (42 U.S.C. 5165) that specifies how the State reduces the number of repetitive loss properties. |

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| **Distribution of Funds** | The HMGP is administered by the State. The mitigation planning and application development process begins at the local level. States prioritize local applications and select projects for funding. | Allocations to eligible Applicants (State or territory) based on the number of NFIP-insured properties and the number of repetitive loss properties in each State or Territory. Set-aside amount reserved for Indian Tribal governments or communities that cannot apply through the State or Territory. | PDM grants are awarded on a competitive basis and without reference to state allocations, quotas, or other formula-based allocation(s) of funds. | Awarded nationally without reference to State allocations, quotas, or other formula-based allocation(s) of funds.<br>Grants will be awarded in the order of the greatest savings to the NFIF. In 2007 this will be demonstrated by the verified benefit-cost analysis of submitted projects. | Allocations to eligible Applicants (State or territory) based on the number of severe repetitive loss properties in each State or Territory. Set-aside amount (10%) reserved for communities that receive little or no assistance under the allocation formula. |
| **Application Deadline** | Generally, applications must be submitted to the State for consideration within 12 months following a disaster declaration. | February 28, 2007, 11:59 p.m., Eastern Standard Time. | February 5, 2007, 11:59 p.m., Eastern Standard Time. | February 28, 2007, 5:00 p.m., Regional Office local time. | To be determined. |
| **Application Review** | • Eligibility and Completeness Review, including Benefit Cost Analysis (BCA), Engineering Feasibility and Mitigation Planning requirements<br>• Environmental and Historic Preservation Reviews | • Eligibility and Completeness Review, including Benefit Cost Analysis (BCA), Engineering Feasibility and Mitigation Planning requirements<br>• Environmental and Historic Preservation Reviews | • Eligibility and Completeness Review, including Applicant/Sub-Applicant eligibility, Benefit Cost Analysis (BCA), and Mitigation Planning requirements<br>• National Ranking, FEMA will score all eligible planning and project sub-applications on the basis of predetermined, objective, quantitative factors to calculate a National Ranking Score. | • Eligibility and Completeness Review, Mitigation Planning requirement<br>• Technical Review: including Benefit Cost Analysis (BCA), for Project and Property Ranking<br>• Environmental and Historic Preservation Reviews | • Eligibility and Completeness Review, Mitigation Planning requirement<br>• Technical Review: including Benefit Cost Analysis (BCA), Engineering Feasibility, for Project Ranking<br>• Environmental and Historic Preservation Reviews |

| PROGRAM ELEMENT | HAZARD MITIGATION GRANT PROGRAM (HMGP) | FLOOD MITIGATION ASSISTANCE (FMA) | PRE-DISASTER MITIGATION (PDM) | REPETITIVE FLOOD CLAIMS (RFC) | SEVERE REPETITIVE LOSS (SRL) PILOT PROGRAM |
|---|---|---|---|---|---|
| **Application Review (cont.)** | | | • National Evaluation--National panels chaired by FEMA and composed of representatives from FEMA Headquarters and Regions, other Federal agencies, States, Federally-recognized Indian Tribal governments, Territories, and local governments convene to evaluate planning and project sub-applications on the basis of additional pre-determined qualitative factors.<br>• Technical Review--FEMA conducts technical reviews for Benefit Cost and Engineering Feasibility on the highest scoring project sub-applications representing approximately 150% of available funding. | | |
| **Deadline to Award Funding** | Generally, HMGP funding must be obligated to the State within 24 months of a disaster declaration. Obligated grant funds must be utilized within the period of performance for the grant award. | See FY 2007 Program Guidance. | Available until expended. | See FY 2007 Program Guidance. | To be determined. |

# Appendix E: STAPLEE Benefit Cost Review Materials

## Table of Contents

STAPLEE Worksheet Example ..... E-3
STAPLEE Worksheet Instructions ..... E-4
STAPLEE Criteria ..... E-5

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**Jurisdiction:** City of Hazardville
**Problem:** Flooding in the City of Hazardville has destroyed Municipal Property
**Goal:** Minimize losses to existing and future structures within flood hazard areas
**Objective:** Reduce Potential damages to the Hazardville Park restroom
**Mitigation Initiative ID Number:**

| STAPLEE Criteria | Social | | Technical | | | Administrative | | | Political | | | Legal | | | Economic | | | | Environmental | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Considerations for Alternative Actions | Community Acceptance | Effect on Segment of Population | Technical Feasibility | Long-Term Solution | Secondary Impacts | Staffing | Funding Allocated | Maintenance and Operations | Political Support | Local Champion | Public Support | State Authority | Existing Local Authority | Potential Legal Challenge | Benefit of Action | Cost of Action | Contributes to Economic Goals | Outside Funding Required | Effect on Land/Water | Effect on Endangered Species | Effect on HAZMAT Waste Sites | Consistent with Community Environmental Goals | Consistent with Federal Laws | Total Score |
| **Demolish and not replace restroom** | -3 | -2 | 0 | -3 | -2 | 0 | 3 | 0 | -1 | n/a | -3 | n/a | 0 | ? | -2 | 0 | -2 | 0 | 0 | 0 | 0 | 0 | n/a | -15 |
| **Relocate restroom within the park** | 3 | 0 | 0 | 3 | 0 | 0 | 0 | 1 | 2 | n/a | 2 | n/a | 0 | 0 | 3 | -1 | 2 | 0 | 1 | 0 | 0 | 1 | n/a | 17 |
| **Construct a berm around the restroom** | 1 | ? | 0 | -1 | -1 | 0 | 1 | 1 | 0 | n/a | 1 | n/a | 0 | ? | 1 | -1 | 0 | 0 | -1 | 0 | 0 | 0 | n/a | 1 |
| **Elevate the restroom** | 2 | 0 | -1 | 2 | 0 | 0 | 2 | 1 | 0 | n/a | 1 | n/a | 0 | 0 | 3 | -2 | 2 | 0 | 0 | 0 | 0 | 1 | n/a | 11 |
| | | | | | | | | | | | | | | | | | | | | | | | | 0 |
| | | | | | | | | | | | | | | | | | | | | | | | | 0 |

| Alternative Action | Comments |
|---|---|
| **Remove the restroom entirely** | The park is used heavily in the summer and this would be an unpopular option. |
| **Relocate restroom within the park** | This option would guarantee that it would not be affected by future flooding, but It is the most expensive option. |
| **Construct a berm around the restroom** | This option may resolve all but the most severe flood events. It may pose a problem for certain people with disabilities and could raise ADA issues. More research is needed to determine potential impacts. |
| **Elevate the restroom** | This action may adversely affect this older, less sturdy facility. A structural inspection will be necessary to determine the viability of this option. |
| | |
| | |

**Navigate using the worksheet tabs below.**

1. **Insert Jurisdiction Name**

2. **Identify the hazard threat or problem**. Problem statements should be clear and factual. Fill in the goal and its corresponding objective.

3. **List the alternative actions** that address the specific objectives that the planning team will evaluate.

4. **Input Subjective Scoring.** For each consideration, determine if the alternative provides a benefit (positive values: High=3; Moderate=2; Low=1) or a Cost (negative values: Low=-1; Moderate=-2; High=-3). If there is no effect, input zero (0). Insert not applicable (n/a) for considerations that don't apply. Insert a question mark (?) if you do not know an answer. The considerations under each criterion are suggested ones to use; you can revise these to reflect your own considerations if necessary.

5. **Comments.** Use for your reference. For example, you can insert what sources of information or individuals that were consulted to develop the alternative action. Question marks will indicate gaps or shortcomings in the particular action, which can be noted in the Comments section.

6. **Review.** The total score equals the net result of the sum of the subjective values. The greater the score, the higher the project benefits. This score can be used to assess and select the mitigation action that may provide the greatest benefit at a reasonable cost for the jurisdiction.

7. **Identify Initiative**. If an action is selected from the evaluation exercise, assign it a Mitigation Initiative Identification Number.

8. **Use a separate worksheet for each objective.** Don't use the original tab. Make a copy of the original worksheet tab (use the Ctrl button with your mouse button and drag and drop to a new tab location, or right click on the tab and make a copy).

## Identification and Analysis of Mitigation Actions

| | |
|---|---|
| *Requirement §201.6(c)(3)(ii):* | [The mitigation strategy shall include a] section that identifies and analyzes a comprehensive range of specific mitigation actions and projects being considered to reduce the effects of each hazard, with particular emphasis on new and existing buildings and infrastructure. |

***Explanation:*** The local jurisdiction **shall** list potential loss reduction actions it has identified in its planning process and analyze various actions that achieve the community's goals and objectives to reduce or avoid the effects of the identified hazards. A *comprehensive range* of specific mitigation actions consists of multiple mitigation actions for each profiled hazard. "No

Action" does not qualify as a mitigation action. Mitigation actions **shall** address **existing** and **new** buildings and infrastructure.

Prior to analyzing and prioritizing mitigation actions, it may be useful for communities to sort identified mitigation actions into the following groups:

- **Prevention:** Government administrative or regulatory actions or processes that influence the way land and buildings are developed and built. These actions also include public activities to reduce hazard losses. Examples include planning and zoning, building codes, capital improvement programs, open space preservation, and storm water management regulations.
- **Property Protection**: Actions that involve the modification of existing buildings or infrastructure to protect them from a hazard, or removal from the hazard area. Examples include acquisition, elevation, relocation, structural retrofits, flood proofing, storm shutters, and shatter-resistant glass.
- **Public Education & Awareness**: Actions to inform and educate citizens, elected officials, and property owners about potential risks from hazards and potential ways to mitigate them. Such actions include outreach projects, real estate disclosure, hazard information centers, and school-age and adult education programs.
- **Natural Resource Protection:** Actions that, in addition to minimizing hazard losses also preserve or restore the functions of natural systems. These actions include sediment and erosion control, stream corridor restoration, watershed management, forest and vegetation management, and wetland restoration and preservation.
- **Structural Projects:** Actions that involve the construction of structures to reduce the impact of a hazard. Such structures include storm water controls (*e.g.*, culverts), floodwalls, seawalls, retaining walls, and safe rooms.

The *2003 Natural Hazards Mitigation Plan for the Thurston Region* identified seven hazard mitigation categories as follows:

- Public Information
- Plan Coordination and Implementation
- Data Collection and Mapping
- Development Regulations
- Hazard Preparedness
- Hazard Damage Reduction
- Critical Facilities Replacement/Retrofit

The term "Public Information" covers all types of educational information that would be beneficial to either avoid natural hazards or deal with their effects. The term "Plan Coordination and Implementation" is used for any activity that supported the planning process or relates to the implementation of the plan within that entity. The term "Data Collection and Mapping" relates to the process of gathering and analyzing new data and then mapping that information so that it can be used for risk assessment.

The term "Development Regulations" relates to the preparation of local regulations to assess these hazards. "Hazard Preparedness" refers to a rather broad list of activities which would take place before an event to prepare for a disaster. This contrasts with "Hazard Damage Reduction" initiatives, which are any activity that would lessen the damage of a disaster event and which is not for a critical facility. The term "Critical Facilities Replacement/Retrofit" indicates those initiatives targeted at improving or replacing identified critical facilities.

The plan **should** describe the process by which the community decides on particular mitigation actions. This description *should* include who participated in the analysis and selection of actions. Some of the mitigation actions initially identified may ultimately be eliminated in the community's action plan due to limited capabilities, prohibitive costs, low benefit/cost ratio, or other concerns.

The information will also be valuable as part of the alternative analysis for the National Environmental Policy Act (NEPA) review required if projects are Federally funded.

## Evaluation Criteria for Mitigation Actions

With regard to analyzing mitigation actions, FEMA's *Developing the Mitigation Plan* (FEMA 386-3) highlights the STAPLEE method—a technique for identifying, evaluating, and prioritizing mitigation actions based on existing local conditions.

The following discussion explains each of the **STAPLEE** evaluation criteria. It includes examples of questions the planning team should consider, as well as who may be the appropriate person or agency to answer these questions as the team works through the list of alternative mitigation actions.

An Excel worksheet is available for Workgroup members and their local planning committees to fulfill the STAPLEE evaluation process. Depending on the size and capabilities of the jurisdiction, it may not be possible to simply attend a planning meeting and answer these questions. In some cases, designated team members may need to investigate the issues further and report back to the team.

**Social:** The public must support the overall implementation strategy and specific mitigation actions. Therefore, the projects will have to be evaluated in terms of community acceptance by asking questions such as:

- Will the proposed action adversely affect one segment of the population?
- Will the action disrupt established neighborhoods, break up voting districts, or cause the relocation of lower income people?
- Is the action compatible with present and future community values?
- If the community is a tribal entity, will the actions adversely affect cultural values or resources?

*Local elected officials, community development staff, and planning board are key team members who can help answer these questions.*

**Technical:** It is important to determine if the proposed action is technically feasible, will help to reduce losses in the long term, and has minimal secondary impacts. Here, you will determine whether the alternative action is a whole or partial solution, or not a solution at all, by considering the following types of issues:

- How effective is the action in avoiding or reducing future losses? If the proposed action involves upgrading culverts and storm drains to handle a 10-year storm event, and the objective is to reduce the potential impacts of a catastrophic flood, the proposed mitigation cannot be considered effective. Conversely, if the objective were to reduce the adverse impacts of frequent flooding events, the same action would certainly meet the technical feasibility criterion.
- Will it create more problems than it solves?
- Does it solve the problem or only a symptom?

*Key team members who can help answer these questions include the town engineer, public works staff, and building department staff.*

**Administrative:** Under this part of the evaluation criteria, you will examine the anticipated staffing, funding, and maintenance requirements for the mitigation action to determine if the jurisdiction has the personnel and administrative capabilities necessary to implement the action or whether outside help will be necessary.

- Does the jurisdiction have the capability (staff, technical experts, and/or funding) to implement the action, or can it be readily obtained?
- Can the community provide the necessary maintenance?
- Can it be accomplished in a timely manner?

**Political:** Understanding how your current community and state political leadership feels about issues related to the environment, economic development, safety, and emergency management will provide valuable insight into the level of political support you will have for mitigation activities and programs. Proposed mitigation objectives sometimes fail because of a lack of political acceptability. This can be avoided by determining:

- Is there political support to implement and maintain this action?
- Have political leaders participated in the planning process so far?
- Is there a local champion willing to help see the action to completion?
- Who are the stakeholders in this proposed action?
- Is there enough public support to ensure the success of the action?
- Have all of the stakeholders been offered an opportunity to participate in the planning process?
- How can the mitigation objectives be accomplished at the lowest "cost" to the public?

*Ensure that a designated member of the planning team consults with the board of supervisors, mayor, city council, administrator, or manager.*

**Legal:** Without the appropriate legal authority, the action cannot lawfully be undertaken. When considering this criterion, you will determine whether your jurisdiction has the legal authority at the state, tribal, or local level to implement the action, or whether the jurisdiction must pass new laws or regulations. Each level of government operates under a specific source of delegated authority. As a general rule, most local governments operate under enabling legislation that gives them the power to engage in different activities.

You should identify the unit of government undertaking the mitigation action, and include an analysis of the interrelationships between local, regional, state, and federal governments. Legal authority is likely to have a significant role later in the process when your state, tribe, or community will have to determine how mitigation activities can best be carried out, and to what extent mitigation policies and programs can be enforced.

- Does the state, tribe, or community have the authority to implement the proposed action?
- Is there a technical, scientific, or legal basis for the mitigation action (i.e., does the mitigation action "fit" the hazard setting)?
- Are the proper laws, ordinances, and resolutions in place to implement the action?
- Are there any potential legal consequences?
- Will the community be liable for the actions or support of actions, or lack of action?
- Is the action likely to be challenged by stakeholders who may be negatively affected?

*Your community's legal counsel is a key team member to include in this discussion.*

**Economic:** Every local, state, and tribal government experiences budget constraints at one time or another. Cost-effective mitigation actions that can be funded in current or upcoming budget cycles

are much more likely to be implemented than mitigation actions requiring general obligation bonds or other instruments that would incur long-term debt to a community. States and local communities with tight budgets or budget shortfalls may be more willing to undertake a mitigation initiative if it can be funded, at least in part, by outside sources. "Big ticket" mitigation actions, such as large-scale acquisition and relocation, are often considered for implementation in a post-disaster scenario when additional federal and state funding for mitigation is available.

Economic considerations must include the present economic base and projected growth and should be based on answers to questions such as:

- Are there currently sources of funds that can be used to implement the action?
- What benefits will the action provide?
- Does the cost seem reasonable for the size of the problem and likely benefits?
- What burden will be placed on the tax base or local economy to implement this action?
- Does the action contribute to other community economic goals, such as capital improvements or economic development?
- What proposed actions should be considered but be "tabled" for implementation until outside sources of funding are available?

*Key team members for this discussion include community managers, economic development staff, and the assessor's office.*

**Environmental:** Impact on the environment is an important consideration because of public desire for sustainable and environmentally healthy communities and the many statutory considerations, such as the National Environmental Policy Act (NEPA), to keep in mind when using federal funds.

You will need to evaluate whether, when implementing mitigation actions, there would be negative consequences to environmental assets such as threatened and endangered species, wetlands, and other protected natural resources.

- How will this action affect the environment (land, water, endangered species)?
- Will this action comply with local, state, and federal environmental laws or regulations?
- Is the action consistent with community environmental goals?

Numerous mitigation actions may well have beneficial impacts on the environment. For instance, acquisition and relocation of structures out of the floodplain, sediment and erosion control actions, and stream corridor and wetland restoration projects all help restore the natural function of the floodplain. Also, vegetation management in areas susceptible to wildfires can greatly reduce the potential for large wildfires that would be damaging to the community and the environment. Such mitigation actions benefit the environment while creating sustainable communities that are more resilient to disasters.

*Key team members include the local health department, conservation commissions, environmental or water resources agency, building officials, environmental groups, fish and game commissions, etc.*

# Researching STAPLEE Criteria

| Evaluation Category | Considerations | Sources of Information |
|---|---|---|
| SOCIAL | Community Acceptance | • Interviews with government staff, non-profit organizations, and neighborhood advocacy organizations<br>• Community plans<br>• Newspaper articles |
| | Adversely Affects Segment of Population | • Maps showing demographics (race, age, income, voting districts, etc.) with locations of proposed mitigation actions |
| TECHNICAL | Technical Feasibility | • Judgment of mitigation experts, scientists, and engineers<br>• Existing literature/studies on the action |
| | Long-term Solution | • Judgment of mitigation experts<br>• Existing literature/studies on the action |
| | Secondary Impacts | • Judgment of mitigation experts<br>• Existing literature Maps showing environmentally sensitive resources with locations of proposed mitigation actions<br>• Scientific and/or engineering evaluations |
| ADMINISTRATIVE | Staffing (sufficient number of staff and training) | • Capability assessment<br>• Jurisdiction organizational chart<br>• Availability of technical assistance from regional or state agencies<br>• Interviews with department heads and relevant staff |
| | Funding Allocated | • Capability assessment<br>• Annual operating budget<br>• Capital improvement budget<br>• Interviews with department heads and relevant staff |
| | Maintenance/Operations | • Capability assessment<br>• Existing literature on maintenance costs<br>• Interviews with department heads and relevant staff |

| Evaluation Category | Considerations | Sources of Information |
|---|---|---|
| POLITICAL | Political Support | • Interviews with elected officials<br>• Newspaper articles |
| | Local Champion or Plan Proponent (respected community member) | • Interviews with elected officials, community leaders, and private sector participants in planning process |
| | Public Support (Stakeholders) | • Interviews with government staff, non-profit organizations, and neighborhood advocacy organizations<br>• Other planning processes<br>• Newspaper articles<br>• Public meetings |
| LEGAL | State Authority | • Research of state codes<br>• Contact with state attorney general's office |
| | Existing Local Authority | • Research of local codes and ordinances<br>• Local legal counsel |
| | Action Potentially Subject to Legal Challenge by Opponents (stakeholders who would be negatively affected) | • Research by local legal counsel<br>• Maps, census, plans |
| ECONOMIC | Benefit of Mitigation Action | • Benefit-cost analysis software/methodology<br>• Judgment of experts<br>• Existing literature Case studies of similar implemented actions<br>• Economic impact assessment |
| | Cost of Mitigation Action | • Order of magnitude cost estimate (e.g., Action A costs five times more than Action B)<br>• Judgment of experts<br>• Local contractors<br>• Case studies |
| | Contributes to Economic Goals | • Judgment of experts<br>• Evaluation of community's comprehensive plan, economic development plan, and other community plans and policies |
| | Outside Funding Required | • Order of magnitude cost estimate<br>• Evaluation of state and federal funding programs |

| Evaluation Category | Considerations | Sources of Information |
|---|---|---|
| ENVIRONMENTAL | Affects Land/Water Bodies | • **Maps, studies, plans**<br>• **Coordination with state and federal resource agencies, including compliance with all relevant statutes and regulations** |
| | Affects Endangered Species | • **Maps, studies, plans Coordination with state and federal resource agencies, including compliance with all relevant statutes and regulations** |
| | Affects Hazardous Materials and Waste Sites | • **Maps, studies, plan**<br>• **Hazardous waste site databases**<br>• **Coordination with state and federal resource agencies, including compliance with all relevant statutes and regulations** |
| | Consistent with Community's Environmental Goals | • **Maps of land use, zoning, sensitive areas, projected growth**<br>• **Interviews with government staff**<br>• **Review of local plans and policies** |
| | Consistent with Federal Laws | • **Contact with federal agencies** |