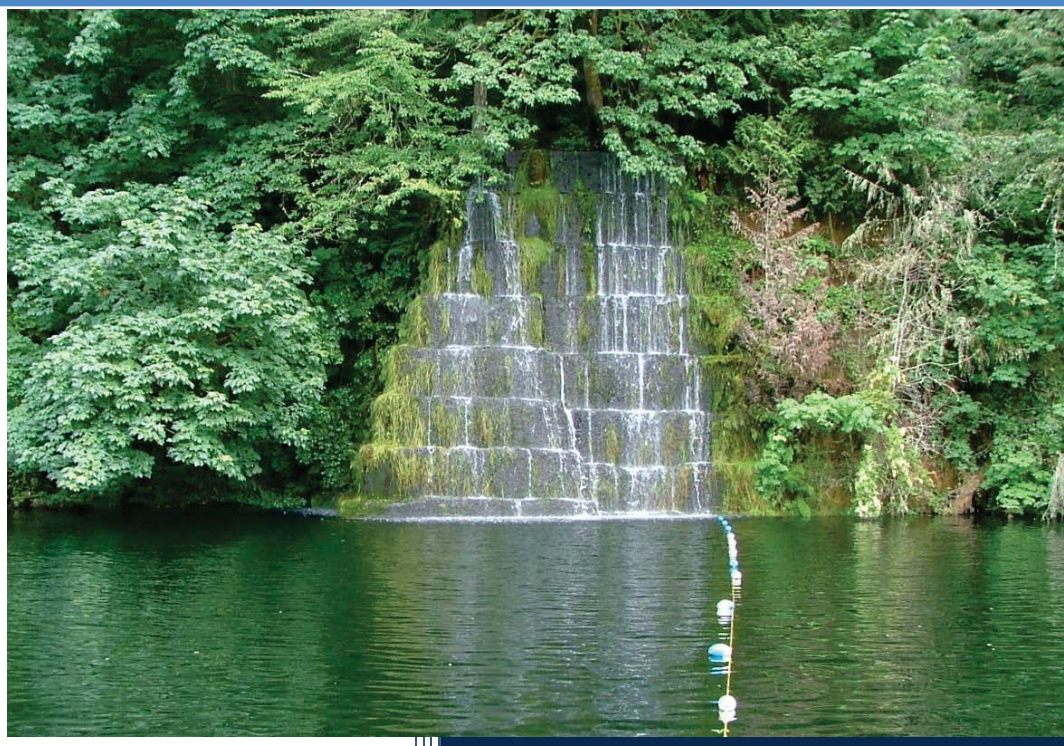
FINAL
June 2011

Shoreline Inventory and Characterization

City of Tenino



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THURSTON REGIONAL PLANNING COUNCIL (TRPC) is a 22-member intergovernmental board made up of local governmental jurisdictions within Thurston County, plus the Confederated Tribes of the Chehalis Reservation and the Nisqually Indian Tribe. The Council was established in 1967 under RCW 36.70.060, which authorized creation of regional planning councils.

TRPC's mission is to **"Provide Visionary Leadership on Regional Plans, Policies, and Issues."** The primary functions of TRPC are to develop regional plans and policies for **transportation** [as the federally recognized Metropolitan Planning Organization (MPO) and state recognized Regional Transportation Planning Organization (RTPO)], **growth management, environmental quality**, and other topics determined by the Council; provide **data and analysis to support local and regional decision making;** act as a "**convener**" to build **community consensus** on regional issues through information and citizen involvement; build **intergovernmental consensus** on regional plans, policies, and issues, and advocate local implementation; and provide **planning, historic preservation, and technical services** on a contractual basis.

This report was prepared as part of the Thurston Regional Planning Council's 2010 regional work program.

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About This Report

Consistent with Governor Gregoire's Plain Talk Executive Order 05-03 (2005), this report is written in a manner that is brief and to-the-point, uses non-bureaucratic language and features a clean design that promotes fast scanning and reading.

Scientific and legal references are kept to a minimum, replaced by a full list of sources in the report appendix.

Cover: City of Tenino Quarry Pool, Tenino, WA
City of Tenino Homepage

Table of Contents

1.0 Introduction 1
1.1 Background and Purpose 1
1.2 SMP Update Guidelines 1
1.3 Study Area 1
1.4 Tenino Shoreline History 2
1.5 Community Historic Preservation 4
2.0 Shoreline Management Act and Growth Management Act 5
2.1 Minimum Shoreline Jurisdiction 5
2.2 Regulatory Framework 7
2.3 Optional Shoreline Jurisdiction 8
2.4 Critical Areas Regulations 9
3.0 Inventory and Characterization Methods 11
3.1 Methods Overview 11
3.2 Approach to Characterizing Ecosystem-wide Processes and Shoreline Functions 11
3.3 Approach to Characterizing Jurisdictional Shorelines 11
4.0. Elements of the shoreline inventory 13
4.1 Regional Overview 13
4.2 Climate 17
4.3 Geology 18
4.4 Surface Water Runoff 19
4.4.1 Flood Hazards 20
4.5 Groundwater Patterns 21
4.6 Water Quality Processes 21
4.7 Water Quality 23
4.7.1 Toxic and Hazardous Materials 25
4.8 Habitats 25
4.8.1 Priority Habitats and Species of Concern 27
5.0 Reach Scale Inventory and Assessment 29
5.1 Tenino Shoreline Reach Segments 29
5.2 Tenino Shorelines *(Western City limits to Shoreline End Point)* 30
5.2.1 Existing and Future Land Use (Zoning), Existing Shoreline Designation 31
5.2.2 Roads, Railroads, Utilities, Shoreline Modifications 33
5.2.3 Water Dependent/Oriented Uses 34
5.2.4 Historic Sites 34
5.2.5 Public Access and Public Waterfront Land Owners 35
5.2.6 Critical Areas 35
5.2.7 Opportunity Sites 36
6.0 Data Gaps 37
7.0 Shoreline Management Recommendations 39
7.1 Shoreline designations and consistency with zoning 39
7.2 Protective regulations and regulatory streamlining 39
7.3 Restoration 39
7.4 Public access 39
8.0 References 41
8.1 Data Sources 41
8.2 Sources Citations 43
9.0 Map Folio 47
10.0 Appendix 69
10.1 Ecology Landscape-Scale Assessment 69
10.2 Important Areas and Alterations 69
10.3 Watershed Characterization Results 70

List of Figures - in the Report Text

Figure 1: Rivers and Streams Minimum and Maximum Shoreline Jurisdiction 5
Figure 2: Chehalis River Basin – WRIA 22 & 23 13

List of Figures - in the Map Folio

Figure 3: Community Location..... 49
Figure 4: 2009 Aerial Photo..... 51
Figure 5: Shoreline Jurisdiction and Environments..... 53
Figure 6: Scatter Creek Aquifer and Tenino..... 55
Figure 7: Cross Section of the Scatter Creek Aquifer 57
Figure 8: 2006 Current Land Use 59
Figure 9: 2010 Current Zoning 61
Figure 10: Public Acess, Public Lands and Historic Sites..... 63
Figure 11: Critical Areas..... 65
Figure 12: Opportunity Sites..... 67

List of Figures - in the Appendix

Figure A1: Watershed Management Matrix 69
Figure A2: Watershed Assessment Units around Tenino 71
Figure A3: Summary of Important Areas for Watershed Processes..... 72
Figure A4: Summary of Alteration Areas for Watershed Processes 73
Figure A5: Summary of Importance and Alteration Areas for Watershed Processes 74

List of Tables

Table 1: Comparison of Existing, Minimal, and Optional Shoreline Jurisdiction..... 8
Table 2: Minimal Shoreline Jurisdiction in Tenino and its UGA..... 9
Table 3: Estimate of Forest Harvest Activity in Thurston County, 1985-2000..... 15
Table 4: Urbanization by Watershed in Thurston County, 1985-2000..... 15
Table 5: Change in Urban (Built) Land Cover in Thurston County, 1985-2000..... 16
Table 6: Estimate of Total Impervious Area by Watershed 16
Table 7: Estimate of Effective Impervious Area by Watershed 17
Table 8: City of Tenino - Hazard Mitigation Initiatives..... 20
Table 9: Tenino Shoreline Reach Segments 29
Table 10: Land Cover, Zoning, and Shoreline Environment Designations..... 32

List of Photographs

Photo 1: Downtown Tenino c 1925 3
Photo 2: Tenino Quarry - Now the Site of the Quarry Pool 3
Photo 3: Old Highway 99 Bridge West of Downtown 30
Photo 4: Scatter Creek Shoreline – Segment A 30
Photo 5: Scatter Creek Shoreline – Segment B 31
Photo 6: Scatter Creek Shoreline – Segment C 32
Photo 7: Old Highway 99 Bridge North of Downtown 33
Photos 8 & 9: Hercules Sandstone Quarry – Segment B..... 34
Photo 10: Scatter Creek Shoreline – Segment B 34
Photo 11: Scatter Creek Shoreline – Segment D 36

1.0 INTRODUCTION

1.1 Background and Purpose

The City of Tenino (City) obtained a grant (Grant No. 1000057) from the Washington State Department of Ecology (Ecology) to prepare a comprehensive update of the City's Shoreline Master Program (SMP) as defined by the State of Washington Shoreline Management Act (SMA) (RCW 90.58). Thurston Regional Planning Council (TRPC) is acting on behalf of the City to conduct a baseline inventory and characterization of the natural and built conditions within the City's shoreline jurisdiction.

1.2 SMP Update Guidelines

The WA Department of Ecology has adopted new guidelines for the preparation of local SMP updates. WAC 173-26-201(3) (c) contains the relevant guidance for the preparation of this report, which is listed below:

- Gather and incorporate all pertinent and available information, existing inventory data and materials from state agencies, affected Indian tribes, watershed management planning, port districts and other appropriate sources.
- Ensure that, whenever possible, inventory methods and protocols are consistent with those of neighboring jurisdictions and state efforts.
- Map inventory information at an appropriate scale.
- Collection of additional inventory information is encouraged and should be coordinated with other watershed, regional, or statewide inventory and planning efforts in order to ensure consistent methods and data protocol as well as effective use of fiscal and human resources.
- Data from inter-jurisdictional, watershed, or regional inventories may be substituted for an inventory conducted by an individual jurisdiction, provided it meets the requirements of this section.

1.3 Study Area

The City of Tenino is located in southern Thurston County, 14 miles south of Olympia and 4.5 miles north of Bucoda. (See Figure 11 in the Map Folio) The city encompasses approximately 1.4 square miles, with another 0.1square miles in its Urban Growth Area. The city's 2009 population was approximately 1,535 people with its projected 2030 population at 3,590 people (TRPC, 2009).

Historically, the lacks of sewers and public transportation were key constraints to further urban development in Tenino. On-site septic disposal was the wastewater treatment option for the entire community. The City adopted a General Sewer Plan in 2002, a Sewer Facility Plan in 2004 and then a General Sewer and Facilities Plan in 2008. Funding for Tenino's

wastewater treatment plant was provided by state and federal sources. The city broke ground on construction of the conveyance system in April of 2008. The system went online in November 2009. Growth will occur from build-out within the city limits and the surrounding Urban Growth Area (UGA). The anticipated population served by sewers by 2026 is 2,287 persons (Gibbs and Olson, 2008).

Tenino has 1.2 miles of shoreline jurisdiction along Scatter Creek. There is another 0.2 mile of shoreline jurisdiction within its Urban Growth Area (UGA). The SMP Update will not be effective in the UGA, until this area is annexed into the City.

1.4 Tenino Shoreline History

Summarized section of 'A Brief History of Tenino' provided by local historian Art Dwelley.

> *"The first settler on the site of Tenino was Stephen Hodgden, a native of Maine who had come west in 1849 to California. {I]n 1851 [he] and took up a donation land claim on the banks of Scatter Creek. His land was … referred to as "Hodgden's Station" and became a regular stop on the stage coach road from the Columbia to Olympia.*
>
> *In 1872 the railroad from the Columbia reached Hodgden's farm and a station was built and named "Tenino". It was the beginning of a settlement that later grew into the Town of Tenino. There is much speculation about the origin of the name, with stories that it was named after a railroad locomotive with number 1090 or a survey stake with that designation marked on it. According to the railroad archives, neither of these tales is true. There is considerable evidence that the name preceded the railroad and is of Indian origin, meaning "a branch in the trail" or "meeting place".*
>
> *The little settlement was pretty quiet for its first few years, with the majority of its commerce coming from farmers around the area and the fact that it was Olympia's closest connection with the railroad. [A]branch line [to Olympia] was … completed in July of 1878. Two trains a day between Olympia and Tenino made connections with trains going to Tacoma or Portland.*
>
> *[Tenino changed from a whistle stop along the railroad to a bustling town with the founding of the first sandstone quarry in 1888. … The first] was located on the site of the present city park and pool, …[the] second quarry [was located] … east of town on the Military Road, and [the] … third quarry was located on Lemon Hill west of Tenino in the early 1900's … under the name of the Hercules Stone Co.*
>
> *Stone quarrying became Tenino's major industry until the market began to die out about 1915-20, with concrete replacing stone as a major building material. Some of Tenino's quarries operated as late as the 1930's, but only on a limited basis. …"*

Old Highway 99 was the principal route from Seattle to Portland, Oregon until the construction of Interstate 5 in the 1960s. Highway 99 crosses Scatter Creek in two locations, one north of downtown and one west of downtown. The bridge north of downtown was replaced in 2007 (see Photo 3 page 30), whereas the bridge to the west of downtown dates from 1923 (see Photo 7 page 33).

Photo 1: Downtown Tenino c 1925
City of Tenino Homepage - *Photo donated by Larry McMillan, Lacey, WA*

Photo 2: Tenino Quarry - Now the Site of the Quarry Pool
City of Tenino Homepage - *Photo donated by Larry McMillan, Lacey, WA*

1.5 Community Historic Preservation

A cultural resource inventory was performed in the mid-1980s with Tenino as a part of Thurston County. Those buildings, structures, sites, and objects which would be suitable for placement on a local, state, and national register were inventoried. Additions have been made to this “inventory” since these reports were prepared.

There are three categories of Historic Registers: “Local,” “State,” and “National” register properties. Nominations for the State or National Register of Historic Places, requires review by the Washington State Department of Archaeology and Historic Preservation (DAHP) and placement by a statewide Historic Advisory Committee. Nominations for all the local historic registers are reviewed by a local historic commission. Each register has its own criteria, with the National Register being the most selective. A Local Register can enroll properties that have an importance to local history, whereas the State Register requires a threshold of statewide or regional importance.

Historic districts comprise the city's significant historic and architectural resources. A National Historic District is established by the community and is adopted by the DAHP. Inclusion in a historic district signifies that a property contributes to an ensemble that is worth protecting by virtue of its historic importance or architectural quality. Tenino has a National Historic District in its downtown, but this is not within either the minimum or optional shoreline jurisdiction.

A historic properties inventory report was prepared for the Hercules #1 Quarry. However, it has not been placed on a “Local,” “State,” and “National” historic register. None of the historic sites within Tenino are located in either the minimum or optional shoreline jurisdiction.

2.0 SHORELINE MANAGEMENT ACT AND GROWTH MANAGEMENT ACT

2.1 Minimum Shoreline Jurisdiction

At a minimum, the Shoreline Management Act (SMA) applies to all Shorelines of the State. (RCW 90.58 & WAC 173-22).

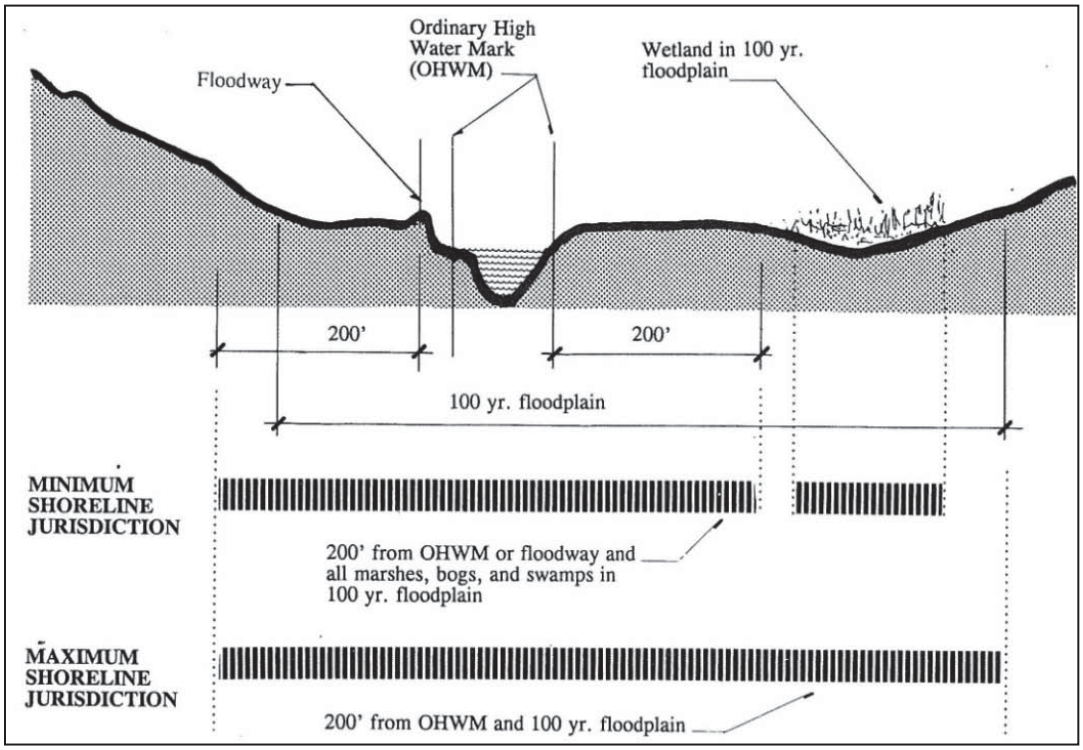

Figure 1: Rivers and Streams Minimum and Maximum Shoreline Jurisdiction
[Skowlund. 1994]

Within the City of Tenino, relevant 'Shorelines of the State' include:

- **"Streams"** with a mean annual flow of greater than 20 cubic feet per second. Mean annual flow is the average (actually the arithmetic 'mean') of the annual mean flows over a period of years. Mean annual flow is not the same as 'annual mean flow' which is the average daily flow over one year. The mean annual flow averages out years of low flows with years of normal or above average flows.

- "**Shorelands**" - Areas extending landward 200 feet in all directions as measured on a horizontal plane from the ordinary high water mark (OHWM). On rivers, the shoreland area also includes the entire **floodway** and contiguous flood plain areas landward 200 feet from the floodway.[1]

- "**Associated Wetlands**" – those which are in *proximity* to and either *influence* or are *influenced by* a stream subject to the Shoreline Management Act. The entire wetland is associated if any part of it lies within the area 200 feet from either the ordinary high water mark or floodway.

Determining the minimum shoreline jurisdiction for Tenino involved the following three steps:

1. Determine the water features currently being regulated under the Shoreline Master Program.
2. Determine if any additional water bodies meet the criteria of shorelines.
3. Determine the extent of any associated wetlands or floodways meeting the criteria.

Step 1: The City of Tenino currently regulates those segments of Scatter Creek which lies within in the city limits. The US Geological Survey (USGS) has established the upstream boundaries of the various shorelines for Western Washington. (Kresch,1998). This end point was evaluated by wetland ecologist from the Department of Ecology. Ecology determined that the intersection of the two branches of the Scatter Creek was the upper limits of SMA jurisdiction and there were no associated wetland above that point. The shoreline end point is noted on various figures.

TRPC prepared a report to determine if Scatter Creek met the minimum flow requirements for a "shoreline of the state". The report titled *Preliminary Shoreline Jurisdiction for Bucoda, Tenino, and Yelm SMP Updates* (2010) describes the analytical process use to estimate the streamflow of Scatter Creek at Tenino. The following is a summary from that report.

USGS does not have a gaging station on Scatter Creek. USGS took scattered summer flow measurements of Scatter Creek in 1942, 1944, and 1958. The nearest gaging station within this watershed with multiple year flow records is located at James Road

[1] The SMA defines floodway as "the area, as identified in a master program, that either: has been established in federal emergency management agency flood insurance rate maps or floodway maps, or those portions of a river valley lying streamward from the outer limits of a watercourse upon which flood waters are carried during periods of flooding that occur with reasonable regularity, although not necessarily annually. The floodway is to be identified, under normal condition, by changes in surface soil conditions or changes in types of quality of vegetative ground cover condition, topography, or other indicators of flooding that occurs with reasonable regularity, although not necessarily annually.

at river mile 2.2. Since this is located some 14 miles downstream of the city, it was not used to estimate the streamflows within Tenino.

From 1993 thru 1995, the Thurston County Environmental Health (TCEH) Department monitored Scatter Creek for various water quality parameters and streamflows. Data was collected from three sites near Tenino: Old Hwy 99 South (west of downtown), Old Hwy 99 North (north of downtown), and Old Military Rd (east of downtown) near the SMA endpoint. The upstream flows were converted to the Old Highway 99 Bridge station west of downtown Tenino at river mile 16.66.

Without a gaging station near Tenino, a regression calculation was undertaken between the 13 field flows taken by TCEH and a continuous recording gage on the Skookumchuck River at Vail. A statistical analysis provided a Pearson correlation of 0.944 which indicates a strong correlation between these two sites. Based on the limited flow records taken from 1993 thru 1995 on Scatter Creek at Tenino, a single value formula estimated the annual flow at the Old Highway 99 Bridge at 34.3 cubic feet per second (cfs).

Since Scatter Creek is dry during the summer, a multiple formula equation for three seasons was created. It provided an R^2 of 0.959, which was a better fit than the previous regression. Based on the USGS gage at Vail, this was used to replicate the entire Scatter Creek streamflow records for October 1967 to September 2008. The results of this second calculation were an estimated Scatter Creek streamflow of 32.2 cfs. Both predicted flows of Scatter Creek are well above the 20 cfs threshold for shoreline jurisdiction.

Step 2: TRPC has determined in consultation with Ecology that there are no additional waterbodies that meet the SMA jurisdiction criteria in Tenino. No additional water bodies meet the criteria as a "shoreline of the state".

Step 3: FEMA has mapped the 100-year floodplain within the City and this is used in the SMA jurisdiction mapping.

2.2 Regulatory Framework

The Growth Management Act (GMA) and the Shoreline Management Act (SMA) were amended in recent years to clarify the regulatory framework for critical areas located within SMA jurisdiction:

- After Ecology approves a comprehensive Shoreline Master Program update, critical areas occurring within shorelines of the state will be regulated through the Shoreline Master Program (and not the Critical Areas Ordinance adopted under GMA) Shoreline master programs may adopt critical areas ordinances by reference.

- Shoreline master programs shall provide a level of protection to critical areas located within shorelines that assures "no net loss" of shoreline ecological functions as defined by Ecology guidelines.
- Local governments were given a new option to extend shoreline jurisdiction to include land necessary for buffers for Critical Areas within their Shoreline Master Program.[2]

2.3 Optional Shoreline Jurisdiction

In addition to minimum jurisdiction, the local government may also choose to apply SMA regulations to additional areas, such as:

- Buffers around critical areas associated with a shoreline, or
- All or portions of the 100-year floodplain.

The City of Tenino currently has 70.1 acres in shoreline jurisdiction. That includes those areas traditionally within shoreline jurisdiction (e.g. 200 ft from the ordinary high water mark), wetlands associated with Scatter Creek, but also the 100-year floodplain. Almost all of this area lies within the minimal shoreline jurisdiction with a little over an acre in the optional shoreline jurisdiction. As part of the 1990 *Shoreline Master Program for the Thurston Region*, all seven local communities (including Tenino) adopted the entire 100-year floodplain (this "optional" area) as shoreline jurisdiction. As a part of the SMP Update, Tenino needs to decide if the new SMP will apply to 'optional' or 'minimum' shoreline jurisdiction.

Table 1: Comparison of Existing, Minimal, and Optional Shoreline Jurisdiction

Existing Shoreline Jurisdiction	Minimal Shoreline Jurisdiction	Optional Shoreline Jurisdiction *(Remainder of 100-year floodplain)*
57.15 acres in City	55.86 acres in City	1.29 acres in City
12.98 acres in UGA	12.95 acres in UGA	0.03 acres in UGA

Given the uniform nature of Scatter Creek through Tenino, it is considered to all be one reach. However, there are five segments based upon the city limits which are described in Table 1. Segment A is the only segment within the Urban Growth Area (UGA) boundary. Segment D (north of the elementary and middle school) extends from Ritter Street to Hayden Street is only along the southern bank, with the narrow 100-year floodplain paralleling the creek. Segment E properties are removed from the creek. They lie within 200 feet of the ordinary high water mark or are within the associated wetland. The segment is from the end of Garfield Avenue, to the shoreline end point north of Old Military Road. The optional

[2] RCW 90.58.030(3)(f)(ii): Any city or county may also include in its master program land necessary for buffers for critical areas, as defined in chapter 36.70A RCW, that occur within shorelines of the state…"

shoreline areas are located in Segments A and B. The Tenino minimum shoreline boundaries and segments are shown on Figure 5 in the Map Folio.

Table 2: Minimal Shoreline Jurisdiction in Tenino and its UGA

Waterbody	City or Urban Growth Area (UGA)	Shoreline Reach Segment	Shoreline Length (feet)	Shoreline Area (acres)
Scatter Creek	UGA	**Segment A** 9th Ave W to Old Highway 99	1,212’	12.95 ac
	City	**Segment B** Old Highway 99 to Morningside Dr	2,708’	27.02 ac
		Segment C West City Limits to Fenton Ave	908’	13.20 ac
		Segment D – South Bank Ritter St to Hayden St	3,136’	15.00 ac
		Segment E Garfield Ave to Shoreline End Point	--- *(not adjacent to creek)*	0.64 ac
		TOTAL*	7,964’	68.81 ac

2.4 Critical Areas Regulations

As required by the Growth Management Act, the City of Tenino has adopted a Critical Areas Ordinances (CAO) to protect important habitats and avoid development in hazardous locations. The City updated its Critical Area Ordinances in 2005 based upon the Best Available Science and protection of ecological functions.

The Tenino CAO designates Scatter Creek as a “Fish and Wildlife Habitat Protection Area.” The standards require avoiding alterations as much as possible, and mitigating for unavoidable alterations within a 150-foot buffer area measured from the ordinary high water mark. This buffer is not a no-touch zone, but does include specific limitations on Clearing and Grading; Vegetation Removal, Disturbance, and Introduction; Fencing; Shoreline Erosion Control Measures; Streambank Stabilization; Roads, Trails, Bridges, and Rights-of-Way; Utility Facilities; Public Flood Protection Measures; Instream Structures; Water Conveyance Facilities; On-site Sewage Systems and Wells; New Agricultural Activities; Structures and Landscaped Areas; and Alteration of Watercourses.

The CAO includes provision for averaging, reducing, or increasing the standard buffer widths, depending on site-specific circumstances. The CAO also allows applicants the flexibility to conduct a habitat assessment to determine whether or not a listed critical fish or

wildlife habitat area, point location, and any associated buffers are located on the site for a proposed development.

There are CAO provisions for “Flood Hazard Areas” to address the 100-year Floodplain. Development standards vary based upon the degree of hazard, within the elevation of the first habitable floor above the elevation of the 100-year flood being the principal standard.

The City’s “Wetlands” requirements assign variable buffer widths to wetlands based upon their rating under Ecology’s rating system. The CAO also includes measure for preventing property damage from development on “Landslide Hazard Areas,” however these steep slopes are located outside of the shoreline jurisdiction.

The existing regulations were adopted based on “Best Available Science,” and address protection of ecological functions. The City may want to rely in great part on that existing regulatory framework as part of achieving “no net loss.” One of the goals of the SMP Update is to integrate appropriate development regulations into the Shoreline Master Program, thereby harmonizing Growth Management Act plans within the Shoreline Management Act.

3.0 INVENTORY AND CHARACTERIZATION METHODS

3.1 Methods Overview

The inventory and characterization report documents shoreline conditions within the City limits. The sources for the data and maps are noted in Section 8.1. The inventory was created by reviewing available and existing data and reports in the Section 8.2. There was extensive work by the jurisdictions (Tribes, Cities, County, Regional, State, Conservation District, Non-Profits among others). Geographic information systems (GIS) mapping for the City is included in the Map Folio.

3.2 Approach to Characterizing Ecosystem-wide Processes and Shoreline Functions

SMA guidelines require local jurisdictions to evaluate ecosystem-wide processes during the SMP updates (WAC 173-26). Ecosystem-wide processes that create, maintain, or affect the Town's shoreline resources were characterized using existing data and reports addressing watershed planning, water quality, and floodplain management.

The Washington Department of Ecology undertook a landscape scale assessment of the Upper Chehalis basin, titled *Chehalis Basin Watershed Assessment - Description of Methods, Models, and Analysis for Water Flow Process* (Stanley et al, 2010). While the report's coarse scale watershed characterization is not intended for use at the site scale, it helps place Tenino into its broader watershed context. A summary of relevant portions of the landscape-scale assessment is included in the Section 10 Appendix.

3.3 Approach to Characterizing Jurisdictional Shorelines

The inventory portion of this report is organized into two sections, with supporting maps contained at the end of the report.

> **Section 4 -** contains a regional overview and a city-wide summary of required elements of the shoreline inventory including land use patterns, critical areas, and other areas of interest.
>
> **Section 5 -** characterizes distinct segments of the shoreline based on the inventory, and identifies opportunities for protecting and restoring the shoreline and improving public access.

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4.0. ELEMENTS OF THE SHORELINE INVENTORY

Ecology master program guidelines (WAC 173-26-201(3)(c)) require that the following elements of the natural and built environment be included in the shoreline inventory:

- Land use patterns, including existing structures and impervious surfaces, open spaces, water-related utilities, shoreline modifications, transportation and navigation, and existing and potential public access sites.
- Critical areas, including wetlands, aquifer recharge areas, geologically hazardous areas (landslide, erosion, seismic, and volcanic), habitat and species (listed and priority), and frequently flooded areas (floodways and flood hazards).
- Known historical or archaeological sites.
- Toxic/hazardous waste cleanup sites.
- Other areas of potential interest.
- Opportunity areas include those areas that represent potential for restoration, enhancement or protection.

4.1 Regional Overview

Parts of Tenino are located along the banks of and within the floodplain of Scatter Creek. It is part of the Upper Chehalis Watershed (Water Resource Inventory Area [WRIA] 23). See Figure 2 below.

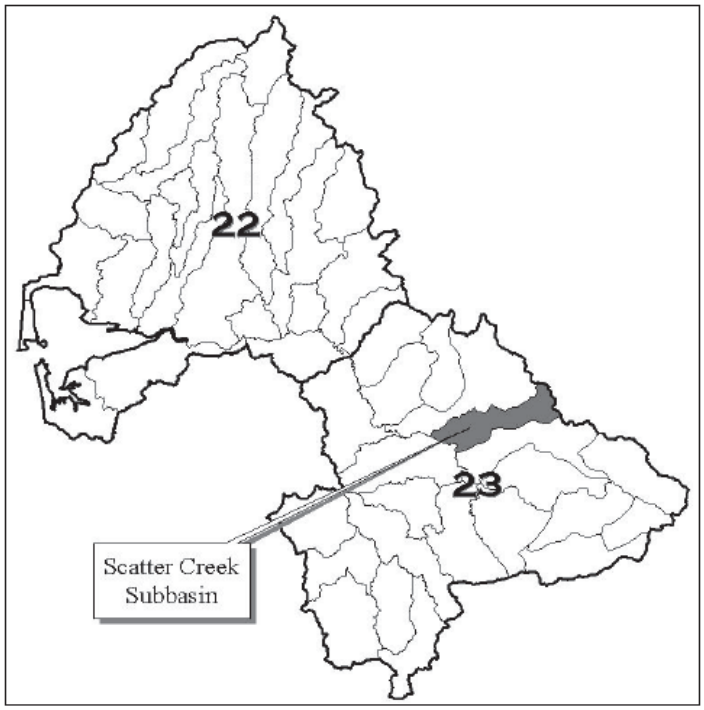


Figure 2: Chehalis River Basin – WRIA 22 & 23

Thurston Regional Planning Council (TRPC) summarizes many types of natural resource data by watershed. The Scatter Creek basin is a part of the 'Chehalis River' watershed in the following tables. That watershed includes about 47,034 acres or 73.49 sq miles.

This TRPC geography is made up of three parts: 1) the Scatter Creek basin, shown above, 2) the Lincoln Creek drainage and 3) areas along the mainstem of the Chehalis River and within southern Thurston County. This mainstem area includes the unincorporated area near the Grand Mount interchange of I-5.

The Scatter Creek basin represents 58 percent of the 'Chehalis River' watershed. It contains 27,423 acres or 42.85 sq miles. The area along the mainstem of the Chehalis River includes 19,611 acres or 30.64 sq miles.

The available data for the Thurston region at the watershed scale is summarized on Tables 2 to 6 (on the following pages). The row for the Chehalis River watershed has been highlighted within each table.

Tables 2 and 3 provide some historical perspective on the predominant conditions within the watershed. Between 1985 and 2000 they show that the Chehalis River watershed had a high percentage of timber harvesting. It also had a moderate percent of urbanization, not as high as the north county urban growth area, but still significant. This likely shows the growth around Grand Mound and Rochester.

Table 4 indicates that 524 acres were converted to urban land cover between 1985 and 2000. This represents one of the higher percentages by watershed, but in terms of actual area fall behind watersheds in the north county urban growth area and the Yelm area.

Tables 5 and 6 use the year 2000 as a baseline, and forecast conditions out to 2030. The year 2000 total impervious land cover (TIA) within 2030 being the forecast year. Within this time period the Chehalis River watershed is expected to see an 81% increase in urban land cover. This places this watershed in the middle range of undeveloped to urbanized watersheds. Table 6 provides a similar forecast for effective impervious area.

Table 3: Estimate of Forest Harvest Activity in Thurston County, 1985-2000

WATERSHED	Total Land Area (acres)	Estimate of Total Forest Lands 2000 (acres)	Total Harvest 1985-2000 (acres)	% of Total Forest Lands 1985-2000
BLACK RIVER	78,971	45,107	8,888	20%
BUDD/DESCHUTES	104,019	59,267	9,842	17%
CHEHALIS RIVER	47,034	21,636	4,763	22%
ELD INLET	23,534	15,593	2,175	14%
HENDERSON INLET	27,170	9,207	355	4%
NISQUALLY RIVER	93,302	55,377	7,318	13%
SKOOKUMCHUCK RIVER	55,163	42,237	15,947	38%
TOTTEN INLET	21,401	16,546	2,833	17%
WEST CAPITOL FOREST	19,272	17,472	3,843	22%
TOTAL	469,867	282,441	55,964	20%

Source: The Rate of Urbanization and Forest Harvest in Thurston County, 1985-2000, TRPC, 2002.

Table 4: Urbanization by Watershed in Thurston County, 1985-2000

		1985-2000 Conversion from:				
WATERSHED	Total Land Area (acres)	Forested Lands (acres)	Agriculture Lands (acres)	Shrub Lands (acres)	Total (acres)	Percent of Total
BLACK RIVER	78,971	4,248	2,110	1,551	7,908	10%
BUDD/DESCHUTES	104,019	4,422	1,427	1,299	7,149	7%
CHEHALIS RIVER	47,034	699	3,264	505	4,468	9%
ELD INLET	23,534	1,193	73	199	1,464	6%
HENDERSON INLET	27,170	1,322	1,470	420	3,212	12%
NISQUALLY RIVER	93,302	6,115	1,275	98	7,489	8%
SKOOKUMCHUCK RIVER	55,163	35	236	20	291	1%
TOTTEN INLET	21,401	519	39	66	623	3%
WEST CAPITOL FOREST	19,272	0	0	0	0	0%
TOTAL	469,867	18,553	9,893	4,159	32,605	7%

Source: The Rate of Urbanization and Forest Harvest in Thurston County, 1985-2000, TRPC, 2002.
Explanations: Conversion designates the loss of one type of land use (forested, agriculture, or shrub) and replacement by an urban landscape. Urban landscapes contain a mixture of built features, landscaping, and natural features.

Table 5: Change in Urban (Built) Land Cover in Thurston County, 1985-2000

WATERSHED	Total (acres)	2000 Urban Cover (acres)	2000 Urban Cover (%)	1985 Urban Cover (acres)	1985 Urban Cover (%)	1985-2000 Increase in Urban Cover (acres)	1985-2000 Increase in Urban Cover (% of Total)	1985-2000 Increase in Urban Cover (% of 1985)
BLACK RIVER	78,971	2,507	3%	1,795	2%	712	1%	40%
BUDD/DESCHUTES	104,019	8,864	9%	7,154	7%	1,710	2%	24%
CHEHALIS RIVER	47,034	2,040	4%	1,517	3%	524	1%	35%
ELD INLET	23,534	932	4%	765	3%	166	1%	22%
HENDERSON INLET	27,170	4,757	18%	3,623	13%	1,135	4%	31%
NISQUALLY RIVER	93,302	4,196	4%	2,998	3%	1,198	1%	40%
SKOOKUMCHUCK RIVER	55,163	693	1%	641	1%	52	0%	8%
TOTTEN INLET	21,401	400	2%	354	2%	45	0%	13%
WEST CAPITOL FOREST	19,272	131	1%	131	1%	0	0%	0%
TOTAL	**469,867**	**24,520**	**5%**	**18,979**	**4%**	**5,541**	**1%**	**29%**

Source: The Rate of Urbanization and Forest Harvest in Thurston County, 1985-2000, TRPC, 2002.

Table 6: Estimate of Total Impervious Area by Watershed

WATERSHED	Total Acres	2000 Land Cover (acres)	2000 Land Cover (percent)	Forecast 2030 (acres)	Forecast 2030 (percent)
BLACK RIVER	78,971	2,640	3.3%	4,894	6.2%
BUDD/DESCHUTES	104,019	9,039	8.7%	12,142	11.7%
CHEHALIS RIVER	47,034	2,214	4.7%	4,022	8.6%
ELD INLET	23,534	944	4.0%	1,564	6.6%
HENDERSON INLET	27,170	4,889	18.0%	6,572	24.2%
NISQUALLY RIVER	93,302	4,354	4.7%	7,355	7.9%
SKOOKUMCHUCK RIVER	55,163	1,422	2.6%	1,699	3.1%
TOTTEN INLET	21,401	400	1.9%	711	3.3%
WEST CAPITOL FOREST	19,272	131	0.7%	131	0.7%
Total	**469,867**	**26,032**	**5.5%**	**39,091**	**8.3%**

Source: Completion of the Future Impervious Area Module Update - January 2007.
http://www.trpc.org/resources/memojan2007.pdf
Note: Estimate includes residential and commercial growth.

Table 7: Estimate of Effective Impervious Area by Watershed

WATERSHED	Total Acres	2000 Land Cover (acres)	2000 Land Cover (percent)	Forecast 2030 (acres)	Forecast 2030 (percent)
BLACK RIVER	78,971	1,828	2.3%	3,515	4.5%
BUDD/DESCHUTES	104,019	6,797	6.5%	9,153	8.8%
CHEHALIS RIVER	47,034	1,541	3.3%	2,893	6.2%
ELD INLET	23,534	681	2.9%	1,147	4.9%
HENDERSON INLET	27,170	3,665	13.5%	4,964	18.3%
NISQUALLY RIVER	93,302	3,134	3.4%	5,409	5.8%
SKOOKUMCHUCK RIVER	55,163	541	1.0%	746	1.4%
TOTTEN INLET	21,401	287	1.3%	520	2.4%
WEST CAPITOL FOREST	19,272	90	0.5%	90	0.5%
Total	**469,867**	**18,564**	**4.0%**	**28,437**	**6.1%**

Source: Completion of the Future Impervious Area Module Update - January 2007. http://www.trpc.org/resources/memojan2007.pdf

Note: Estimate includes residential and commercial growth.

4.2 Climate

Southern Thurston County has a predominantly marine climate characterized by mild temperatures both summer and winter. Extreme temperatures are unusual for the area because prevailing westerly winds bring maritime air over the basin and provide a moderating influence throughout the year.

During the spring and summer, high-pressure centers predominate over the northeastern Pacific, sending a northwesterly flow of dry, warm air over the basin. The dry season extends from late spring to midsummer, with precipitation generally limited to showers during this period. Average summer temperatures are in the 50s and 60s degrees F, although hot, dry easterly winds that occasionally cross the Cascade Mountains can raise daytime temperatures into the 90s.

In fall and winter, strong winds and heavy precipitation occur throughout the basin. Storms are frequent and may continue for several days. Successive secondary fronts with variable rainfall may move onshore daily or more often. Heavy rainfall frequently is produced by these storms when warm, saturated air rises over the coastal range and west slopes of the Cascades.

Southern Thurston County and the area around Tenino receives moderate to heavy rainfall when storms move onshore and through the basin. Normal annual precipitation at the closest rainfall gage in Centralia is 41.6 inches, with 77 percent falling during the period October through March. By comparison the average for the last 28 years at the Olympia Airport is 49 inches (Romero, 2009).

Snowfall in the region is generally low. The average annual snowfall is approximately 9 inches, with a recorded extreme maximum of 45 inches. Most of the snowfall occurs in January, with an average of about 4.5 inches (USACE, 2003).

4.3 Geology

The underlying geology of the study area is the end product of long term-tectonic, glacial, fluvial, and hillslope processes occurring at the western end of the North American plate for over 40 million years (e.g. Snavely et al,1958; Noble and Wallace, 1966; Drost et al, 1998; and Logan et al, 2009). Glacial processes dominate the surficial deposits and landforms in the South Puget Sound lowlands. The complex geologic history of the region can be boiled down into three general time frames, ordered here from oldest to newest.

From 50 to 2 million years ago, volcanism and marine deposition formed bedrock which is now the basement rock that underlies the study area at depth. This volcanism likely occurred as the North American plate overrode more dense oceanic rocks. All of these rocks have been modified by compression stresses and faulting toward the end of this period. These rocks are typically referred to as the 'Tertiary bedrock' denoted on regional geology maps (WDNR, 2010).

Next, the landscape underwent glacial and inter-glacial periods between 2 million to 14,000 years ago. For much of the Pleistocene epoch, multiple continental glaciations have occurred that have provided the raw materials and shaped much of the modern landscape in the Puget Sound lowlands. The Vashon stage, ending around 14,000 years ago, was the most recent period where the study area was covered with glacial ice. Meltwater patterns from the retreating ice carved complex drainageways that likely included an outlet from the Puget Sound lowlands to what is now the Chehalis River and Grays Harbor. Significant deposition of coarser (outwash) and finer (till and lacustrine) glacial layers occurred during this period, resulting in unconsolidated deposits (Noble and Wallace, 1966; Drost et al, 1998; Logan et al, 2009).

Finally, from 14,000 years ago to present, the post-glacial reorganization occurred following the recession of the large ice sheets. New drainage patterns formed when fluvial and hillslope processes modified the surficial landforms throughout the study area. The advance of ice in the Puget Sound lowlands is now thought to be near the ridgeline of Chain Hill and the other unnamed hills to the north of Tenino. The Tenino valley likely became an outwash path of meltwater originating from the Tenalquot Prairie north Rainier. Both the Olympia Lobe and the Yelm Lobe of the Vashon glacier contributed to this meltwater flow (Noble and Wallace, 1966; Logen, et al, 2009).

The current WDNR state geology map places Tenino within a small valley of recessional outwash. This extends south of Old Highway 99 Bridge onto Rock Prairie south and west of the city. Noble and Wallace, 1966, provides a slightly more detailed view. According to the geologic map this band of alluvium parallel to Scatter Creek is discontinuous though the city and terminates to the west of the Burlington Northern Santa Fe (BNSF) Railroad crossing.

However, a comparison to the Thurston County Soils Map indicates this is not the case and is likely an artifact of the course scale geology in this portion of the county (USDA, 1990).

The hillsides around the city are comprised of marine, brackish-water, and nonmarine sedimentary rocks (Snavely el.al. 1958). This is the source of the native Tenino Sandstone which was mined by the various sandstone quarries. The majority of most valley hillsides are comprised of undifferentiated drift which were laid down prior to the most recent (Frasier) glaciation period. Also, to the south is an andesite flow of Northcraft Formation located under Northcraft Mountain.

4.4 Surface Water Runoff

Scatter Creek originates within the Tenino valley to the east of the city. Some 'old-timer' accounts indicate that McIntosh Lake once flowed into the Scatter Creek drainage, but it now flows to the Deschutes River. According to the *Catalog of Washington Streams and Salmon Utilization*, Scatter Creek is about 20.6 miles in length (Williams, et al, 1976).

Stream flow generated within the Chehalis River basin originates primarily from rainfall, although snowmelt occasionally augments runoff in the highest elevation reaches. Stream flows in the basin show seasonal variation characterized by sharp rises of short duration from October through March, corresponding to the period of heaviest rainfall. After March, flows tend to decline gradually to a relatively stable baseflow, which is maintained from July into October.

Significant portions of Scatter Creek are seasonally dry. This appears to the typical summer month condition upstream of I-5 until the autumn rains arrive. "During a site visit in early November of 2002, Scatter Creek was dry through the city of Tenino, and throughout a long stretch of stream extending from the Colvin property (between approximately river mile 12 and 13) downstream to approximately river mile 7 immediately downstream of a commercial aquaculture facility that has been in operation since 1978" (Parametrix, 2003).

The upper Chehalis River experiences major flooding occurs during the wet season, usually from November through February. There is some flooding along Scatter Creek, but outwash dominated prairies can experience a condition called 'groundwater flooding'. Once these extensive areas of outwash soils are fully recharged by local rainfall, low lying areas can pond or flood independently from any riparian flood events. Since areas of high groundwater are relatively flat, flood waters can remain standing for several months. Flood waters resemble ponds or lake like conditions (Brewster, 2009).

This geohydrologic condition is unique to only a handful of locations within the US, and locally was the first noted during the flood of 1972. The most recent groundwater flooding events occurred in the winter of 1996-97, and then again in the winter of 1998-1999. The lower reaches of Scatter Creek drainage were affected during these groundwater flooding events (Brewster, 2009). Thurston County Emergency Management records show that more than 50 percent of the private property damage occurred on lands outside the mapped FEMA

100-year floodplain; and a US Army Corps of Engineers report notes that the frequency of a groundwater flooding is probably on the order of every 25 years (Morrison, 1999).

4.4.1 Flood Hazards

Table 8: City of Tenino - Hazard Mitigation Initiatives
(Brewster, 2010)

Priority	I.D. Number	Category	Action	Status
1 of 10	TEN-MH 3	Critical Facilities Replacement/Retrofit	Retrofit Tenino High School for generator hookup capability.	New
2 of 10	TEN-MH 1	Critical Facilities Replacement/Retrofit	Purchase and install a 20KW generator at the Tenino Police Building.	Modified
3 of 10	TEN-FH 1	Public Information	Flood Hazard Education and Community Outreach	New
4 of 10	TEN-FH 2	Data Collection and Mapping	Scatter Creek Stream Gage Installation and Data Monitoring	New
5 of 10	TEN-FH 4	Data Collection and Mapping	Flood Hazard Analysis and Project Prioritization	New
6 of 10	TEN-FH 3	Data Collection and Mapping	Flood Hazard Mitigation Review of City Ordinances and Best Practice Amendments	New
7 of 10	TEN-MH 2	Critical Facilities Replacement/Retrofit	Retrofit the Tenino City Fire Hall building and set up an alternate disaster command center.	Modified
8 of 10	TEN-MH 5	Hazard Preparedness	Construct third well and redundant reservoir above City Park.	New
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.	New
10 of 10	TEN-EH 1	Data Collection and Mapping	Fund engineer study of potential seismic retrofits for historical buildings.	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.

4.5 Groundwater Patterns

While Scatter Creek is the principle aquatic resources within the study area, groundwater flow is largely dependent upon infiltrated rainfall. The glacial deposits within the Tenino valley overlay older geologic units or Vashon Till. Groundwater aquifers and flow patterns have been investigated in the past by the USGS (Snavely et al 1958), with the most recent report being printed over 40 years ago (Noble and Wallace, 1966). These studies only identified a few geologic units within the study area.

In the Tenino valley east of downtown, there are thought to be two aquifers separated by hardpan. In the valley bottom, the groundwater table can be found within 10 feet of the surface, particularly during the winter months. Wells near the center of the valley flowed up to 250 gallons per minute and are 30 to 70 feet in depth. Along the hillsides of the valley there is little groundwater (Noble and Wallace, 1966).

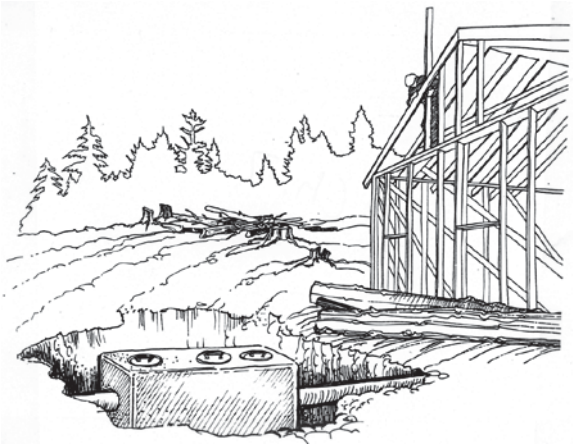
Figure 7 in the Map Folio is a cross section of the Scatter Creek aquifer generally from I-5 to Tenino. It was prepared by the Thurston County Environmental Health Department based upon the available wells logs throughout 2007.

4.6 Water Quality Processes

The quality of the water flowing through aquatic systems is the end result of the interaction of water with biota, soils, and urban and rural land uses, and infrastructure. Ecosystem processes that impact the source, concentration, and transport of mineral and organic constituents are: biotic uptake (e.g., plant growth), decomposition (e.g., plant death), adsorption (e.g., chemical binding), and dissolution (e.g., chemical unbinding). In general, elements cycle between dissolved and particulate forms in water to plants, animals, and soils; and back to the water column via decomposition.

Processes that influence water quality occur over a variety of scales. As water moves through an ecosystem, it has the opportunity to cycle (deposit, uptake, entrain, and/or transport) mineral and organic constituents that can affect water quality. The longer water is able to contact soil and vegetation, the more cycling can occur. Longer water contact times typically occur in low gradient areas in the landscape such as riverine and depressional wetland systems. Water contact time is shorter in areas where rivers have been channelized, and the floodplain filled and paved.

Some of the more common alterations to water quality processes within the study area are as follows:

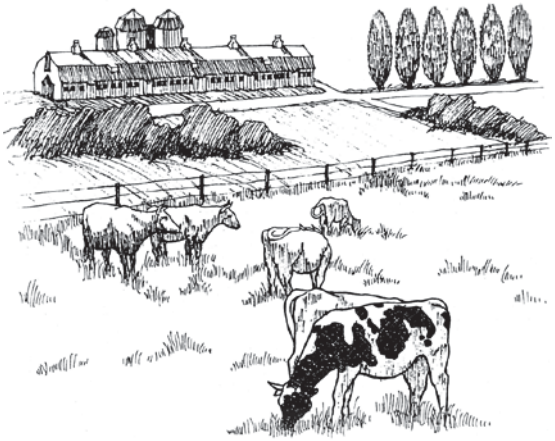


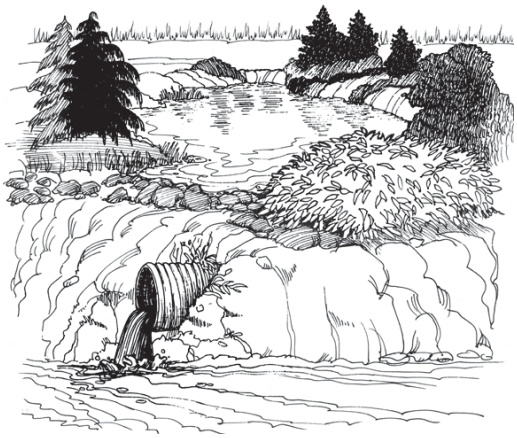
On-Site Systems: Tenino has transitioned from all on-site septic systems to a Class A - reclaimed water, wastewater treatment facility located on Rock Prairie. The facility was complete in late 2009, and now all structures in the city are connected (City of Tenino, 2009 & 10).

During this transition it was noted that "almost 30 percent of the all existing onsite-septic systems were failing or had failed prior to connection with the sewer" (The Tenino Independent, March 31, 2010).

Agricultural Practices: Outside of Tenino poor animal keeping practices can be the source for high nutrient loading and Fecal Colifrom. Unrestricted livestock access has been identified as a problem for several stretches along the creek (Pickett, 1994).

Priority areas for Agricultural Best Management Practices and follow-up monitoring are between Interstate 5 and the Old Highway 99 Bridge west of downtown, and that portion of Scatter Creek to the east Old Military Road (Rountry, 2004).





Stormwater: The installation of impervious surfaces and stormwater conveyance infrastructure can bypass natural hydrologic pathways that include infiltration and percolation through soils.

Constituents that can negatively impact water quality (e.g., metals, oils and grease, nutrients, bacteria) can build up on impervious surfaces, to be washed off during storm events.

4.7 Water Quality

Water quality alterations can be generally assessed by comparing water quality in streams and rivers to State water quality standards. The Washington Department of Ecology (WDOE) maintains a database of water bodies where known water quality issues exist, known generally as the 303(d) list. Two segments of Scatter Creek near the mouth are on the 2008 list as Category 4a - for: 1) Temperature, and 2) Fecal Coliform. Upstream segments of Scatter Creek (including Tenino) are only listed for Fecal Coliform. This indicates that they are included in the pollution reduction plan (TMDL) adopted by USEPA in 2004. Another parameter, pH, is listed as a Category 2 "*Water of Concern"* where there is some evidence of a water quality problem, but not enough to require action at this time. (WDOE, 2008 Water Quality Assessment Tool).

In 2004, the U.S. Environmental Protection Agency (USEPA) adopted a clean-up plan for multiple basins within the Upper Chehalis Watershed. This document contains a prioritized list of follow-up actions, with many of the implementation measures derived from a series of other technical documents. The table lists Scatter Creek for impairments to dissolve oxygen and temperature at the mouth (James road). Upstream at river mile 8 (near Gibons Road), Scatter Creek is listed as a priority of 5 of 22 for Fecal Coliform, and at river mile 19 (east of Tenino) 19 of 22 also for Fecal Coliform (Rountry, 2004).

Generally, water quality in the Scatter Creek is defined as "good" by the Thurston County Environmental Health Department. In water year 2007/08, there was one turbidity measurement, and the creek has elevated nutrients (TCEH, 2010).

Temperature

Thurston County Environmental Health Division began monitoring Scatter Creek in September 1993. The current monitoring program consists of two sampling sites. The downstream-most station is located at James Road near Scatter Creek's confluence with the Chehalis River. The upstream sampling site at stream mile 8 is located at the Gibson Road crossing of Violet Prairie. Monitoring done between 1993 and 2002 generally consisted of sample collection during the wet season, December through March, and during late summer and early fall. In December 2003, the sampling frequency was increased to monthly, which now generates twelve data points per year. Scatter Creek at the Gibson Road is in a losing reach (discharging into the ground) and during the summer and early fall becomes a stagnant isolated pool. When that condition exists no sampling is done.

There are two temperature standards that apply in the lower reaches of Scatter Creek. The primary criteria, which applies to the Gibson Road site is a 7-day average daily maximum (DAD-Max) of 16° C which is intended to protect core summer salmonid habitat. An additional temperature criterion of a 7-day average daily maximum of 13° C to protect salmon and trout spawning and incubation applies between February 15 through July 1.

Temperature data collected through this ambient monitoring program are instantaneous measurements. Because there are not continuous temperature recordings from which the 7-day average daily maximum can be calculated, the instantaneous data can only be used as an indicator of possible temperature violations. During the months when the creek was flowing at the Gibson Road site, the temperature measurements were cooler than the maximum temperature criterion. (TCEH - Draft, 2010).

The 2004 USEPA Pollution Clean-Up Plan for the Upper Chehalis Watershed identified the need for additional shade along the Scatter Creek as a means of reducing stream temperatures. That plan calls for increasing the existing shade levels along the creek by 12% (Rountry, 2004).

The 2001 Limiting Factors Report suggests that the riparian conditions and shade for Scatter Creek are considered to be 'poor', and it notes that there are extensive areas of 'low' mean canopy cover. The loss of tree canopy was primarily due to agricultural conversion. Measures suggested to improve these conditions are described in section 4.8.

Fecal Coliform

The state water quality standard for fecal coliform bacteria has two parts: Part 1 - the geometric mean shall not exceed 100 colonies per 100 milliliters of sample and, Part 2 - no more than 10% of the samples shall exceed 200 colonies per 100 mL.

Both parts of the fecal coliform standard were met in water years 2007/08 and 2008/09. The water quality standard for dissolved oxygen is a lowest one-day minimum of 9.5 mg/L. There have been no violations since 2000. The water quality standard for pH requires the pH to be within the range of 6.5 to 8.5. The creek met the pH standard in 2007/08 and 2008/09 (TCEH, 2010).

4.7.1 Toxic and Hazardous Materials

There are number of chemicals and petroleum products that are identified as toxic or hazardous by the Washington State Department of Ecology. It maintains a database of known and suspected contamination sites which may included: sites of known contamination, the location of landfills and dumps, areas of elevated nitrate and chloride levels as well as pesticide contamination. The data includes site name and address, contaminant group and media, and remediation status.

A review of the records indicates that there are six sites located in city which are most leaking underground storage tanks from former gas stations. None of these sites are located within shoreline jurisdiction (TCEH, 2009).

4.8 Habitats

Tenino is located at the southern extent of the Puget Trough province. This ecosystem is dominated by the presence of a broad coniferous forest but can include river floodplains, and other features, such as prairies (e.g., Frost Prairie south of Tenino) and oak woodlands (e.g. along Scatter Creek).

The freshwater aquatic systems of this region are highly influenced by the presence of a formerly ubiquitous forest. Large wood (known as Large Woody Debris [LWD]) significantly influences the geomorphic form and ecological functioning of riverine and lacustrine ecosystems in the Pacific Northwest. LWD consists of logs or trees that have fallen into a river or stream.

In a natural system, LWD provides organic material to aquatic ecosystems and is considered a principal factor in forming stream structure and associated habitat characteristics (e.g., pools and riffles). Riparian vegetation is the key source of LWD. LWD is primarily delivered to rivers, streams, or wetlands by mass wasting (landslide events that carry trees and vegetation as well as sediment), windthrow (trees, branches, or vegetation blown into a stream or river), or bank erosion (Stanley et al, 2005).

The presence, movement, storage, and decomposition of LWD influence shoreline functions as follows:

- Delivery of wood and organics affects vegetation and habitat functions such as instream habitat structure (pools and riffles) and species diversity; and
- Riparian vegetation and LWD, provides habitat in the form of nesting, perching, and roosting as well as thermal protection, nutrients, and sources of food (terrestrial insects) to a variety of fish and wildlife species.

The 2001 limiting factors report prepared for the Upper Chehalis Watershed (WRIA 23) notes that Scatter Creek has some challenging conditions for salmon and steelhead. While

the instream large woody debris was considered to be ‘good’, it shade and riparian conditions are both noted as ‘poor’. While the number of pools in the lower stream (below I-5) is ‘good’ the upper segments, which include that in the City of Tenino, go seasonally dry.

The sediment quality is rated as ‘poor’ which has excessive sedimentation in many reaches, some with unrestricted animal access. The creek also has a high road density per square mile of watershed. Because the energy in the creek is low, armoring of the shoreline is not an issue, and there are no reported fish blockages on the mainstem of the creek (Smith and Wenger, 2001).

The addition of riparian vegetation along Scatter Creek is noted in the 2001 limiting factors report. It suggests the following high priority actions to improve the riparian conditions (Smith and Wenger, 2001):

GOAL:

- Open three or more miles of good quality habitat used by at least one stock of salmon or steelhead.

Restoration Actions:

- Implement (the) TMDL for water temperature and pH. Address fecal coliform as it relates to increased BOD loads.
- Increase instream LWD to help address channel incision and flow issues. This includes appropriate riparian restoration to result in better future LWD levels.
- Reduce livestock access to streams.
- Provide education regarding the impacts of livestock access and increase enforcement.
- Revegetate open riparian areas with native plants including conifers in appropriate places.
    - Plant oaks and appropriate under-story plants in appropriate prairie areas. *(Moderate priority)*
    - Interplant conifer into hardwood riparian areas that were historically conifer areas. *(Moderate priority)*
    - Plant conifer adjacent to and outside existing and limited existing conifer hardwood riparian areas. *(Moderate priority)*
- Increase activities that lead to natural recharge of the aquifers and maintain or improve hydrological maturity.
- Restore wetlands and off-channel habitat.
- Reduce water withdrawals from both surface and ground sources.
- Increase activities that lead to natural recharge of the aquifers and maintain or improve hydrologic maturity.

Currently, there are no restoration proposals for within the vicinity of Tenino according to *The Chehalis Basin Salmon Habitat Restoration and Preservation Work Plan for WRIAs 22*

and 23 (Napier et al, 2008). The Thurston Conservation District has been working on three fish barrier correction projects. They are located at river mile 23.01, on a tributary to Scatter Creek, just north of Tenino and east of Old Highway 99. The project was funded by the Family Forest Fish Passage Program, and construct occurred in the summer of 2010 (Kuttle, 2010).

4.8.1 Priority Habitats and Species of Concern

The Washington Department of Fish and Wildlife (WDFW) maintain a habitat database with the most current locations of "Priority Habitats and Species" and "Species of Concern." In general, priority species and their habitats are in sharp decline within Western Washington. Priority species include those with the concerns of extinction. These may be listed by the state or Federal government as "endangered" or "threatened." Examples might include the Bald Eagle or the Peregrine Falcon. The habitat database also includes species which are considered to be "sensitive" or "monitored", such as the Olympic Mudminnow.

Along Scatter Creek there are two species of salmon: Coho and winter Steelhead. Resident cutthroat trout are also present, but the extent of fisheries habitat within this basin is limited by the creek being dry during much of the summer. Mink and Wood duck are known to reside within the Scatter Creek floodplain.

In addition to state and federal regulations protecting endangered species, local governments adopt regulation to protect priority habitats and species of concern. In the City of Tenino regulations are contained with the local Critical Areas Ordinance (CAO). In Tenino they are referred to as Critical Fish and Wildlife Habitat Areas (BCC 18D.40). The specific CAO regulations which apply are summarized in Section 2.4.

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5.0 REACH SCALE INVENTORY AND ASSESSMENT

5.1 Tenino Shoreline Reach Segments

Given the uniform nature of Scatter Creek through Tenino, it is considered to all be one reach. However, there are five segments based upon the City limits which are described in Table 9 below, and on Figure 5 in the Map Folio.

Table 9: Tenino Shoreline Reach Segments

Waterbody	City or Urban Growth Area (UGA)	Shoreline Reach Segment	Shoreline Length (feet)	Shoreline Area (acres)
Scatter Creek	UGA	**Segment A** 9th Ave W to Old Highway 99	1,212'	12.95 ac
	City	**Segment B** Old Highway 99 to Morningside Dr	2,708'	27.02 ac
		Segment C West City Limits to Fenton Ave	908'	13.20 ac
		Segment D – *South Bank* Ritter St to Hayden St	3,136'	15.00 ac
		Segment E Garfield Ave to Shoreline End Point	NA *(Removed from creek)**	0.64 ac
		TOTAL*	7,964'	68.81 ac

- **Segment A** - lies south of Old Highway 99. It is outside the City within the Urban Growth Area (UGA) boundary.
- **Segment B** – is located north of Old Highway 99. Historic sandstone quarry and access road with creek crossing.

  (Scatter Creek in Thurston County)
- **Segment C** – is a short segment between the BNSF mainline and the Tenino High School.

  (Scatter Creek in Thurston County)
- **Segment D** – lies along the south bank of Scatter Creek north of Tenino Elementary and Middle Schools.

  (Scatter Creek in Thurston County)
- **Segment E** – is a small area within 200 feet of Scatter Creek and/or in the associated wetland. Only limited areas within the City from end of Garfield Ave to the branching of Scatter Creek, which is the end of shoreline jurisdiction.

5.2 Tenino Shorelines *(Western City limits to Shoreline End Point)*

Summary: Within Tenino the minimum shoreline jurisdiction extends from the western City limits to the shoreline jurisdiction end point. The end point is where Scatter Creek branches and is located about midway from Reynolds Street (extended) to Old Military Road, and lying to the north of Old Military Road. While Scatter Creek extends further to the east, it is not considered a "shoreline" beyond that point. The segments in the City are interspersed with segments that are located in unincorporated Thurston County. The segments within the City and its UGA total approximately 7,964 feet in length and 68.81 acres.

Photo 3: Old Highway 99 Bridge West of Downtown
Segment A (foreground) and Segment B beyond the bridge - TRPC, Oct 2009

Photo 4: Scatter Creek Shoreline – Segment A
Downstream of Old Highway 99 Bridge west of downtown - TRPC, 2010

5.2.1 Existing and Future Land Use (Zoning), Existing Shoreline Designation

Existing and Future Land Use (Zoning): Land uses within the Tenino minimum shoreline jurisdiction ranges from low density residential to Planned Industrial Park. For the most part, there are few residences within shoreline jurisdiction and a number of parcels with no improvements. The extents of Tenino shoreline jurisdiction is shown on Figure 5 in the Map Folio.

- **Segment A** – Within this portion of the Tenino Urban Growth Area (UGA) boundary, there are 3 parcels & 2 residences, City zoning is *Single Family Environmentally Sensitive* (off of Huston Street), and County zoning of *Rural Residential Resource 1 per 5 acres*.
- **Segment B** – 15 parcels & 9 residences, zoned as *Single Family Environmentally Sensitive* (including the former quarry), and 3 parcels as *Pubic – Semi Public* owned by the BNSF Railroad, not including the right-of-way.
- **Segment C** – 10 parcels & no residences, 5 owned by the BNSF Railroad zoned as *Pubic – Semi Public*, 1 parcel zoned *Single Family Environmentally Sensitive*, 1 parcel zoned as *Single Family*, and 2 parcels zoned as *Pubic – Semi Public* in the corner of the Tenino High School grounds.
- **Segment D** – 3 parcels & 2 residences as *Single Family Environmentally Sensitive*. The Tenino Elementary and Middle Schools are located to the south of these parcels.
- **Segment E** – 3 parcels & 2 residences, the wetlands along creek are zoned as *Single Family Environmentally Sensitive*.

Photo 5: Scatter Creek Shoreline – Segment B
South of Morningside Drive - TRPC, 2010

Few of the existing residences are located close to Scatter Creek. The newer residences east of Highway 99 in Segment D have setbacks of 70 and 75 feet. The minimum shoreline setback for a Conservancy shoreline is noted in the following section. Within Segment B the eastern portion of the former Hercules Quarry lies within 30 feet of water's edge, with the quarry floor elevated about 30 feet above the creek. There are some work shacks near the creek (See Photo 9), but there are no permanent structures within the shoreline jurisdiction.

Existing Shoreline Designation: The existing Shoreline Environment Designation (SED) for this reach is "Conservancy". In the Conservancy Environment the shoreline setback was a minimum of 100 feet from the ordinary high water mark, and the minimum lot size of dry land area in one (1) acre. These shoreline standards may supersede the local zoning setbacks and densities (Aaland, 1990).

Table 10: Land Cover, Zoning, and Shoreline Environment Designations

Land Use (Refer to Figure 8)	**Zoning** (Refer to Figure 9)	**Shoreline Environment Designations** (Refer to Figure 5)
Natural Resources Residential Low Density	Rural Residential Resource 1/5 (46%)	Conservancy
Vacant Land	Single Family Environmentally Sensitive (43%)	Conservancy
Utilities	Pubic – Semi Public (11%)	Conservancy

Photo 6: Scatter Creek Shoreline – Segment C
South of Fenton Avenue (McDuff Road Bridge); BNSF Railroad to right - TRPC, 2010

5.2.2 Roads, Railroads, Utilities, Shoreline Modifications

Roads, Railroads and Utilities: Road and railroad crossing are common in most of the Tenino shoreline segments.

- **Segment A** – Old Highway 99 separates Segments A & B.
- **Segment B** – Old Highway 99 separates Segments B & A. The bridge, built in 1923, and the road right of way are located in Segment B. A bridge to the former Hercules Quarry crosses Scatter Creek approximately 950 feet north of Old Highway 99 Bridge. It was reconstructed during the mid-1980s, when the quarry was reopened. At the north end of this segment is Morningside Drive and a bridge across the creek. Just south of the bridge is a City water main crossing. At the Morningside Drive under pass of the BNSF Railroad, there is a dual culvert for flooding overflow placed along an old meander of Scatter Creek.
- **Segment C** – In this segment there is a culvert under the BNSF Railroad mainline. There is also a bridge on Fenton Avenue (McDuff Road) which was rebuilt in 1987.
- **Segment D** – The Highway 99 Bridge north of downtown is located in this Segment. It was rebuilt in 2007.
- **Segment E** – There are no known road, railroad, nor utility crossings in this segment.

Photo 7: Old Highway 99 Bridge North of Downtown – Segment D
North of Tenino Elementary School – TRPC, 2010

Shoreline Modifications: The bridge approaches for these road crossings and the BNSF culvert have been hardened. There is a dual culvert creek crossing on private property about 790 feet north of the Old Highway 99 Bridge west of downtown. Beyond these, there are no other known armored shorelines within the City.

5.2.3 Water Dependent/Oriented Uses

Water Dependent/Oriented Uses: There are no Water Dependent, Water Enjoyment nor Water Related Uses located within Tenino's minimum or optional shoreline jurisdiction.

5.2.4 Historic Sites

Historic Sites: A historic properties inventory report has been prepared for the Hercules #1 Quarry. However, it is not on a "Local," "State," or "National" historic register. See Figure 10 in the Map Folio.

Photos 8 & 9: Hercules Sandstone Quarry – Segment B
North of Old Highway 99 Bridge west of downtown - TRPC, 2010

Photo 10: Scatter Creek Shoreline – Segment B
Bridge to the Hercules Quarry – TRPC, 2010

5.2.5 Public Access and Public Waterfront Land Owners

***Public Access and Public Waterfront Land Owners*:** There are no developed public access sites within City, but there is an informal access along the South side of Old Highway 99 Bridge west of downtown. (See Photo 3) The City may consider the following as opportunities for expanding public access to Scatter Creek.

- The City may wish to explore the opportunities of providing access from the road crossings to the edge of the creek as a means of expanding shoreline public access. These would need to be individually evaluated to determine if they are suitable projects.
- Opportunity Site D (listed in Section 5.27) may include an educational trail to the creek for the elementary and middle school. This would necessitate a conservation easement or similar from the private property owner.
- Once these concepts have been discussed and evaluated, they could be adopted by the City as amendments to the *City of Tenino Park Plan.*

5.2.6 Critical Areas

Floodplains: Floodplains along Scatter Creek include 31.19 acres in the City and 7.23 acres in the UGA. Only one residence in Segment A and two residences in Segment B appear to be located within the FEMA 100-year floodplain. Also known as "Frequently Flooded Areas", they are regulated by the City's Critical Areas Ordinance (CAO). The CAO provides for limited development activity within a 100-year floodplain. These are subject to site requirements and the elevation of new structures above the 100-year floodplain.

Wetlands: There are extensive riparian wetlands along Scatter Creek Wetlands which are concentrated within the 100- year floodplain. Overall, wetlands throughout the City are dominated by reed canary grass, which is an invasive species. City wetlands range from scrub-shrub wetlands in Segment A, to a mixed forested scrub-shrub wetland in Segment B up to the Hercules Quarry access. North of the quarry is a large farmed emergent wetland to Morningside Drive. Segment C is a former farmed emergent wetland. Segments D and E are mixed forested and scrub-shrub wetlands.

Critical Fish and Wildlife Habitat Areas: There are two species of salmon found along Scatter Creek: Coho and winter Steelhead. Resident cutthroat trout are also present. The basin limits the abundance and extent of fisheries habitat by being dry during much of the summer. Mink and wood duck are found within the Scatter Creek floodplain.

Landslide Hazard Areas: There are some steep slopes within the City, but they are associated with existing or past sandstone mining operations.

5.2.7 Opportunity Sites

Within Tenino there are opportunities for providing additional shoreline public access, protecting existing ecological functions, and improving currently degraded habitat improvements. The *City of Tenino Park Plan* does not have any proposals for future public access or public parks along Scatter Creek.

All of the following opportunity sites are on private property, and as such will require willing property owners. These would require voluntary fee-simple acquisition or conservation easements held by a land trust or similar non-profit organization. Two restoration projects in unincorporated Thurston County are also noted below, with all the opportunity sites shown on Figure 12 in the Map Folio.

The potential Opportunity Sites along Scatter Creek within the City of Tenino are as follows:

- ***Opportunity Site A***: Remove obstructions to flow: Segment B – *Private property*
  1) Arrange for legal access across creek from an adjacent property owner,
  2) Remove dual culverts and fill, and
  3) Replant riparian vegetation.
- ***Opportunity Site B***: Reestablish riparian area and shade: Segment B – *Private property*
  1) Obtain conservation easement – donation or acquire with grant funds,
  2) Fence riparian buffer, and
  3) Replant riparian vegetation and trees along the creek.
- ***Opportunity Sites C1 & C2:*** Reestablish riparian area and shade: Thurston County Segments – *Private property – C1: Coordinate with Site B; and C2: Coordinate with Site D*
  1) Obtain conservation easement – donation or acquire with grant funds,
  2) Remove reed canary grass, 3) Replant riparian vegetation and trees along the creek, and
  4) Potential looped interpretive trail with Site D
- ***Opportunity Site D***: Preserve existing riparian area: Segment D – *Private property*
  1) Obtain conservation easement – donation or acquire with grant funds,
  2) Create a possible outdoor classroom with interpretative trail for the elementary and middle school, 3) Potential looped interpretive trail with Site C2.

Photo 11: Scatter Creek Shoreline – Segment D
North of Tenino Elementary & Middle Schools – TRPC, 2010

6.0 DATA GAPS

This section describes specific data gaps or limitations identified during development of the shoreline analysis and characterization as required by Ecology's guidelines. This data gap list is not considered exhaustive, rather a list of sources and/or information need for future updates.

Data missing or not available for this report include:

- **Scatter Creek Stream Gage -** A new mitigation action in the Tenino Hazard Mitigation Annex is the addition of a continuous recording stream gage in the city on Scatter Creek. As noted in Section 2.1 the lack of flow records made the shoreline evaluation of Scatter Creek difficult. Surface flow records would assist the Thurston County Resource Stewardship Department – Water Resource Program to develop a groundwater model for the upper Scatter Creek aquifer.

- **Fencing and Riparian Habitat Sites -** With no current restoration proposal for anywhere near Tenino within the Scatter Creek watershed, the long-term restoration goals of the basins cannot be attained. Additional information is needed from the WRIA 22 Lead Entity and the Thurston Conservation District about specific potential sites for stream fencing and/or habitat restoration opportunities due to past animal keeping practices. These should then be scoped out and prioritized for funding actions.

- **Updated Floodplain Mapping** – The available floodplain mapping for Tenino was prepared by FEMA in the early 1980s. In February 2009, FEMA notified Thurston County it intends to remap the floodplain along the Chehalis River, but it is unclear if this includes Scatter Creek. This is particularly important for Scatter Creek because of the extensive areas of groundwater flooding.

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7.0 SHORELINE MANAGEMENT RECOMMENDATIONS

7.1 Shoreline designations and consistency with zoning

Overall, the condition of Scatter Creek is relatively consistent throughout city limits and the UGA. The creek is mostly surrounded by a wetland complex, which provides significant wildlife habitat, even though it is infested with reed canary grass. The creek suffers from seasonal low flows, poor shade and riparian conditions, and sedimentation, but is home to coho salmon, winter steelhead and cutthroat trout. The creek is primarily undeveloped, with some limited farming and residential development.

These existing conditions suggest that all of the Scatter Creek shoreline should be designated as “Urban Conservancy,” which is generally consistent with the existing SMP designation of “Conservancy”. This would occur throughout the City and on the county shorelines within the UGA. An “urban conservancy” designation could be developed consistent with current city zoning which is primarily “Rural Residential Resource 1/5,” “Single Family-Environmentally Sensitive,” and “Public - Semi Public.”

7.2 Protective regulations and regulatory streamlining

Two primary goals of the local shoreline master program update are to ensure regulations achieve no net loss or ecological functions and to integrate and harmonize with existing GMA plans and regulations. Lands within shoreline jurisdiction are generally protected from significant development under the city’s current CAO.

- The City may consider referencing the CAO as the primary protection mechanism in the SMP, which would achieve both goals.

7.3 Restoration

This report identifies four sites with opportunities for reestablishing riparian areas and shade, and removing a flow obstruction. These opportunities could be further developed in a restoration plan in subsequent phases of SMP development.

- The City may consider consulting the schools on options for linking a possible trail to an education program where students could monitor creek conditions and seek to restore creek functions.

7.4 Public access

Scatter Creek shorelines are all in private ownership, with the exception of public road crossings and bridges.

- The City may consider consulting with Public Works staff on the possibility of improving creek access at public road crossings.
- The City may consider exploring the potential for obtaining a conservation easement on lands associated with the elementary and middle school as an opportunity for an interpretive trail.
- The City may consider consulting the schools on options for linking a trail to an education program where students could monitor creek conditions and/or seek to restore creek functions.

8.0 REFERENCES

8.1 Data Sources

The state master program guidelines state that shoreline inventory and characterizations to support local SMP amendments should be based on scientific and technical information. Inventories should use existing sources of information that are both relevant and reasonably available (WAC 173-26-201(3)(c)).

Data for the following Reach Scale Inventory and Assessment was collected from a variety of sources. Maps and the Geographical Information System (GIS) data were prepared by TRPC. Data for the textual sections was collected from Federal, Tribes, state, county, and regional government agencies, conservations districts, and non-profits. Unless otherwise noted, the sources for the reach scale data are indicated in the inventory template on the following pages.

Feature Name

- 2009 Aerial Photography
- (Thurston GeoData Center, Thurston County)
- Urban Growth Areas line is shown in dashed black and white
- Minimum Jurisdiction is shown in transparent yellow.
- Reaches are mapped on the Ordinary High Water Mark.

WRIA, Watershed, Basin

- WRIAs, Watersheds, Basins – Thurston GeoData Center

Size/Length

- TRPC LIDAR -corrected Hydro GIS Layer

Topography

- Topography – LIDAR – Puget Sound LIDAR Consortium (2002)

Surface Hydrology

- TRPC LIDAR-corrected Hydro GIS Layer and Various Basin Studies (listed below)

Existing Shoreline Designations

- Thurston GeoData Center & TRPC 1975 Regional Shoreline Master Program

Minimal & Optimal Shoreline Jurisdiction

- TRPC calculation - 2009 Aerial Photography, new town boundary, and 1975 SMP map

General Land Cover

- TRPC 2000 Land Cover Analysis and 2009 Aerial Photography

Current Land Use

- TRPC 2006 Buildable Lands Inventory

Future Land Use (Zoning)

- TRPC 2006 Buildable Lands Inventory, and City of Tenino

Water Dependent/Oriented Uses

- TRPC 2006 Buildable Lands Inventory, and research by TRPC staff

Roads

- Roads – Street Atlas of Thurston County; Thurston GeoData Center Roads Data Layer

Railroads, Utilities

- TRPC 2006 Buildable Lands Inventory and 2009 Aerial Photography

Shoreline Modifications

- Basin studies and TRPC observations

Historic Properties

- TRPC Historic Properties Database
- DAHP, Washington Information System for Architectural and Archaeological Records Data (WISAARD)

Public Waterfront Land Owners

- TRPC 2006 Buildable Lands Inventory

Public Access

- TRPC 2008 Regional Trails Plan
- TPRC 2009 Profile
- TRPC 1991 Shoreline Public Access Inventory

Critical Areas

Wetlands

- Wetland Indicators, TRPC

Habitat Conservation Areas

- Based on adopted Critical Areas Ordinances (buffers of streams)

Priority Habitats & Species

- Washington Department of Fish and Wildlife – not mapped due confidentiality per data sharing agreement

Floodplains & Floodways

- 100-year Floodplains – FEMA, Thurston GeoData Center
- Floodways - FEMA, Thurston GeoData Center

Landslide Hazard Areas

- Based on adopted Critical Area Ordinances

Known sites with Toxic or Hazardous Materials

- Elevated Nitrate Areas – Thurston GeoData Center
- Elevated Chloride Levels – Thurston GeoData Center
- Areas of Pesticide Contamination – Thurston GeoData Center
- Landfills and Dumps – Thurston GeoData Center
- Contamination Sites – Washington State Department of Ecology
- Leaking Underground Storage Tanks – Washington State Department of Ecology

Water Quality - State Listings

- United States Environmental Protection Agency—Total Maximum Daily Loads Program
- Washington State Department of Ecology—Surface Water Quality Standards, Water Quality Listings by Category, 2008 Integrated Water Quality Assessments—Surface Water and Sediments

Water Quality - Local Information

- *Thurston County Water Resources Monitoring Report—2008-2009 Water Year, 2008-2009 Water Year*, 2010

Fisheries

- *Thurston County Water Resources Monitoring Report—2008-2009 Water Year*, 2008-2009 Water Year, Thurston County Water Resources, Resource Stewardship Department, 2010.
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9.0 MAP FOLIO

List of Figures - in the Map Folio

Figure 3: Community Location..... 49
Figure 4: 2009 Aerial Photo..... 51
Figure 5: Shoreline Jurisdiction and Environments..... 53
Figure 6: Scatter Creek Aquifer and Tenino..... 55
Figure 7: Cross Section of the Scatter Creek Aquifer 57
Figure 8: 2006 Current Land Use 59
Figure 9: 2010 Current Zoning 61
Figure 10: Public Acess, Public Lands and Historic Sites..... 63
Figure 11: Critical Areas..... 65
Figure 12: Opportunity Sites..... 67

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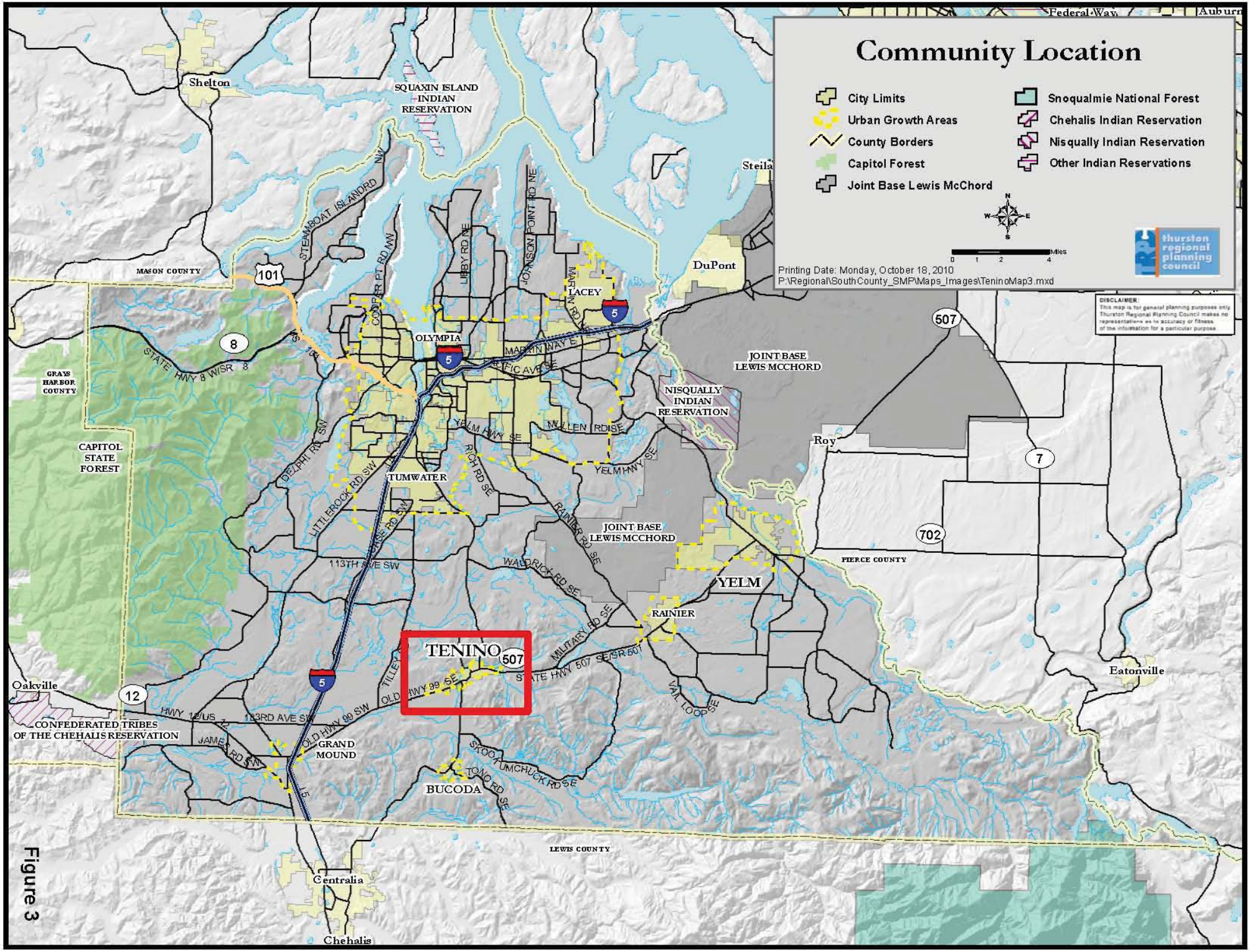
Community Location
City Limits
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County Borders
Capitol Forest
Joint Base Lewis McChord
Snoqualmie National Forest
Chehalis Indian Reservation
Nisqually Indian Reservation
Other Indian Reservations
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thurston 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.
Shelton
SQUAXIN ISLAND INDIAN RESERVATION
Steilacoom
DuPont
Federal Way
Auburn
MASON COUNTY
GRAYS HARBOR COUNTY
CAPITOL STATE FOREST
OLYMPIA
LACEY
TUMWATER
JOINT BASE LEWIS MCCHORD
NISQUALLY INDIAN RESERVATION
Roy
YELM
RAINIER
TENINO
PIERCE COUNTY
Eatonville
Oakville
CONFEDERATED TRIBES OF THE CHEHALIS RESERVATION
GRAND MOUND
BUCODA
LEWIS COUNTY
Centralia
Chehalis
STEAMBOAT ISLAND RD NW
COOPER PT RD NW
LIBBY RD NE
JOHNSON POINT RD NE
MARTIN WAY E
PACIFIC AVE SE
STATE HWY 8 WSR 8
DELPHI RD SW
LITTLEROCK RD SW
YELM HWY SE
MULLEN RD SE
RICH RD SE
RAINIER RD SE
WALDRICK RD SE
MILITARY RD SE
113TH AVE SW
TILLEY RD SW
OLD HWY 99 SE
STATE HWY 507 SE/SR 507
VAIL LOOP SE
HWY 12/US 12
163RD AVE SW
JAMES RD SW
OLD HWY 99 SW
SKOOKUMCHUCK RD SE
TONO RD SE
101
8
5
507
7
702
12

Figure 3

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2009 Aerial Photo

City Limits

Urban Growth Boundary

1,000 500 0 1,000 Feet

N W E S

Figure 4

thurston regional planning council

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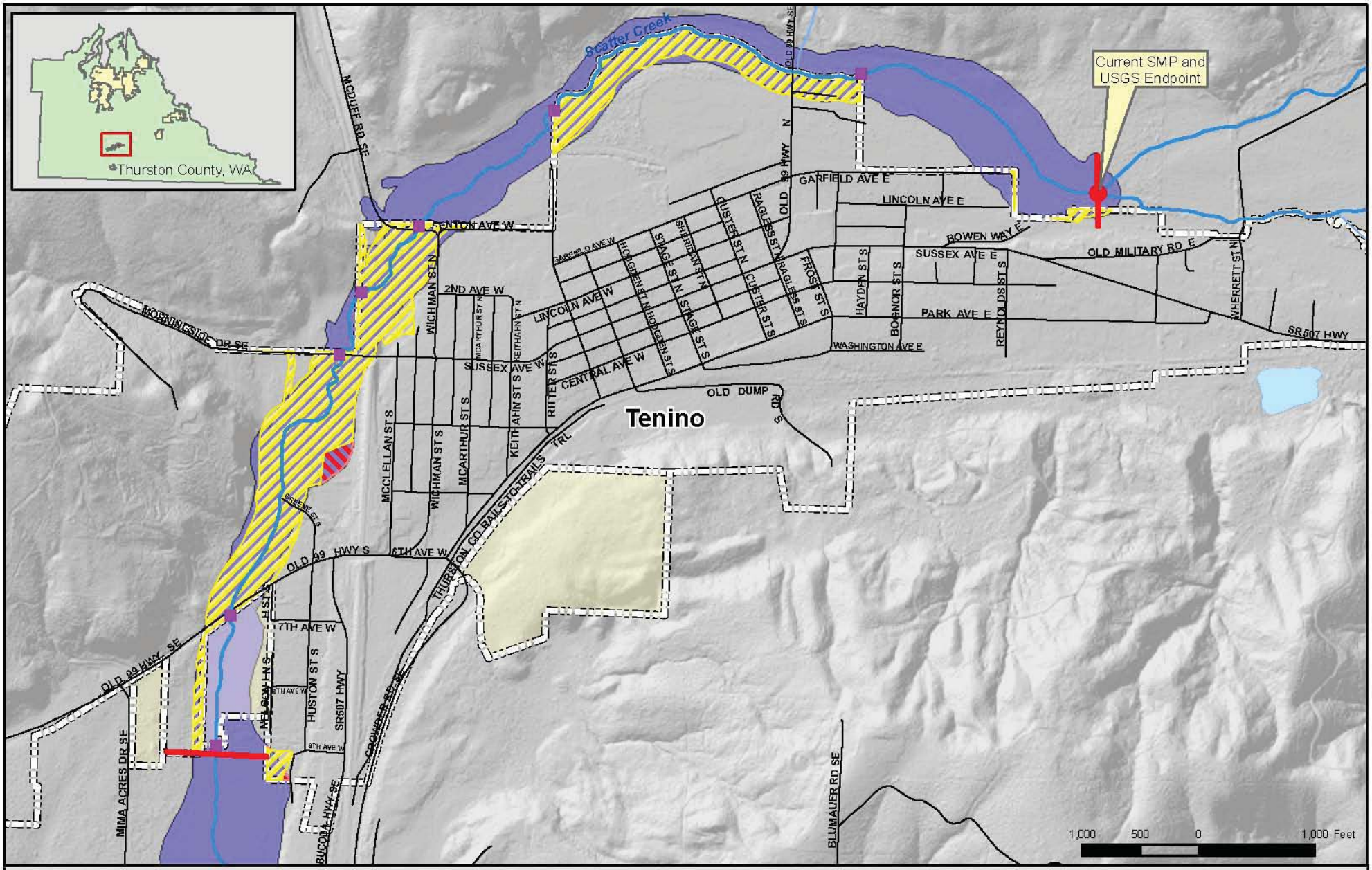

Shoreline Jurisdictions and Environments

Figure 5

Shoreline Jurisdictions

- Minimum Jurisdiction
- Optional Jurisdiction

Existing Shoreline Environment Designations

- Conservancy

- Thurston County Reach Breaks
- Shoreline Endpoint
- Tenino Reach Break
- City Limits
- Urban Growth Boundary

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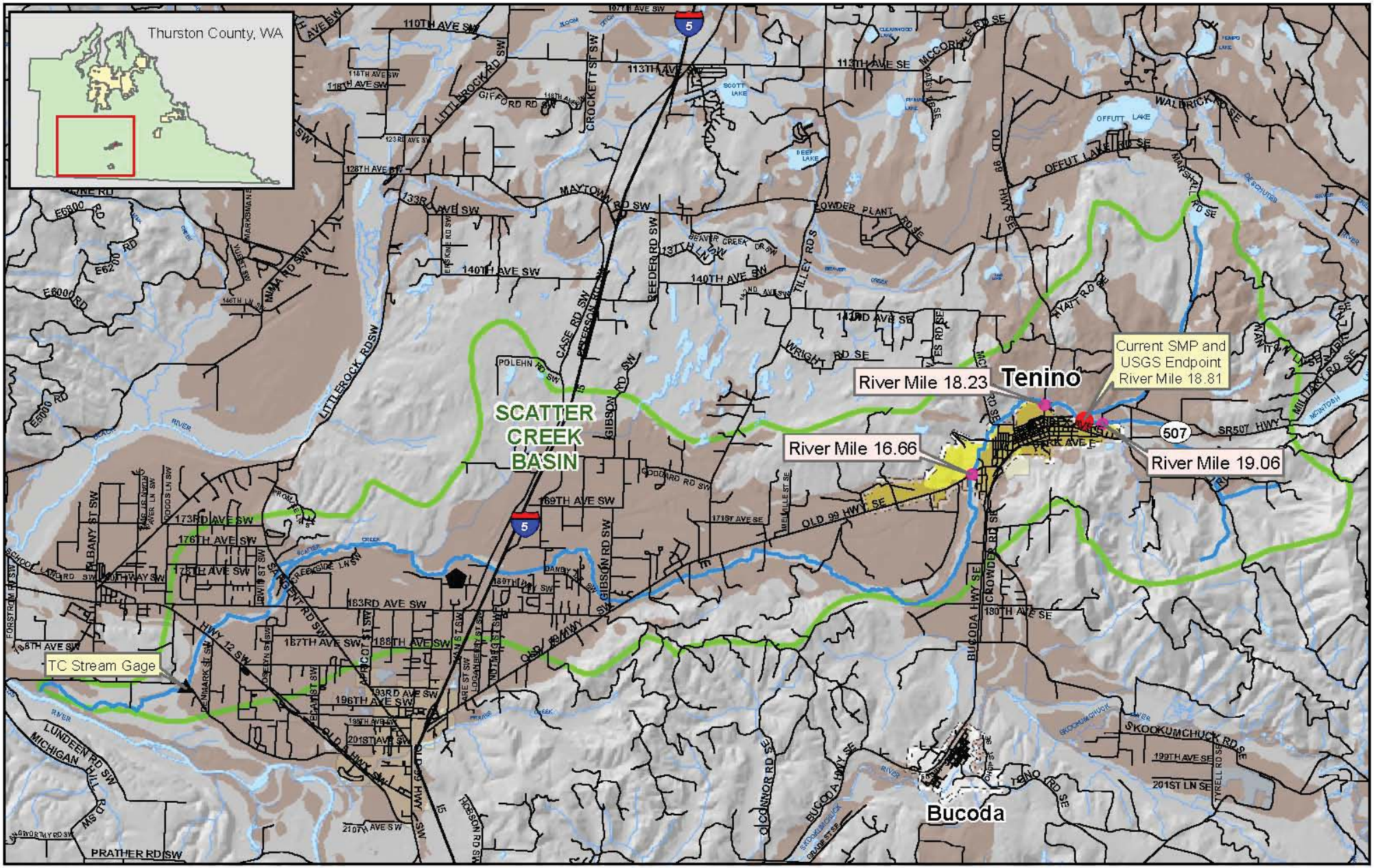

Scatter Creek Basin and Tenino

Figure 6

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- Fish Hatchery
- TC or Other Stream Gage
- Shoreline Endpoint
- Basin Boundary
- City Limits
- Urban Growth Boundary
- City of Tenino
- Outwash Soils

1 0.5 0 1 Miles

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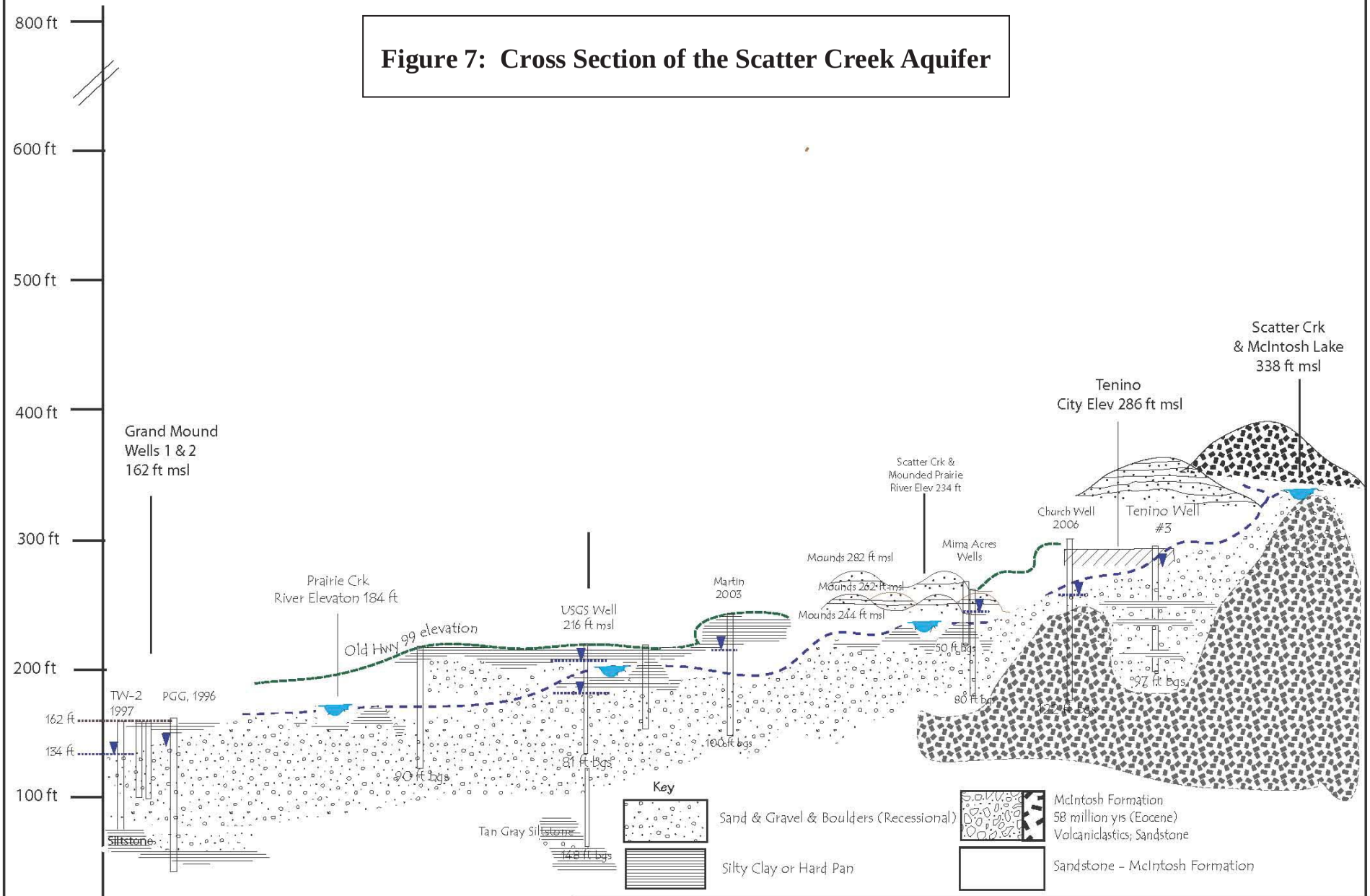
Figure 7: Cross Section of the Scatter Creek Aquifer



Thurston County Environmental Health	Title: Geologic Cross-Section A -A' *DRAFT*	
	Drawn: Nadine L. Romero, Hydrogeologist, L.P.G., L.P.HG.	
Project Site: Scatter Crk	Date: August 7, 2007	FIGURE C

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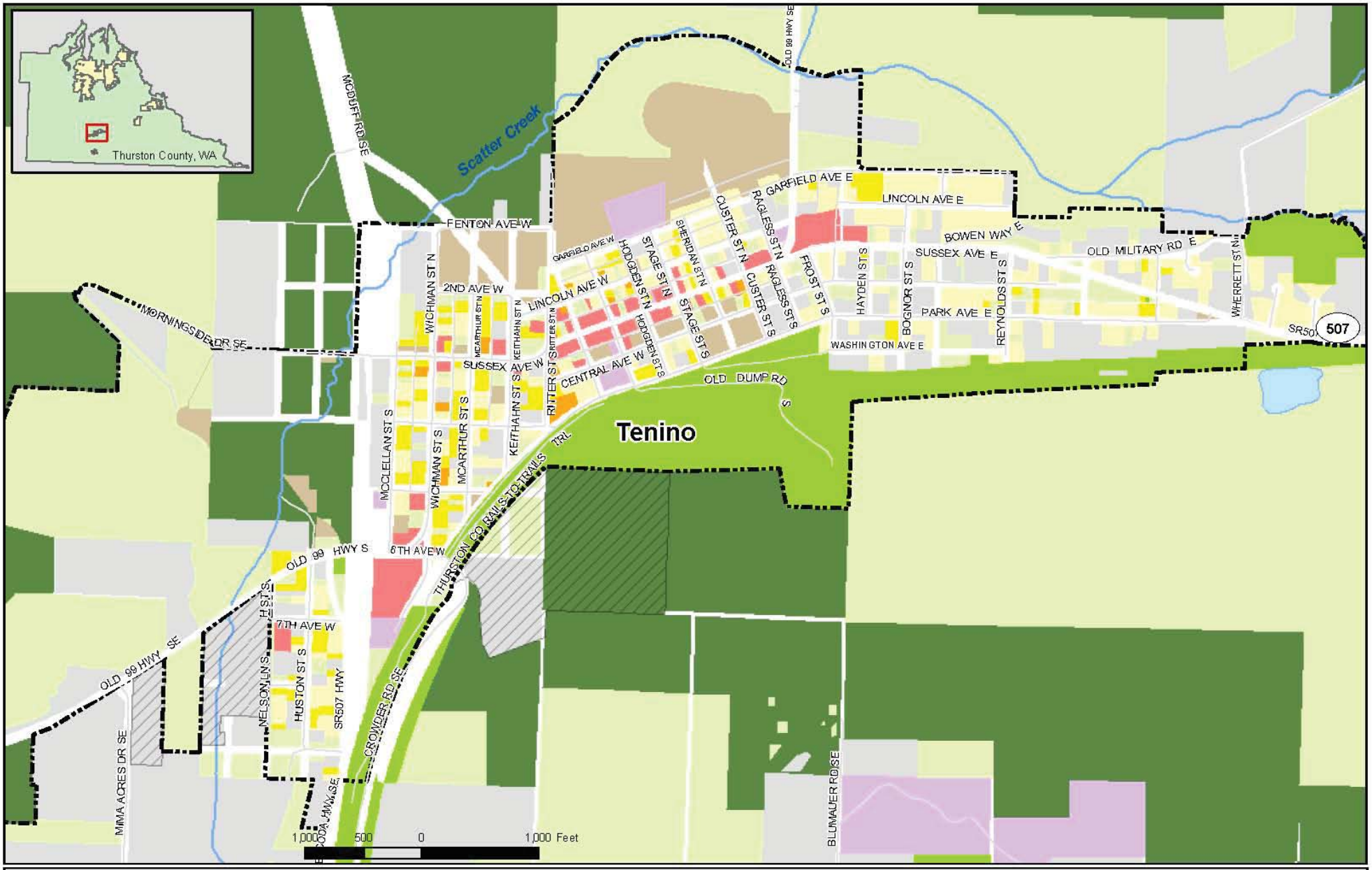

2006 Current Land Use

Figure 8

Commercial
Industrial
Government/Institutional

Residential
- Low Density - 0 to <3.5 du/acre
- Moderate Density - 3.5 to <6.5 du/acre
- High Density - 6.5 to <14.5 du/acre
- Very High Density - 14.5 or more du/ac

Other
- Vacant Land
- Water Bodies
- Natural Resources (Public and Private)
- Parks, Preserves, & Open Space
- Parks Boundaries

City Limits
Urban Growth Boundary

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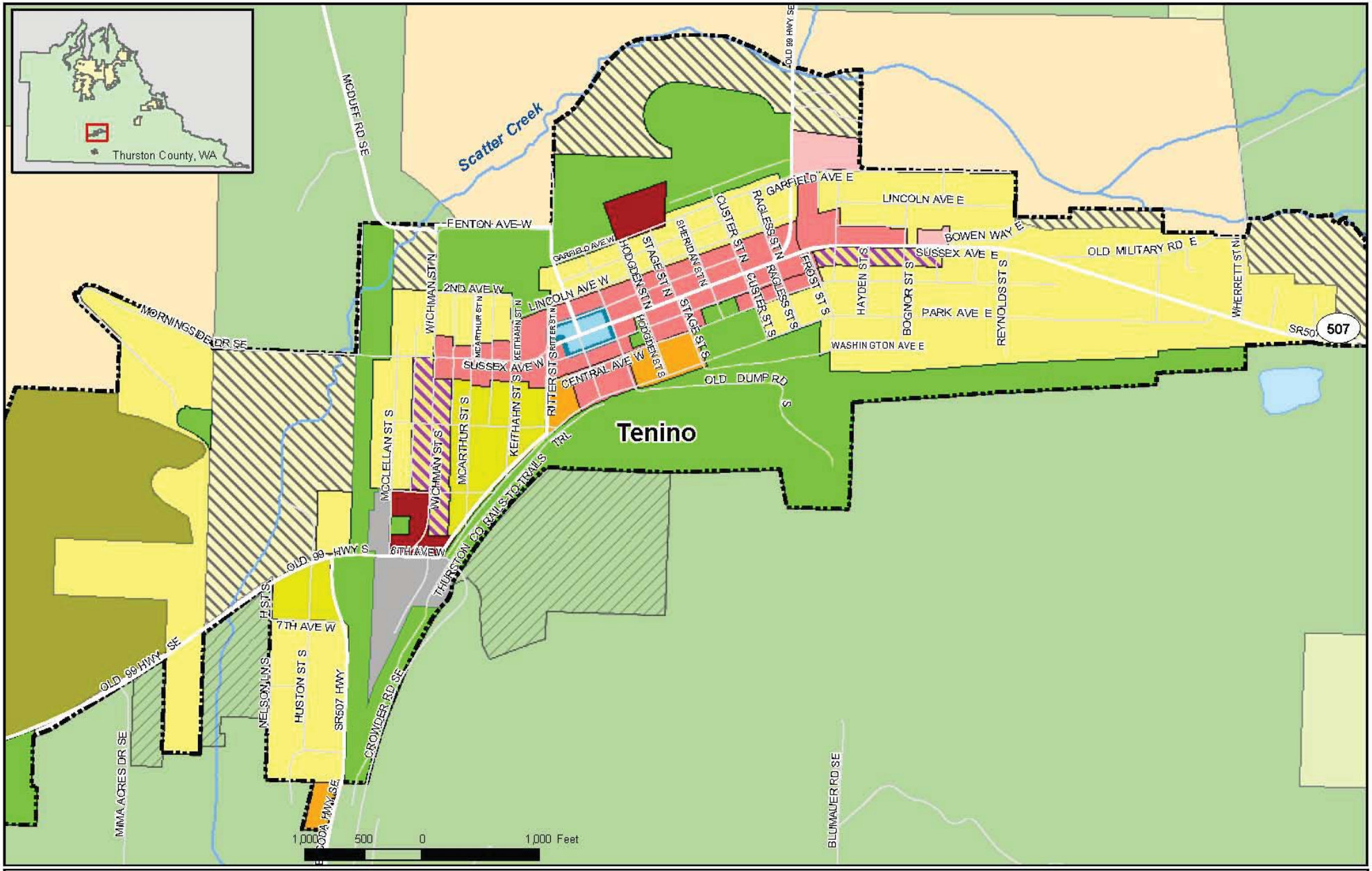

2010 Current Zoning

Figure 9

Historic Preservation
Professional Office Overlay
Single Family ES
Single Family
Single Family Duplex
RRR 1/5
Multi-Family Residential
Mixed Use
Commercial - 1
Commercial - 2
Industrial
Public / Semi-Public

County Zoning
RURAL 1/20
RURAL RESIDENTIAL RESOURCE 1/5
URBAN RESERVE 1/5

City Limits
Urban Growth Boundary

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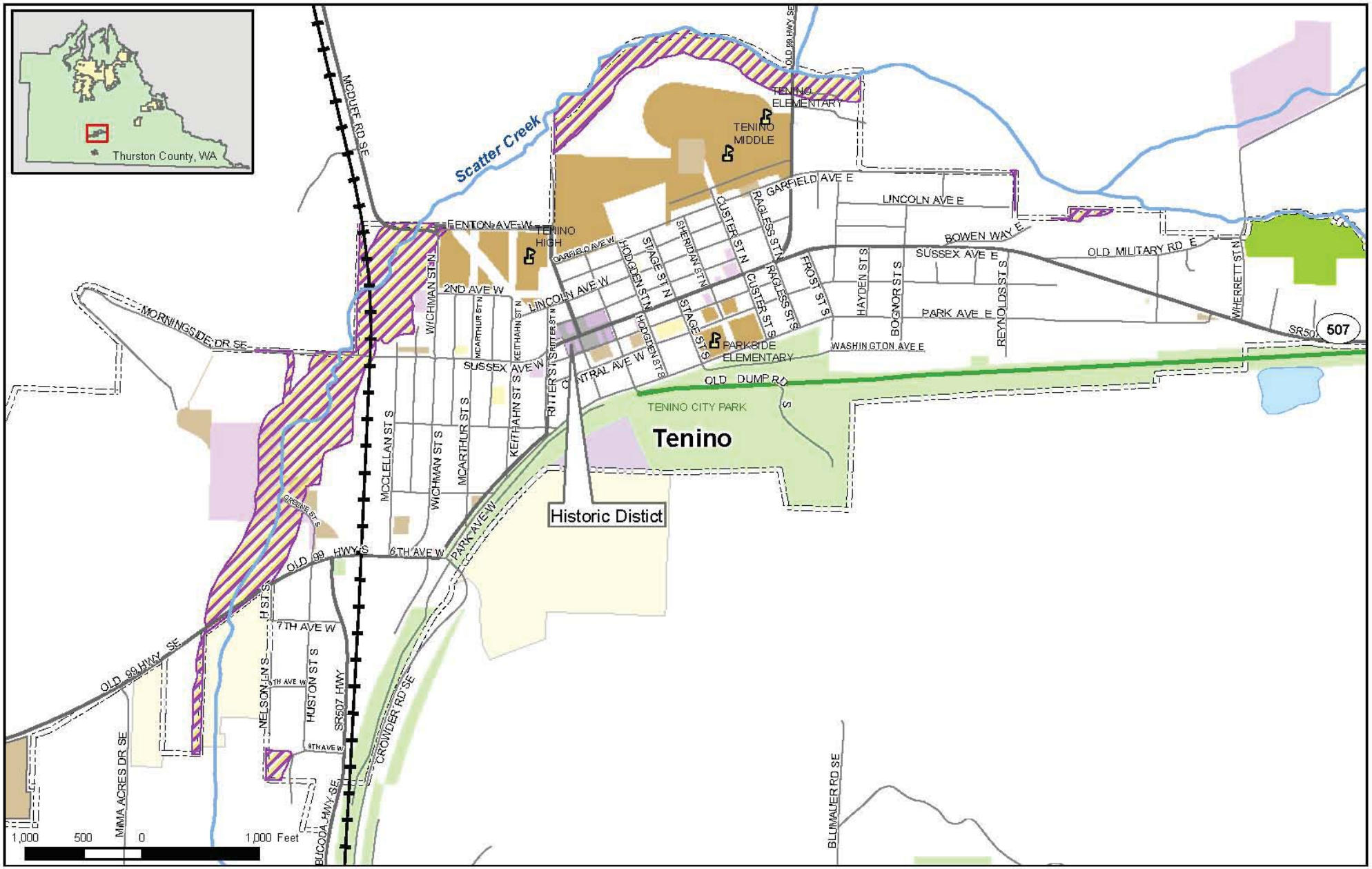

Public Access, Public Lands and Historic Sites

Figure 10

Minimum Jurisdiction
City Limits
Urban Growth Boundary
BNSF Railroad
Historic District

Private Institutional or Community Lands
Subdivision Open Space
Other Open Space including Land Trusts
Churches and Private Camps
Historic Properties

Public Lands
Schools, Colleges, Universities
Parks
Other Local, State, Tribal Lands
Paved Trail

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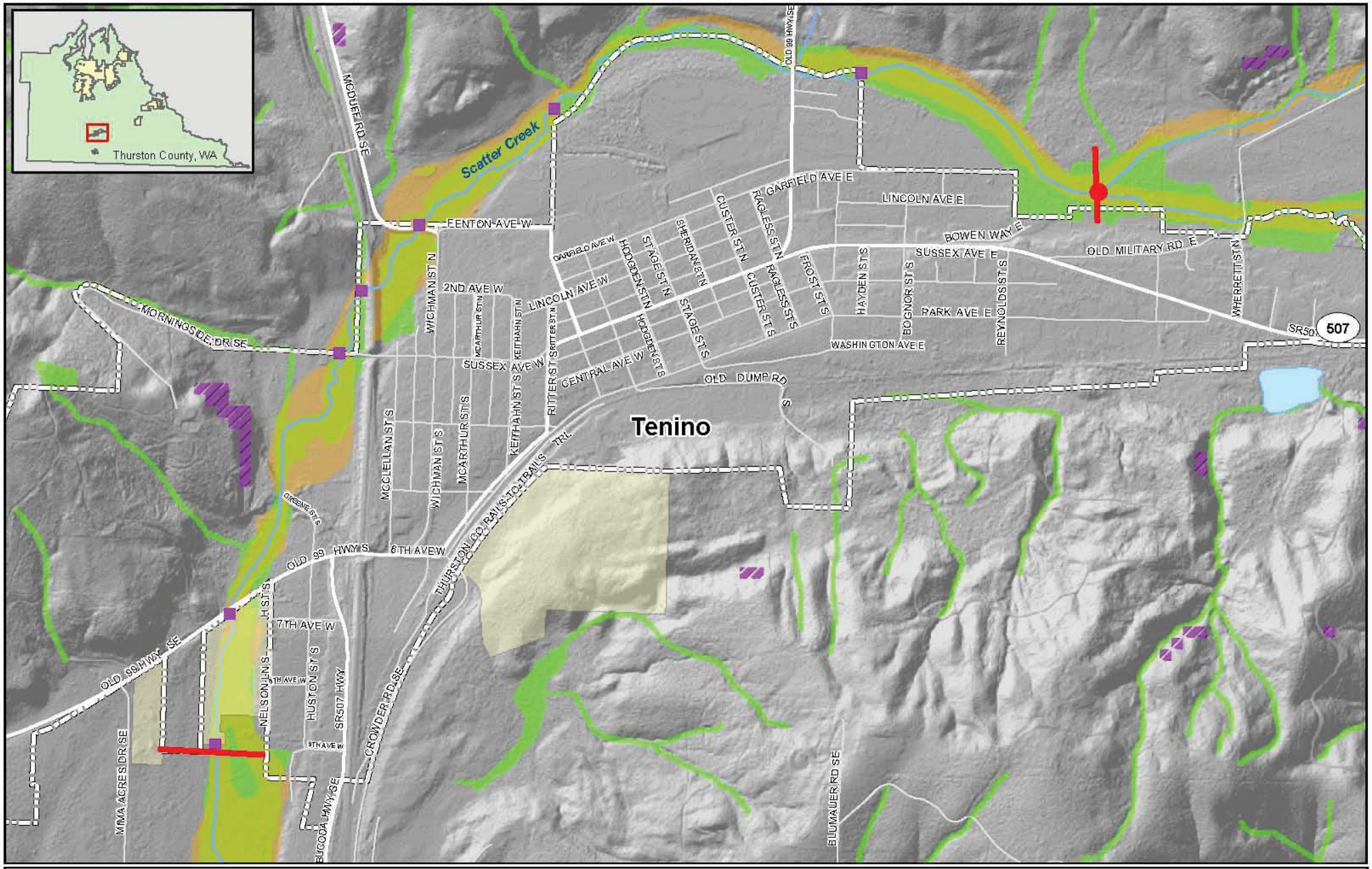

Critical Areas

- Shoreline Endpoint
- Thurston County Reach Breaks
- Tenino Reach Break
- 100 Year Floodplain
- Steep Slopes
- Wetland Indicators
- City Limits
- Urban Growth Boundary

1,000 500 0 1,000 Feet

N W E S

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Figure 11

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Opportunity Sites

Minimum Jurisdiction

Tenino Reach Break

City Limits

Urban Growth Boundary

1,000 500 0 1,000 Feet

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Figure 12

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10.0 APPENDIX

10.1 Ecology Landscape-Scale Assessment

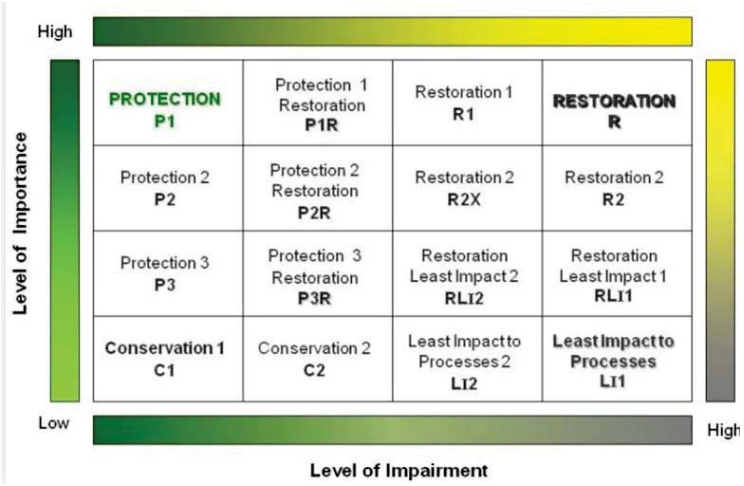
The Washington Department of Ecology undertook a landscape scale assessment of the Upper Chehalis basin, titled *Chehalis Basin Watershed Assessment - Description of Methods, Models, and Analysis for Water Flow Process* (Stanley et al, 2010). While the reports course scale watershed characterization is not intended for use at the site scale, it will provide useful context locating Bucoda into its broader watershed context.

This analysis includes the application of a landscape-level analysis tool that has been developed by the Washington Department of Ecology (Ecology, 2005). This analysis specifically looks at hydrologic processes, where the important areas are, and how they have been altered over time. The two results are then taken together to suggest areas where protection or restoration of ecosystem process would be the most effective. While this analysis is specifically focused on hydrologic processes, the parameters used are fairly general landscape-level measures that can be used as a general proxy for overall level of functioning.

10.2 Important Areas and Alterations

Important areas and alterations for the Chehalis Watershed and study area were identified and assessed, consistent with the methods in Stanley et al, 2005 and Stanley et al, 2010. A watershed matrix was created which combines the results of the importance and impairment maps. Each box in the matrix corresponds with a management recommendation for that rating. See Figure A-1 below.

Figure A1: Watershed Management Matrix



The colors correspond to colors used on a GIS map to represent areas most appropriate for restoration (yellow), protection (green) and less impact to processes (gray). (Stanley et al. 2010, p 60)

- Analysis units rating **high for importance** and **low for impairment** will be in the upper left corner of the matrix. These analysis units will be the most suitable candidates for PROTECTION, ensuring that the associated watershed process will remain intact.

- Analysis units rating **high for importance** and **high for impairment** will be in the upper right corner of the matrix will be most suitable for RESTORATION. Focusing restoration in these units will increase the likelihood that associated watershed processes will be restored.

- Analysis units rating **low for importance** and **low for impairment** will be in the lower left corner of the matrix. These analysis units will be the most suitable candidates for CONSERVATION. These areas have an intact suite of processes and functions that support existing aquatic ecosystems which would require considerable time to restore elsewhere on the landscape. Higher intensity land use activities may be appropriate, but care should be taken to establish land use patterns that protect and maintain watershed processes.

- Analysis units rating **low for importance** and **high for impairment** will be in the lower right corner of the matrix. These analysis units will be the most suitable candidates for LEAST IMPACTS TO PROCESSES. These areas can be considered as more suitable for urban land use activities.

10.3 Watershed Characterization Results

The results of the Chehalis Basin Watershed Assessment are depicted in the following figures. Figure A-2 shows the extent and id number of the assessment units around Bucoda. Figure A-3 shows the important areas, Figure A-4 shows the alteration areas, and Figure A-5 shows the importance and alteration areas combined together. The assessment units were analyzed within their landscape group, which is depicted by a large black line on these figures.

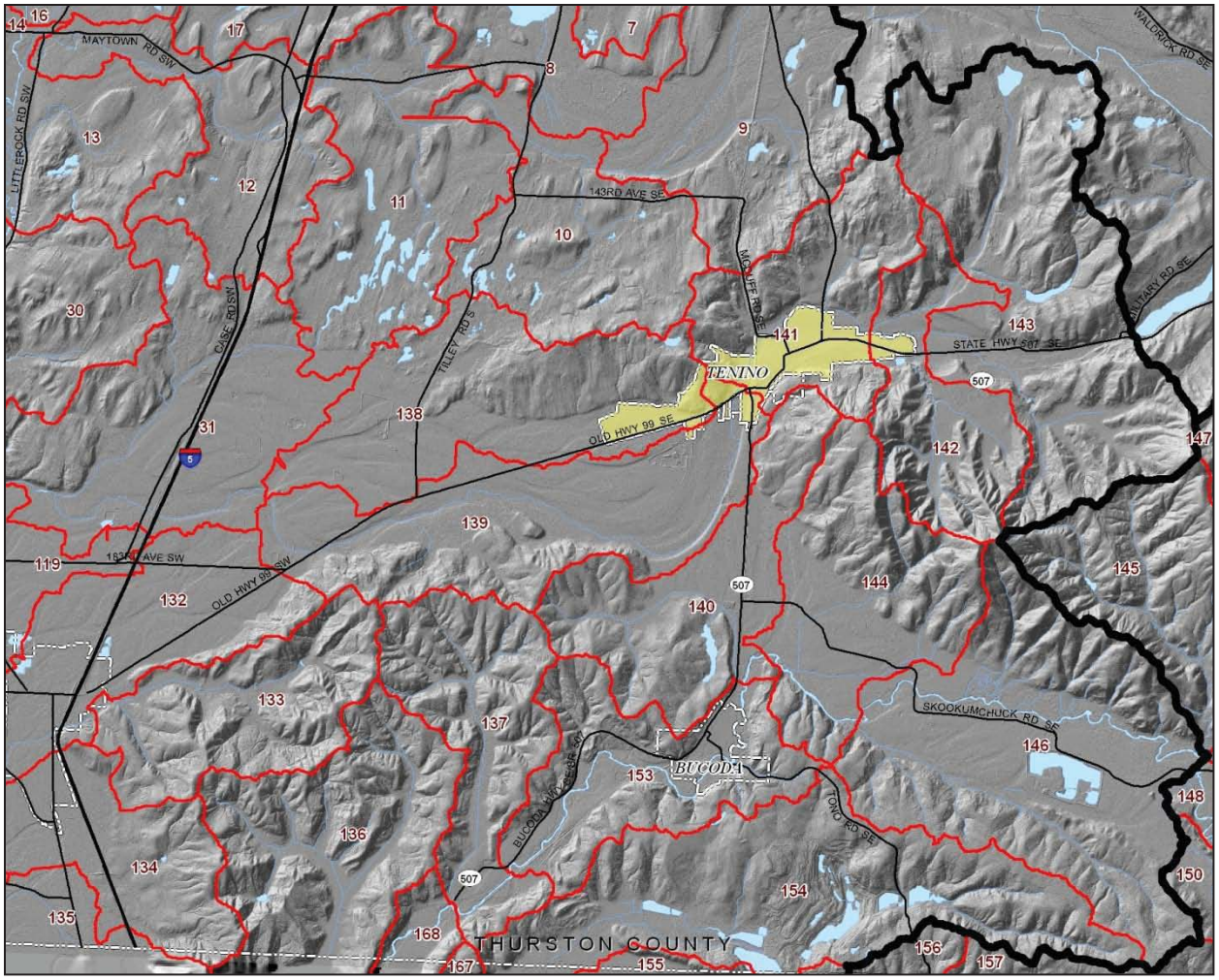


Figure A2: Watershed Assessment Units around Tenino

Lowland Landscape Group – Tenino is located in the "lowland" landscape group. It is characterized by being less than 500 feet in elevation, low gradient landform, geologically composed of glacial drift, with lower precipitation and rain dominated storm events. These analysis units are 2 to 5 square miles in size. They tend to have diverse land cover types, and higher development pressure.

Mountainous Landscape Group - The "mountainous" landscape group (located to the east of Bucoda) is characterized by being higher than 500 feet in elevation, comprised of bedrock areas, rain-on snow- and snow dominated areas, higher precipitation areas, and high relief topography. These analysis units are larger being from 8 to10 square miles in size. They have a more uniform land cover type (forests), and with low pressure for development.

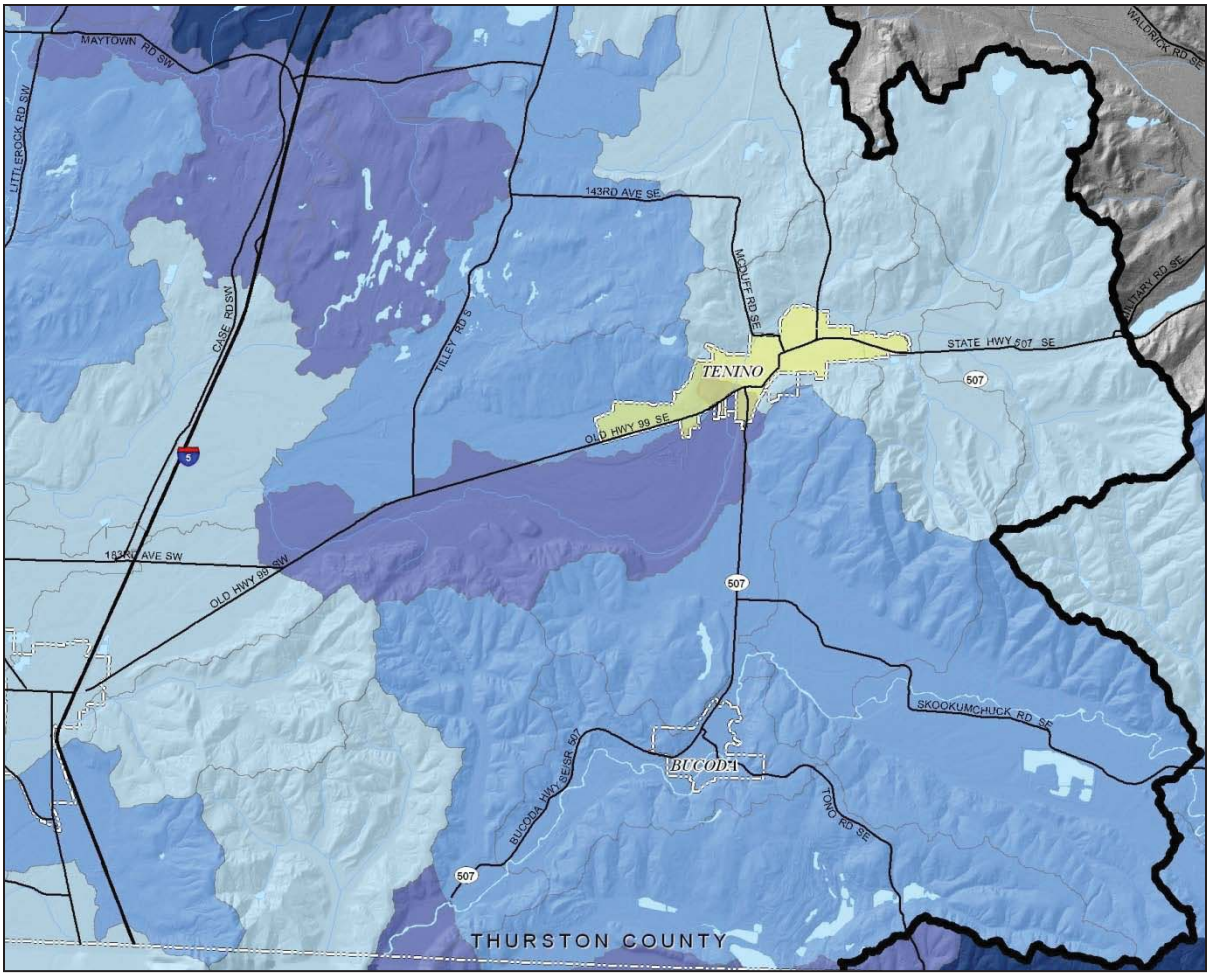
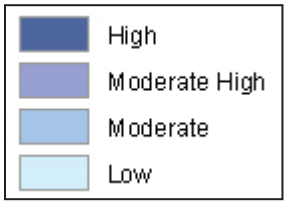


Figure A3: Summary of Important Areas for Watershed Processes



This map represents results of all components (delivery, storage, recharge discharge). The black outline delineates the mountain from the lowland landscape group. Analysis units are evaluated only within their landscape group. Dark blue analysis units are the most important (High rating) and lightest blue analysis units are less important (Low rating) for the water process. This map shows the combined scores for all three components of the importance model - delivery, surface and ground water. Results are shown in quantiles.

Tenino is located primarily in watershed assessment unit #141, with small portions in three adjacent units. Much of Rock Prairie west of Tenino is in a “Moderate High” important, while those hillsides to the north of the prairie are “Moderate”. Other parts of Tenino and those areas to the east are in a “Low” importance category.

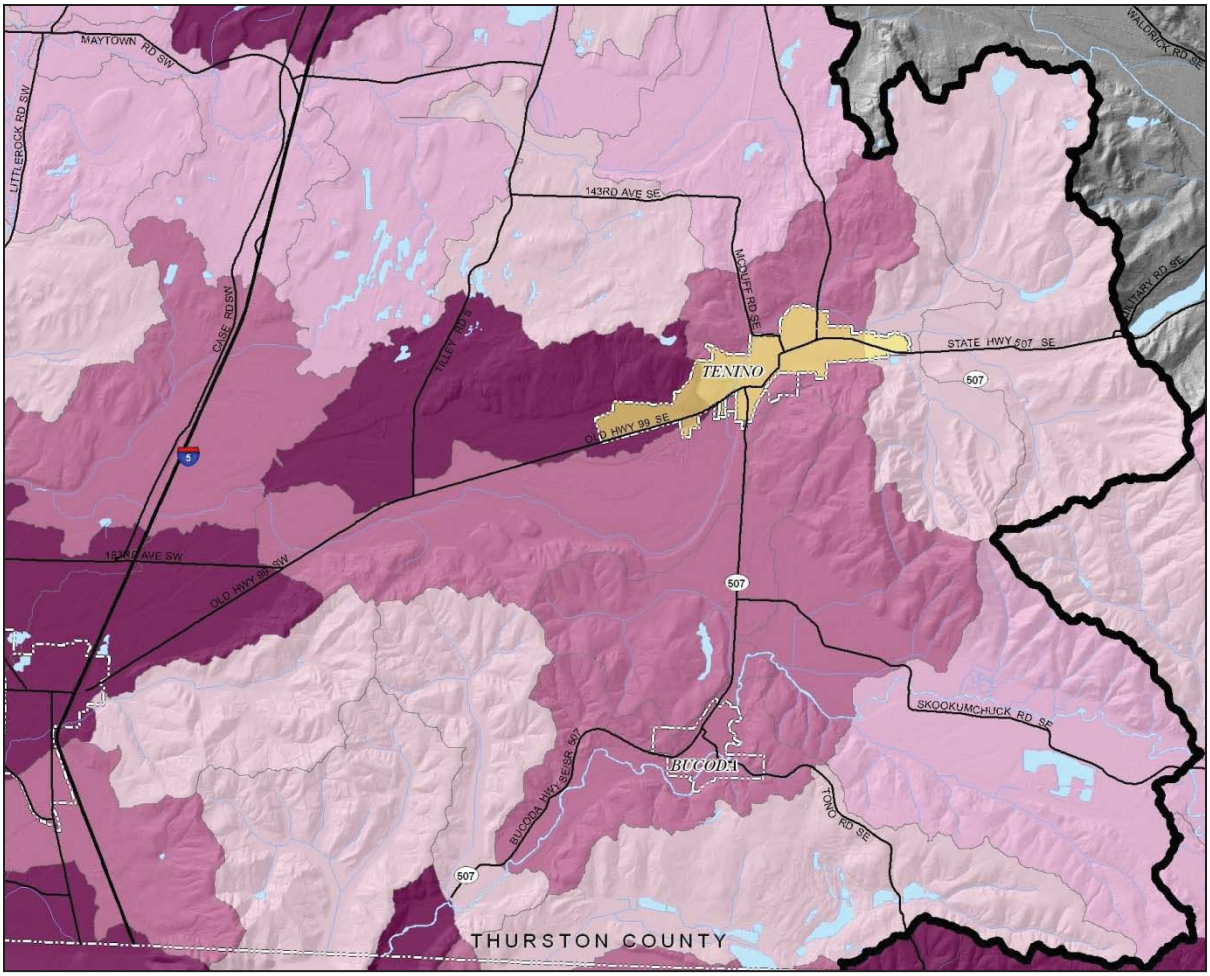
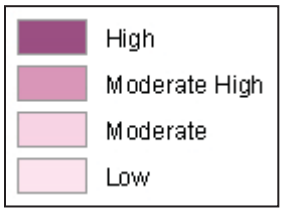


Figure A4: Summary of Alteration Areas for Watershed Processes



In this map the darkest pink areas are the most impaired. The various impairments of the water flow process were displayed in separate GIS maps by Stanley et al, 2010, but are combined in this image. Results are shown in quantiles.

Tenino is located primarily in watershed assessment unit #141, with small portions in three adjacent units. The eastern part of Tenino lies in a “Low” alteration category, with most of the city is in a “Moderately High” category. Those portions of the city north of Old Highway 99 and west of SR 507 are located in a “High” category.

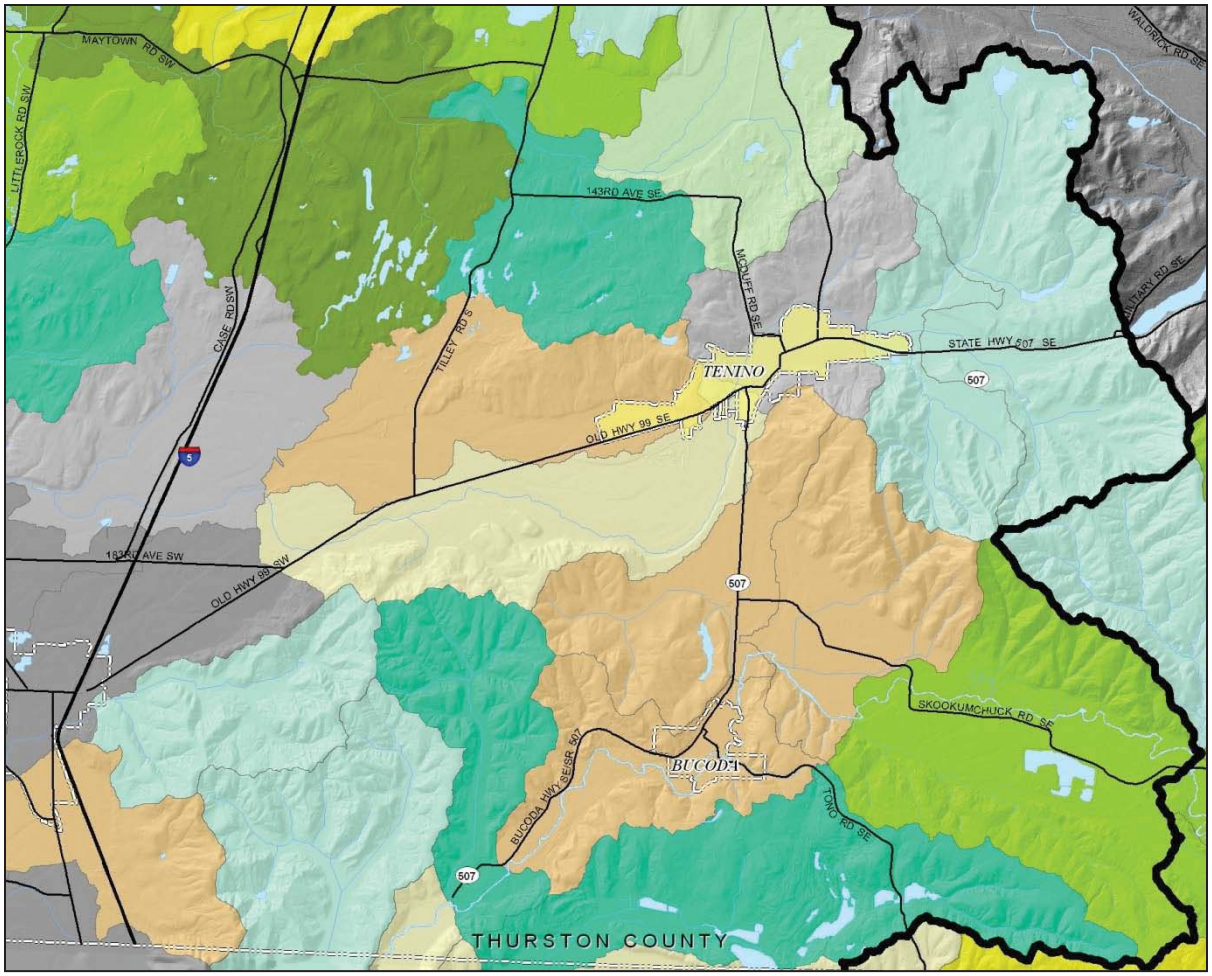


Figure A5: Summary of Importance and Alteration Areas for Watershed Processes

Protection	Protection / Restoration 1	Restoration 1	Restoration
Protection 2	Protection / Restoration 2	Restoration 3	Restoration 2
Protection 3	Protection / Restoration 3	Restoration Least Impact 2	Restoration Least Impact 1
Conservation 1	Conservation 2	Least Impact to Processes 2	Least Impact to Processes 1

Combining the ratings of "importance" and "impairment" identifies a potential overall management approach for each analysis unit. Darker green indicates that an analysis unit is most suitable for protection of processes; darker yellow is most suitable for restoration of processes; orange to gray indicates analysis units where future disturbance will probably have less impact on watershed processes.

Tenino is located primarily in watershed assessment unit #141, with small portions in three adjacent units. The eastern most parts of Tenino lie within a "Conservation" category. The majority of the community lies within a unit where development would have the "Least Impact to Process 2". Those portions of the city north of Old Highway 99 and west of SR 507 are located within a "Restoration Least Impact 1or 2" category. Overall, the community is located within assessment units which have low importance values, and a high degree of impairment.

Ecology management recommendations for areas in the “Restoration Least Impact 1or 2” category are that these units can be considered as more suitable for urban land use activities. Planning measures employing protection of critical aquatic resources and appropriately sited development should be considered. However, offsite mitigation in other areas suitable for restoration should be evaluated as a higher priority (Stanley, et al, 2010)

Ecology management recommendations for areas with a “Conservation” category are that these areas have an intact suite of processes and functions that support existing aquatic ecosystems and would require considerable time to restore elsewhere on the landscape. Management strategies in these areas may rely more heavily on wildlife assessments and the need to protect critical habitats. Higher intensity land use activities may be appropriate in these areas relative to protection areas, but care should be taken to establish land use patterns (i.e. land use types, activities, development policies, standards and regulations) that protect and maintain watershed processes (Stanley, et al, 2010).